



U.S. Secretary of Labor Explains . . .

The New Occupational Safety and Health Act

Enforcement of the Act began this month, when the vanguard of federal compliance officers took to the field. No radical changes are foreseen in the chemical process industries. Noise control gets high priority.

J. D. HODGSON, U. S. Secretary of Labor

Realizing that human resources are this nation's most valuable asset, the U.S. has through the years passed a variety of laws to protect its workers.

Yet, until recently, governmental responsibility for the safety and health of most U.S. workers—except for those involved in government contract work and in longshoring and maritime work—has rested with the individual states.

Many employers, it is true, have been conscientious about providing safe and healthful working conditions. Some, in fact, have managed to reduce the frequency of accidents by as much as 80 or 90%. Others, regrettably, have often put expediency ahead of safety, profits ahead of prudence.

For this reason, Congress last December enacted the Occupational Safety and Health Bill of 1970. The law, which became effective on Apr. 28, provides protection for 57 million working men and women in more than 4 million business and industrial establishments. It applies to virtually any business affecting interstate commerce.

Why Was the Law Needed?

Between 1926 and 1955, the number of lost-time accidents per million employee-hours-worked in all industries had declined from 32 to 7.

But, since 1958, when a low injury-frequency rate of 11.4 was reached for manufacturing industries, the picture has continued to worsen. Ten years later, the rate had increased to 14.0, reaching 14.8 in 1969.

Better Record in the Chemical Process Industries

Throughout the years, the chemical process industries have maintained a considerably better safety record than manufacturing as a whole.

Yet, even in this highly technical area, the injury frequency rate for the chemical and allied products group has risen from 7.5 in 1958 to 8.1 in 1969. Worse, in the five-year period from 1964 to 1969, the rate jumped from 7.2 to 8.1—a 12.5% increase.

It is true that the safety record has varied widely within the industry. For example, in 1968, the latest year for which we have detailed breakdowns, the injury frequency rate ranged from a low of 3.4 in the plastics and synthetic-materials group to a high of 13.5 in paints, varnishes and allied products.

In any case, it appears that the technological advances that have brought better goods and an easier way of life to most Americans have taken their toll in the safety and health of the individual in the workplace.

Environmental Control in the Workplace

The newly-found national passion for environmental control should perhaps be most appropriately directed to the workplace, for that is where 80 million Americans spend the greatest share of their waking hours. It is there that they are so often exposed to hazards that can cause disabling injuries or adversely affect their health, perhaps permanently.

In fact, the record shows that more than 14,000

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deaths and 2 million disabling injuries have occurred annually in U.S. workplaces over the past few years. That means that each year 55 Americans die and 8,500 more suffer disabling injuries as a result of on-the-job accidents. It means also the loss of 250 million employee-days of labor each year—five times the number of employee-days lost due to strikes.

Safety Enforcement Can Reduce Injury Rates

Experience has proved that when safety standards are enforced, dramatic drops in injury rates are possible. For example, the Maritime Safety Act of 1958 gave the Secretary of Labor responsibility for the safety and health of longshoremen and shipyard workers aboard ships in U.S. ports and shipyards. Since 1960, when we began to collect statistics for this program, the injury frequency rate for longshoring has dropped 53%, and that for shipyards has been reduced by 47%.

The success of this program alone is ample justification for governmental presence in the occupational safety and health field. If effective legislation can save lives and reduce injuries on the waterfront, it can do so elsewhere.

There are numerous occupational hazards inherent in the business of the chemical process industries. The new Occupational Safety and Health Law will not, in general, require any radical changes. It will merely require that those responsible improve upon the safety and health measures that are already applicable.

Writing standard operating procedures to cover emergencies as well as the usual operational steps is, of course, essential to the safe operation of chemical plants.

Noise Control a Priority Goal

In the chemical process industries, as in the entire manufacturing industry, the reduction of noise will be a priority goal. The roar of industrial furnaces must be reduced by mufflers. The sheet-metal ducts that carry fresh air through a plant should be covered with noise-absorbing materials. Special reducing valves or attenuating materials should be employed to cut down the noise of liquids and gases traveling through pipes. Plastic choppers should be surrounded by noise-absorbing enclosures.

Under the new law, plants that expose workers to excessive noise will be required to administer periodic audiograms to such workers, a precaution not now being taken in many chemical plants.

Reducing the Hazard of Burns

Well-placed safety facilities, such as emergency showers and eyewash fountains, along with adequate safety education can greatly reduce the hazard of burns in a chemical processing plant.

Routine precautions include: covering all hot pipes with insulation; requiring that workers wear appropriate protective clothing when handling acids or hot liquids in open containers; advising those employees whose duties require taking down and putting up piping that they should never open pipes under pressure.

Proper equipment and a safe place to operate it will reduce the incidence of burns in welding and cutting operations. Workers should be required to wear protective equipment, including gloves, face mask, and bib apron. The worker's breathing zone should be properly ventilated.

Other Sources of Trouble

Fixed ladders without cages are a source of unnecessary falls—with possibly disastrous consequences when a worker catapults from one of the numerous high places that have to be reached in the course of a day's work.

In plants manufacturing sulfuric acid, precautions must be taken against the inhalation of sulfur dioxide, a source of lung irritations.

In plants producing anilines, the danger lies in the absorption and inhalation of nitrobenzene when cleaning out tanks. Adequate ventilation, along with protective clothing and supplied-air respirators, will guard against the very real possibility of suffocation or poisoning by inhalation.

Standards To Be Followed

Certain existing safety and health standards will be adopted as initial standards under the new act. They include consensus standards, such as those set up by the National Fire Protection Assn. and the American National Standards Inst., and those established federal standards that now apply under the Walsh-Healey Public Contracts Act, the McNamara-O'Hara Service Contract Act, the Maritime Safety Act, the National Foundation on the Arts and the Humanities Act, and the Construction Safety Act.

Because initial standards have already been subject to public review, the new Act does not require hearings or submission of written comments in connection with their promulgation.

The initial standards were published in the *Federal Register* on May 29. Employers not previously covered have 90 days after publication to familiarize themselves with the standards. For those employers now subject to established federal standards, the new law applies immediately upon publication.

Responsibility of Employers

Both employers and employees have responsibilities under the act.

In general, employers must comply with the specific occupational and health standards promulgated under the Act, and, in addition, must furnish each

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of their employees "a place of employment free from recognized hazards that are causing or are likely to cause death or serious physical harm."

In addition, employers are required to:

- Notify employees of their protections and obligations under the act.
- Keep records of work-related deaths, illnesses, and injuries.
- Keep records of employee exposure to potentially toxic materials or harmful physical agents.
- Notify employees of exposure to toxic materials or harmful physical agents that exceed limits set in any applicable standard.

Responsibility of Employees

In turn, employees are required to comply with the standards, rules and orders that have been set up to protect them.

They also have the right to report any safety and health hazards they observe. The law protects those workers who exert their right to file a complaint by prohibiting their employers from discriminating against them.

Labor-Department Compliance Officers

In keeping with President Nixon's "New Federalism" concept, administration of this new program will be decentralized to the greatest possible extent.

Under the general direction of George C. Guenther, my Assistant Secretary for Occupational Safety and Health, Safety Compliance Officers will work out of 10 regional offices and 43 area offices. These men, many of them safety officers and safety engineers, are being subjected to an intensive training course to prepare them for their new duties. Early this month, 150 compliance officers went into the field, the vanguard of a nationwide force.

Subject to regulations I shall issue, representatives of both the employer and employees will be allowed to accompany the Labor Dept. inspector on an inspection tour. If the employees have no authorized representative, the inspector will consult with several employees to obtain their views.

To Provide Technical Assistance

In addition to handling compliance inspections and enforcement of safety standards, the compliance officers will provide local technical assistance to federal and state governments and to industry, helping them enhance the safety of the workplace.

Furthermore, to help employers meet the requirements of the Act, we plan to institute training programs designed to increase the number and competence of personnel engaged in occupational safety and health work.

The law also establishes a National Institute for Occupational Safety and Health, which will develop techniques for dealing with occupational safety and

health problems, explore ways to discover latent diseases, and establish acceptable levels for exposure to toxic materials or harmful physical agents.

Finally, for the small businessman lacking the funds to make required modifications, the government will provide economic assistance.

Citations for Violations

If an inspector believes that there is a violation of the Occupational Safety and Health Act, he is required to issue a citation to the employer.

There are various penalties for such violations.

A "serious violation"—one in which there is a substantial probability that death or serious physical harm could result from a condition that exists, or from one or more practices, means, methods, operations, or processes that have been adopted or are in use—calls for a civil penalty of up to \$1,000.

For a violation of a less serious nature, an employer may also be assessed a penalty of up to \$1,000.

Willful or repeated violations may be assessed a civil penalty of not more than \$10,000 for each violation.

Willful violation causing death to any employee shall, upon conviction, be punished by a fine of not more than \$10,000, or by imprisonment of not more than six months, or both.

When an employer contests citations or proposed penalties, an independent Occupational Safety and Health Review Commission, consisting of three members who have been appointed by the President, will decide whether or not violations have occurred and will assess any penalties.

A Job That Must Be Done

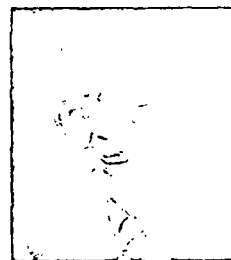
The time has come for all of us—government and industry, employers and employees—to unite to eliminate needless illness, injury and death from the American workplace.

The time has come to eradicate the physical suffering, financial loss and family tragedy that so often result from on-the-job accidents and injuries.

With the cooperation of employers, workers and labor leaders, the new Occupational Safety and Health Act will help to ensure the safety and well-being of working Americans. ■

Meet the Author

J. D. Hodgson has served as U. S. Secretary of Labor since July 2, 1970, having joined the Nixon Administration as Under Secretary of Labor in February 1969. He came to the Labor Dept. from Lockheed Aircraft Corp., where he had served as Corporate Vice-President for Industrial Relations. He holds an A.B. degree from the University of Minnesota and has done graduate work there and at U.C.L.A., where he was an instructor in labor relations for five years.



JUNE 28, 1971/CHEMICAL ENGINEERING

GUIDELINES TO THE DEPARTMENT OF LABOR'S OCCUPATIONAL NOISE STANDARDS

Introduction

Noise has long been recognized as a cause of occupational loss of hearing. Some companies have for many years taken steps to reduce noise levels and the exposure of their employees to them. In promulgating noise standards under the Walsh-Healey Public Contracts Act, the Department of Labor has merely made mandatory minimum standards which have proved both practical and effective in preventing hearing loss in many plants.

Measurement, control, and protection against noise is a somewhat technical subject and one with which plant management, which is responsible for the enforcement of safety regulations, may not be familiar. Therefore, this paper:

First, explains the terms used in section 50-204.10 of the Safety and Health Standards for Federal Supply Contracts, as amended and published in the *Federal Register* on May 20, 1969.

Second, explains just what is expected of the employer in order to be in compliance with the requirements.

Third, specifies certain instruments, equipment, and procedures which will be acceptable as a basis for judging compliance. These latter points are of particular interest to technical personnel, either at the plant or engaged on a consultative basis, to assist them in developing and carrying out the required controls and procedures.

This paper is equally applicable to employers currently covered by safety regulations promulgated by the Secretary of Labor under the McNamara-O'Hara Service Contract Act, as amended on January 22, 1970.

Determining Sound Level Exposures, and Permissible Limits

Basically, section 50-204.10 sets maximum permissible noise levels and exposures, and explains the types of corrective action which must be taken if these noise levels are exceeded.

Paragraph (a) of this section states:

"(a) Protection against the effects of noise exposure shall be provided when the sound levels exceed those shown in Table I of this section when measured on the A scale of a standard sound level meter at slow response . . ."

Loss of hearing occurs as a result of the cumulative effect of exposure to sound above a maximum intensity and over a maximum duration in a given period of time. For the purpose of this standard, the basic permissible intensity is 90 dBA for a duration of 8 hours out of a day. The amount of sound energy absorbed during such an exposure is considered to be the upper limit of a daily dose which will not produce disabling loss of hearing in more than 20 percent of the exposed population.

Table I indicates the duration of exposure to higher sound intensities which will result in no more damage to hearing than produced by 8 hours at 90 dBA. Employees

must not be exposed to steady sound levels above 115 dBA, regardless of the duration.

TABLE I

PERMISSIBLE NOISE EXPOSURES 1/

Duration per day, hours	Sound level dBA slow
8	90
6	92
4	95
3	97
2	100
1½	102
1	105
½	110
¼ or less	115

^{1/}When the daily noise exposure is composed of two or more periods of noise exposure at different levels, their combined effect should be considered, rather than the individual effect of each. If the sum of the following fractions: $C_1/T_1 + C_2/T_2 + \dots + C_n/T_n$ exceeds unity, then, the mixed exposure should be considered to exceed the limit value. C_n indicates the total time of exposure at a specified noise level, and T_n indicates the total time of exposure permitted at that level.

The abbreviation dB in the right-hand column of the table stands for decibels, the unit of measurement of sound levels. The A scale is one of several on the sound level meter, a measuring instrument used to determine sound intensity. On this scale, the instrument reacts in much the same way as does the human ear in that it is much less responsive to low pitched tones than to those of higher pitch. The "slow" response is another setting of the instrument which causes it to average out high level noises of brief duration (such as hammering), rather than responding to the individual impact noises.

It is important to note that decibels are measured on a logarithmic rather than a linear scale. Every increase of 10 dB represents an increase of approximately 300 percent in sound pressure. A 100 dB noise is, therefore, 3 times as intense as a 90 dB noise, rather than about 10 percent more intense, as might be expected. Illustrated another way, if one machine produces a sound level of 90 dB, a second machine of the same kind placed next to it will result in a combined noise level of 93 dB, rather than 180 dB, which might be expected.

Exposures at Different Sound Levels

The footnote to Table I describes the method by which several separate exposures to different sound levels during a day are to be treated in determining whether or not the combined exposure is within permissible limits.

As an illustration, assume that an employee works most

of the day in an area in which the sound level is 90 dBA, but for 15 minutes out of each of 7 hours, he is in an area of 100 dBA, and for one 15-minute period each day, he is in an area of 105 dBA.

This adds up to 6 hours at 90 dBA: permissible duration of exposure, 8 hours; 1½ hours at 100 dBA: permissible exposure, 2 hours; and ¼ hour at 105 dBA: permissible exposure, 1 hour. Tabulating it, we have:

dBA	Actual Time Permissible Time	
	C (hours)	T (hours)
90	6	8
100	1 3/4	2
105	1/4	1

Putting these values into an equation, we get:

$$\frac{6}{8} + \frac{1.75}{2} + \frac{0.25}{1} = \frac{6}{8} + \frac{7}{8} + \frac{2}{8} = \frac{15}{8} = 1.87$$

Since this total exceeds unity, the daily exposure is above the permissible limit, even though the total exposure at each sound level is below the permissible duration for that level.

No matter how briefly a person is exposed to higher sound pressure levels, if he spends the remainder of the day at a level of 90 dBA, his exposure will exceed the permissible limit. Only by being in an area having a sound level well below 90 dBA can his exposure to higher levels be compensated.

Assuming that the 6 hours are spent in areas of relatively low sound pressure levels, are the two exposures to higher levels permissible?

The equation becomes:

$$\frac{1.75}{2} + \frac{0.25}{1} = \frac{1.75 + 0.50}{2} = \frac{2.25}{2} \text{ or } 1.125.$$

This is still greater than unity and, therefore, not permissible. Either the exposure to the 100 dBA level would have to be reduced to 1.5 hours or the exposure to the 105 dBA level to 0.125 hours or 7½ minutes in order not to exceed the permissible total exposure.

$$\frac{1.5}{2} + \frac{0.25}{1} = \frac{2.0}{2} = 1$$

$$\text{or } \frac{1.75}{2} + \frac{0.125}{1} = \frac{2.0}{2} = 1$$

Impulse or Impact Noise

The last sentence in paragraph (d) of section 50-204.10 states:

"Exposure to impulsive or impact noise should not exceed 140 dB peak sound pressure level."

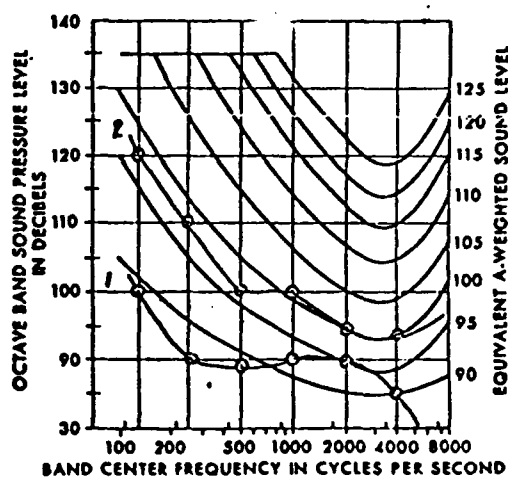
This sets the upper limit of sound level to which a person should be exposed, regardless of the brevity of the exposure.

In contrast with the 115 dBA upper limit for steady noise, the higher intensity for impact noise is permissible because the noise impulse resulting from impacts, like hammer blows or explosive processes, is past before the ear has time to react fully. Impact noise levels are to be measured only with an impact meter or an oscilloscope.

Converting Octave Band Analyzer Readings

Many plants have done a great deal of noise control work based on measurements taken with the type of instrument that measures the sound level at each of a number of frequencies, or pitches, of the sounds produced rather than the overall total noise, as measured by the sound level meter. A chart is provided in the regulations to permit readings obtained from an octave band analyzer to be converted to corresponding values as indicated in Table I. Section 50-204.10, paragraph (a), second sentence, states:

When noise levels are determined by octave band analysis, the equivalent A-weighted sound level may be determined as follows:



Equivalent sound level contours. Octave band sound pressure levels may be converted to the equivalent A-weighted sound level by plotting them on this graph and noting the A-weighted sound level corresponding to the point of highest penetration into the sound level contours. This equivalent A-weighted sound level, which may differ from the actual A-weighted sound level of the noise, is used to determine exposure limits from Table I.

The above graph illustrates in a general way what was said previously about the response of a sound level meter working on the A scale. It minimizes, as does the ear, the low frequency sounds and emphasizes, as does the ear, the high frequency sound. Thus, a 90 dB reading on the A scale may include as high as 105 dB at 125 cycles per second, but

would accept no more than 89 dB at 2,000 and 4,000 cycles per second.

To illustrate use of the graph in converting octave band readings into A-scale sound level meter readings, two sets of values of octave band readings have been plotted. The series numbered 1 shows readings at or below the 90 dBA curve, except at 2,000 cycles per second, where the reading falls on the 95 dBA curve. In this case, the sound level for use of Table I should be taken as 95 dBA. In the series marked 2, all the readings are below the 100 dBA curve, except at 1,000 cycles, where the reading is just on the curve. One hundred dBA would therefore be the value to be used in Table I.

As noted in the explanation of the graph, the actual sound levels measured with a sound level meter on the A scale may differ somewhat from the values determined by plotting the readings from an octave band analyzer on the graph. These differences, for most sounds, are of the same order of magnitude as the errors to be expected in the measurement and are not important. The intention was to provide a simple and relatively accurate means of conversion from one system of measurement to another to accommodate existing, effective plantwide programs.

Variable Noises

Paragraph (c) of section 50-204.10 states the final consideration in determining whether or not a permissible sound level is being exceeded:

"(c) If the variations in noise level involve maxima at intervals of 1 second or less, it is to be considered continuous."

This means that where the sound level meter on the A scale at slow response moves up from a generally steady reading, say from 88 to 92 dB, at intervals of one second or less, the high reading shall be taken as that to be used in Table I.

As a corollary to this, intermittent sounds of brief duration at intervals greater than one second should, as far as practical, be measured as to intensity and duration and the total duration over a day be ascertained. This total should be entered in the equation given in footnote 1, Table I, to determine the permissible limit. These intermittent sounds, which can be measured with a sound level meter, should not be confused with impulse sounds of very short duration resulting from impacts or explosions.

Control Measures

Paragraph (b) of section 50-204.10 refers to control measures to be taken:

"(b) When employees are subjected to sound exceeding those listed in Table I of this section, feasible administrative or engineering controls shall be utilized . . ."

The Department of Labor considers "feasible" to mean the following, as stated in the Oxford English and Merriam-Webster Dictionaries: "Capable of being done, accomplished or carried out; capable of being dealt with successfully."

Engineering Noise Control Measures

Engineering controls are those which reduce the sound intensity either at the source of the noise or in the hearing zone of the workers.

The following are examples:

A. Maintenance

1. Replacement or adjustment of worn and loose or unbalanced parts of machines.

2. Lubrication of machine parts and use of cutting oils.

3. Properly shaped and sharpened cutting tools.

B. Substitution of Machines

1. Larger, slower machines for smaller, faster ones.

2. Step dies for single operation dies.

3. Presses for hammers.

4. Rotating shears for square shears.

5. Hydraulic for mechanical presses.

6. Belt drives for gears.

C. Substitution of Processes

1. Compression for impact riveting.

2. Welding for riveting.

3. Hot for cold working.

4. Pressing for rolling or forging.

D. Vibration Dampening

1. Increase mass.

2. Increase stiffness.

3. Use rubber or plastic bumpers or cushions.

4. Change size to change resonance frequency.

E. Reducing Sound Transmission Through Solids

1. Flexible mountings.

2. Flexible sections in pipe runs.

3. Flexible shaft couplings.

4. Fabric sections in ducts.

5. Resilient flooring.

F. Reducing Sound Produced by Fluid Flow

1. Intake and exhaust mufflers.

2. Fan blades designed to reduce turbulence.

3. Large, low speed fans for smaller, high speed fans.

G. Include Noise Level Specifications When Ordering New Equipment

H. Isolating Noise Sources

1. Completely enclose individual machines.

2. Use baffles.

3. Confine high noise machines to insulated room.

I. Isolating Operator

Provide a relatively sound-proof booth for the operator or attendant of one or more machines.

Controlling noise at the source, as illustrated by A through H1, is the ideal means of preventing noise induced hearing loss. The results are relatively long lasting; the operator of the individual machine is protected, as well as those employees at a distance from it, and there is no need for wearing protective equipment or following prescribed schedules of exposure. The measures listed under H2, H3, and I will, if effective, limit the number of persons exposed to high noise levels, but are unlikely to protect operators and those close to the noise sources.

A number of the listed controls can be accomplished quite inexpensively by plant personnel. Others require considerable expense and highly specialized technical knowledge to ensure the expected results. It is therefore strongly recommended that plants avail themselves of the services of competent acoustical engineers in planning and carrying out their noise control programs.

The Department of Labor expects employers to explore the possibility and practicability of controlling noise by engineering and to take all feasible measures before

resorting to use of administrative controls or of personal protective equipment.

Administrative Controls

If noise cannot be reduced to permissible intensities through engineering controls, administrative controls should be developed in order to limit duration of workers' exposure to noise levels above 90 dBA to the limits shown in Table I.

The following are examples:

1. Arrange work schedules so that employees working the major portion of a day at or very close to the 90 dBA limit are not exposed to higher noise levels.
2. Ensure that employees who have reached the upper limit of duration for a high noise level, in accordance with Table I, work the remainder of the day in an environment with a noise level well below 90 dBA.
3. Where the man-hours required for a job exceed the permissible time for one man in one day for the existing sound level, divide the work among two, three, or as many men as are needed, either successively or together, to keep individual noise exposure within permissible time limits.
4. If less than full-time production of a noisy machine is needed, arrange to run it a portion of each day, rather than all day for part of the week.
5. Perform occasional high level noise producing operations at night or at other times when a minimum number of employees will be exposed.

Measures such as these can often be instituted at little cost or effort, simply by introducing noise exposure as a factor in production planning. While not as satisfactory as controlling noise at its sources, administrative control measures are more easily enforced, than is the requirement to wear personal protective equipment. For this reason it is preferred.

Personal Protective Equipment

When engineering and administrative controls fail to bring noise levels or duration of exposure to them below permissible levels, the use of personal protective equipment is required, as stated in the second sentence of paragraph (b), section 50-204.10:

"If such controls fail to reduce sound levels within the levels of the table, personal protective equipment shall be provided and used to reduce sound levels within the levels of the table."

The use of personal protective equipment is considered by the Department to be an interim measure while engineering and administrative controls are being perfected. There will be very few cases in which the use of this equipment will be acceptable as a permanent solution to noise problems.

Some methods of control, such as providing an isolation booth for operators, or conducting noisy operations when few employees are in the plant, may require use of personal protective equipment by the operator when he must emerge from his booth to make adjustments, or by those few employees who carry on the noisy operation.

In addition, the regulations require *both provision and use* of personal protective equipment. How the latter is accomplished is up to the employer. The Department recommends, however, that an educational and promo-

tional program precede initiation of required use of such equipment, and continue as long as necessary to achieve 100-percent acceptance by employees. In the absence of an observable high proportion of use, the Department would consider the lack of a training and promotional program as constituting a violation of the regulation.

Selection of Personal Protective Equipment

Cotton stuffed in the ears has little value and will not be accepted by the Department, because of the relatively small attenuation (reduction of noise level) and the care which must be taken in using it.

Fine glass wool can be used instead of cotton, because the attenuation which can be achieved is very good. It is an acceptable protective device.

Wax impregnated cotton, when properly inserted in the ear, provides protection equivalent to that provided by plugs or muffs. If supervisors can assure that this material is properly used and fresh material is provided daily, then this type of ear protection would be acceptable.

Properly fitted earplugs are essentially equal in attenuating ability to ear muffs; either is acceptable to the Department. Plugs are inexpensive but must be fitted to the individual. In addition, plugs, and any other type of protector inserted into the ear, must be issued by a trained person under the direction of a physician or by the physician himself. Frequent checks must be made to see that the plugs are being properly inserted.

Ear muffs, though relatively expensive, may be issued by any designated person in the plant, as the only fitting required is adjustment of the head band. This makes it very easy for the supervisor to check on proper use of the muffs. Long hair and spectacle or goggle temples will interfere with the seal made by the cushioned edges of the muffs and will correspondingly reduce the actual attenuation, as stated by the manufacturer.

Regardless of the type of ear protector decided upon, its attenuation, as stated by the manufacturer, must be sufficient to reduce the noise level in the worker's ear to the level and for the duration prescribed in Table I. The manufacturer's stated values are determined under ideal conditions, and, therefore, as a precaution, it is wise to assume that the attenuation actually attained in use in the shop will be at least 5 dB less than the stated value. Only those ear protectors which have been tested in accordance with ANSI standard Z24.22-1957, "Method for Measurement of the Real-Ear Attenuation of Ear Protectors at Threshold," are acceptable to the Department.

The Department strongly recommends that any employee who is exposed to high sound levels and requests ear protection be provided with it, even if the duration of exposure is within the limits prescribed by Table I.

Hearing Conservation Program

Section 50-204.10 concludes with paragraph (d):

"(d) In all cases where the sound levels exceed the values shown herein, a continuing, effective hearing conservation program shall be administered."

Therefore, where the sound level in a working area has not been reduced to 90 dBA or below by engineering means, and reliance must be placed on administrative controls to limit duration of exposure, or on ear protection

to reduce the sound level actually reaching the ear, a hearing conservation program is required. The program will be applied to all those employees whose work brings them either steadily or infrequently into areas in which sound levels exceed 90 dBA.

Definitions

"Continuing" means that the program will be in effect and in use as long as noise levels above 90 dBA occur in the plant.

"Effective" means that exposed employees will not suffer continuing deterioration of hearing acuity because of their exposure, but that incipient loss of hearing will be detected and necessary steps taken to prevent further deterioration before serious hearing loss has occurred.

In a broad sense, "hearing conservation" covers the entire range of actions required by section 50-204.10. As used in paragraph (d), however, it refers to audiometry — periodic checks on the hearing ability of individual employees; and noise surveys — periodic checks of the noise level in the areas in which employees are working.

Audiometry

Audiometric tests will be made of all individuals working regularly or infrequently in areas in which the noise level is above 90 dBA. The purpose of these tests is to assure that administrative controls in use or ear protection devices provided are being adhered to or properly used and are effective in preventing loss of hearing from the noise levels encountered.

Audiometric tests may be made as frequently as specified by the plant's regular or consulting physician, but only under very special conditions shall they be made less than once a year.

The tests may be made in a doctor's office or elsewhere outside the plant, providing the test facilities, techniques, and records are equal to or exceed the minimum requirements described below.

1. Test Facilities and Procedures

The test booth or room shall meet criteria of ANSI standard S3.1-1960 (or latest), "Standard for Background Noise in Audiometric Rooms" for testing to a minimum level of 10 dB on the ISO 1964 audiometric scale.

The booth or room may be either prefabricated or locally built. Doors, gaskets, and other parts of the room or booth which may deteriorate, warp, or crack shall be carefully inspected periodically and necessary repairs or replacements made at once to ensure that successive audiometric tests of each individual are directly comparable and will give a true evaluation of the individual's hearing ability.

The operator of the audiometer should be positioned outside the room or booth but able to see the interior through a window. The person being tested must face away from the operator and the audiometer to ensure that all his responses are based on sound signals alone.

The test shall consist of an air conduction octave band analysis, as described in ANSI standard S3.1, and shall include, at least, 500, 1,000, 2,000, and 4,000 Hz.

The audiometric tests shall be made by a person trained and skilled in audiometric testing.

2. Audiometers

The audiometer used to make these tests shall meet the specifications for limited range, pure tone audiometers in ANSI standard S3.6-1969, "Specifications for Audiometers."

The audiometer shall have a certificate of calibration before it is placed in use, and shall be recalibrated each year thereafter. This calibration shall check both frequency and intensity at each setting, rise time and overshoot, and electrical and mechanical integrity. A current certificate attesting to such calibration shall be readily available for inspection by the Department of Labor.

On the audiometer shall be a statement indicating whether it is calibrated to ASA 1951 values or to the current American National Standard, which is identical to the ISO 1964 standard.

The audiometer shall be subjected to a biological check, preferably once a week but at least once a month, or before each use of the instrument if it is used less than once a month. The check shall be made by testing a person with a known and stable audiometric curve. The monthly check should include movement and bending of cord, wire, and lead, knob turning, switch actuating, and button pushing to ensure that there are no sounds other than the test tones. A log of these checks shall be maintained and be available for inspection.

3. Records

In addition to the certificates and logs referred to in 2 above, a record of each audiogram made on each individual tested shall be available for inspection. Records of audiometric tests shall indicate whether readings are based on ASA 1951 or on American National Standard (ISO 1964). The complete records on each employee required to be tested shall be retained for 1 year following termination of employment or transfer to an area in which noise levels above 90 dBA do not exist.

The records will be examined for evidence of any deterioration of hearing acuity and of action taken to prevent further deterioration in those employees found to suffer some loss of acuity. Conclusions as to effectiveness of control measures taken will be based on examination of a significant number of audiograms and not upon the basis of one or two cases.

4. Audiometric Tests Outside of Plant

If audiometric tests are done outside the plant, the Department of Labor representative will also inspect the facilities and test records, as noted below, and the same standards will apply.

Plant management will make arrangements for such inspection with the person conducting the audiometric tests and may accompany the representative in his inspection and review of records.

Noise Surveys

A noise survey of each area in the plant in which sound levels exceed 90 dBA shall be made at least once each year to ensure that sound levels have not increased above those originally existing. The survey may also establish that noise levels in some areas have been reduced to levels below 90 dBA and thereby justify discontinuing application of requirements for administrative controls, ear protection, and audiometric tests of individuals in such areas.

A noise survey of an area is recommended whenever a change is made in either equipment or type of operations so that significant changes in noise level will be acted upon immediately.

Tests of noise levels will be made with a sound level meter on the A-scale, slow response. The use of octave band analyzers or impact meters for control or other purposes shall be in addition to, not in place of, tests made with the sound level meter.

The sound level meter used will be one meeting specifications in ANSI standard S1.4-1961, "General Purpose Sound Level Meters."

Records will be made of such surveys showing: the instrument used; date, time, and location of such tests; machinery or equipment generating the noise; and name of person making the test.

Test records shall be kept readily available for inspection for 1 year or until a subsequent survey is made, if done more frequently.

The noise survey will be made by an insurance carrier, a consultant, a representative of a State health or labor department, or by a qualified individual designated by the company.

Compliance Plan

Whenever a noise survey shows noise levels in excess of those listed in Table I, necessary steps to reduce the noise exposure to or below those levels shall be ascertained and a detailed plan, with completion dates for individual steps, shall be prepared.

Following the original survey which shows existence of overexposures, the steps in a typical compliance plan might include the following, not necessarily in this order and some usually going on simultaneously:

1. A detailed survey of sound levels and sound spectra to determine the sources of excessive sound levels.

2. Initiation of engineering studies to determine methods for reducing sound levels at their sources.

3. Planning and initiation of feasible administrative controls, such as modifying production schedules to divide noisy jobs among enough people to bring each below the permissible limit or spreading part-time noisy operations.

4. Initial audiograms for personnel excessively exposed.

5. Installation of a personal protective equipment program.

6. Followup audiograms at appropriate intervals to assess effectiveness of the personal protective equipment program and administrative controls.

7. Installation of engineering controls, or process changes to reduce noises at their source.

8. Repeated noise surveys to measure effectiveness of the engineering changes.

When the compliance plan involves long term engineering projects (for example, 1 or 2 years) it may be revised from time to time as conditions change. The orderly completion, on schedule, of the various phases of the compliance plan, together with other components of the hearing conservation program, will be considered compliance with the regulation.

Applicable ANSI standards are available from the American National Standards Institute, 1430 Broadway, New York, N.Y. 1010018.

S1.4-1961 - Specification for General Purpose Sound Level Meters - \$2.75

S1.6-1967 - Preferred Frequencies and Band Numbers for Acoustical Measurements - \$2.75

S3.1-1960 - Criteria for Background Noise in Audiometer Rooms - \$2.75

S3.6-1969 - Specification for Audiometers - \$4.50

References in parentheses are to the corresponding classification as used in the National Electrical Code (NFPA No. 70, ANSI Standard CI-1968) for the convenience of persons familiar with those classifications.

(i) Power-operated industrial trucks shall not be used in atmospheres containing hazardous concentration of acetylene, butadiene, ethylene oxide, hydrogen (or gases or vapors equivalent in hazard to hydrogen, such as manufactured gas), propylene oxide, acetaldehyde, cyclopropane, diethyl ether, ethylene, isoprene, or unsymmetrical dimethyl hydrazine (UDMH).

(ii) (a) Power-operated industrial trucks shall not be used in atmospheres containing hazardous concentrations of metal dust, including aluminum, magnesium, and their commercial alloys, other metals of similarly hazardous characteristics, or in atmospheres containing carbon black, coal or coke dust except approved power-operated industrial trucks designated as EX may be used in such atmospheres.

(b) In atmospheres where dust of magnesium, aluminum or aluminum bronze may be present, fuses, switches, motor controllers, and circuit breakers of trucks shall have enclosures specifically approved for such locations.

(iii) Only approved power-operated industrial trucks designated as EX may be used in atmospheres containing acetone, acrylonitrile, alcohol, ammonia, benzene, benzol, butane, ethylene dichloride, gasoline, hexane, lacquer solvent vapors, naphtha, natural gas, propane, propylene, styrene, vinyl acetate, vinyl chloride, or xylenes in quantities sufficient to produce explosive or ignitable mixtures and where such concentrations of these gases or vapors exist continuously, intermittently or periodically under normal operating conditions or may exist frequently because of repair, maintenance operations, leakage, breakdown or faulty operation of equipment.

(iv) Power-operated industrial trucks designated as DY, EE, or EX may be used in locations where volatile flammable liquids or flammable gases are handled, processed or used, but in which the hazardous liquids, vapors or gases will normally be confined within closed containers or closed systems for which they can escape only in case of accidental rupture or breakdown of such containers or systems, or in the case of abnormal operation of equipment; also in locations in which hazardous concentrations of gases or vapors are normally prevented by positive mechanical ventilation but which might become hazardous through failure or abnormal operation of the ventilating equipment; or in locations which are adjacent to Class I, Division 1 locations, and to which hazardous concentrations of gases or vapors might occasionally be communicated unless such communication is prevented by adequate positive-pressure ventilation from a source of clear air, and effective safeguards against ventilation failure are provided.

(v) In locations used for the storage of hazardous liquids in sealed containers

or liquified or compressed gases in containers, approved power-operated industrial trucks designated as DS, ES, GS, or LPS may be used. This classification includes locations where volatile flammable liquids or flammable gases or vapors are used, but which, would become hazardous only in case of an accident or of some unusual operating condition. The quantity of hazardous material that might escape in case of accident, the adequacy of ventilating equipment, the total area involved, and the record of the industry or business with respect to explosions or fires are all factors that should receive consideration in determining whether or not the DS or DY, ES, EE, GS, LPS designated truck possesses sufficient safeguards for the location. Piping without valves, checks, meters and similar devices would not ordinarily be deemed to introduce a hazardous condition even though used for hazardous liquids or gases. Locations used for the storage of hazardous liquids or of liquified or compressed gases in sealed containers would not normally be considered hazardous unless subject to other hazardous conditions also.

(vi) (a) Only approved power-operating industrial trucks designated as EX shall be used in atmospheres in which combustible dust is or may be in suspension continuously, intermittently, or periodically under normal operating conditions, in quantities sufficient to produce explosive or ignitable mixtures, or where mechanical failure or abnormal operation of machinery or equipment might cause such mixtures to be produced.

(b) The EX classification usually includes the working areas of grain handling and storage plants, room containing grinders or pulverizers, cleaners, graders, scalpers, open conveyors or spouts, open bins or hoppers, mixers, or blenders, automatic or hopper scales, packing machinery, elevator heads and boots, stock distributors, dust and stock collectors (except all-metal collectors vented to the outside), and all similar dust producing machinery and equipment in grain processing plants, starch plants, sugar pulverizing plants, malting plants, hay grinding plants, and other occupancies of similar nature; coal pulverizing plants (except where the pulverizing equipment is essentially dust tight); all working areas where metal dusts and powders are produced, processed, handled, packed, or stored (except in tight containers); and other similar locations where combustible dust may, under normal operating conditions, be present in the air in quantities sufficient to produce explosive or ignitable mixtures.

(vii) Only approved power-operated industrial trucks designated as DY, EE, or EX shall be used in atmospheres in which combustible dust will not normally be in suspension in the air or will not be likely to be thrown into suspension by the normal operation of equipment or apparatus in quantities sufficient to produce explosive or ignitable mixtures but where deposits or accumulations of such

dust may be ignited by arcs or sparks originating in the truck.

(viii) Only approved power-operated industrial trucks designated as DY, EE, or EX shall be used in locations which are hazardous because of the presence of easily ignitable fibers or flyings but in which such fibers or flyings are not likely to be in suspension in the air in quantities sufficient to produce ignitable mixtures.

(ix) Only approved power-operated industrial trucks designated as DS, DY, ES, EE, EX, GS, or LPS be used in locations where easily ignitable fibers are stored or handled, including outside storage, but are not being processed or manufactured. Industrial trucks designated as E, which have been previously used in these locations may be continued in use.

(x) On piers and wharves handling general cargo, any approved power-operated industrial truck designated as Type D, E, G, or LP may be used, or trucks which conform to the requirements for these types may be used.

(xi) If storage warehouses and outside storage locations are hazardous only the approved power-operated industrial truck specified for such locations in this paragraph (c) (2) shall be used. If not classified as hazardous, any approved power-operated industrial truck designated as Type D, E, G, or LP may be used, or trucks which conform to the requirements for these types may be used.

(xii) If general industrial or commercial properties are hazardous, only approved power-operated industrial trucks specified for such locations in this paragraph (c) (2) shall be used. If not classified as hazardous, any approved power-operated industrial truck designated as Type D, E, G, or LP may be used, or trucks which conform to the requirements of these types may be used.

(d) *Converted industrial trucks.* Power-operated industrial trucks that have been originally approved for the use of gasoline for fuel, when converted to the use of liquefied petroleum gas fuel in accordance with paragraph (g) of this section, may be used in those locations where G, GS or LP, and LPS designated trucks have been specified in the preceding paragraphs.

(e) *Safety guards.* (1) High Lift Rider trucks shall be fitted with an overhead guard manufactured in accordance with paragraph (a) (2) of this section, unless operating conditions do not permit.

(2) If the type of load presents a hazard, the user shall equip fork trucks with a vertical load backrest extension manufactured in accordance with paragraph (a) (2) of this section.

(f) *Fuel handling and storage.* (1) The storage and handling of liquid fuels such as gasoline and diesel fuel shall be in accordance with NFPA Flammable and Combustible Liquids Code (NFPA No. 30-1969).

(2) The storage and handling of liquefied petroleum gas fuel shall be in accordance with Handling of Liquefied Petroleum Gases (NFPA No. 58-1969).

(g) *Charging and charging storage batteries.* (1) Battery charging installations shall be located in areas designated for that purpose.

(2) Facilities shall be provided for flushing and neutralizing spilled electrolyte, for fire protection, for protecting charging apparatus from damage by trucks, and for adequate ventilation for dispersal of fumes from gassing batteries.

(3) When racks are used for support of batteries, they should be made of materials nonconductive to spark generation or be coated or covered to achieve this objective.

(4) A conveyor, overhead hoist, or equivalent material handling equipment shall be provided for handling batteries.

(5) Reinstalled batteries shall be properly positioned and secured in the truck.

(6) A carboy tilter or siphon shall be provided for handling electrolyte.

(7) When charging batteries, acid shall be poured into water; water shall not be poured into acid.

(8) Trucks shall be properly positioned and brake applied before attempting to change or charge batteries.

(9) When charging batteries, the vent caps should be kept in place to avoid electrolyte spray. Care shall be taken to assure that vent caps are functioning. The battery (or compartment) cover(s) shall be open to dissipate heat.

(10) Smoking shall be prohibited in the charging area.

(11) Precautions shall be taken to prevent open flames, sparks, or electric arcs in battery charging areas.

(12) Tools and other metallic objects shall be kept away from the top of uncovered batteries.

(h) *Lighting for operating areas.* (1) Controlled lighting of adequate intensity should be provided in operating areas. (See American National Standard Practice for Industrial Lighting, A11.1-1965 (R1970)).

(2) Where general lighting is less than 2 lumens per square foot, auxiliary directional lighting shall be provided on the truck.

(i) *Control of noxious gases and fumes.* (1) Concentration levels of carbon monoxide gas created by powered industrial truck operations shall not exceed the levels specified in § 1910.93.

(2) Questions concerning degree of concentration and methods of sampling to ascertain the condition should be referred to a qualified industrial hygienist.

(j) *Dockboards (bridge plates).* See § 1910.30(a).

(k) *Trucks and railroad cars.* (1) The brakes of highway trucks shall be set and wheel chocks placed under the rear wheels to prevent the trucks from rolling while they are boarded with powered industrial trucks.

(2) Wheel stops or other recognized positive protection shall be provided to prevent railroad cars from moving during loading or unloading operations.

(3) Fixed jacks may be necessary to support a semitrailer and prevent up-ending during the loading or unloading

when the trailer is not coupled to a tractor.

(4) Positive protection shall be provided to prevent railroad cars from being moved while dockboards or bridge plates are in position.

(l) *Operator training.* Only trained and authorized operators shall be permitted to operate a powered industrial truck. Methods shall be devised to train operators in the safe operation of powered industrial trucks.

(m) *Truck operations.* (1) Trucks shall not be driven up to anyone standing in front of a bench or other fixed object.

(2) No person shall be allowed to stand or pass under the elevated portion of any truck, whether loaded or empty.

(3) Unauthorized personnel shall not be permitted to ride on powered industrial trucks. A safe place to ride shall be provided where riding of trucks is authorized.

(4) The employer shall prohibit arms or legs from being placed between the uprights of the mast or outside the running lines of the truck.

(5) When leaving a powered industrial truck unattended, load engaging means shall be fully lowered, controls shall be neutralized, power shut off, brakes set, key or connector plug removed. Wheels shall be blocked if the truck is parked on an incline.

(6) A safe distance shall be maintained from the edge of ramps or platforms while on any elevated dock, or platform or freight car. Trucks shall not be used for opening or closing freight doors.

(7) Brakes shall be set and wheel blocks shall be in place to prevent movement of trucks, trailers, or railroad cars while loading or unloading. Fixed jacks may be necessary to support a semitrailer during loading or unloading when the trailer is not coupled to a tractor. The flooring of trucks, trailers, and railroad cars shall be checked for breaks and weakness before they are driven onto.

(8) There shall be sufficient headroom under overhead installations, lights, pipes, sprinkler system, etc.

(9) An overhead guard shall be used as protection against falling objects. It should be noted that an overhead guard is intended to offer protection from the impact of small packages, boxes, bagged material, etc., representative of the job application, but not to withstand the impact of a falling capacity load.

(10) A load backrest extension shall be used whenever necessary to minimize the possibility of the load or part of it from falling rearward.

(11) Only approved industrial trucks shall be used in hazardous locations.

(12) Whenever a truck is equipped with vertical only, or vertical and horizontal controls elevatable with the lifting carriage or forks for lifting personnel, the following additional precautions shall be taken for the protection of personnel being elevated.

(i) Use of a safety platform firmly secured to the lifting carriage and/or forks.

(ii) Means shall be provided whereby personnel on the platform can shut off power to the truck.

(iii) Such protection from falling objects as indicated necessary by the operating conditions shall be provided.

(13) Spinner knobs must not be attached to steering handwheels of trucks not originally equipped with such.

(14) Fire aisles, access to stairways, and fire equipment shall be kept clear.

(n) *Traveling.* (1) All traffic regulations shall be observed, including authorized plant speed limits. A safe distance shall be maintained approximately three truck lengths from the truck ahead, and the truck shall be kept under control at all times.

(2) The right of way shall be yielded to ambulances, fire trucks, or other vehicles in emergency situations.

(3) Other trucks traveling in the same direction at intersections, blind spots, or other dangerous locations shall not be passed.

(4) The driver shall be required to slow down and sound the horn at cross aisles and other locations where vision is obstructed. If the load being carried obstructs forward view, the driver shall be required to travel with the load trailing.

(5) Railroad tracks shall be crossed diagonally wherever possible. Parking closer than 8 feet from the center of railroad tracks is prohibited.

(6) The driver shall be required to look in the direction of, and keep a clear view of the path of travel.

(7) Grades shall be ascended or descended slowly.

(i) When ascending or descending grades in excess of 10 percent, loaded trucks shall be driven with the load up-grade.

(ii) Unloaded trucks should be operated on all grades with the load engaging means down-grade.

(iii) On all grades the load and load engaging means shall be tilted back if applicable, and raised only as far as necessary to clear the road surface.

(8) Under all travel conditions the truck shall be operated at a speed that will permit it to be brought to a stop in a safe manner.

(9) Stunt driving and horseplay shall not be permitted.

(10) The driver shall be required to slow down for wet and slippery floors.

(11) Dockboard or bridgeplates, shall be properly secured before they are driven over. Dockboard or bridgeplates shall be driven over carefully and slowly and their rated capacity never exceeded.

(12) Elevators shall be approached slowly, and then entered squarely after the elevator car is properly leveled. Once on the elevator, the controls shall be neutralized, power shut off, and the brakes set.

(13) Motorized hand trucks must enter elevator or other confined areas with load end forward.

(14) Running over loose objects on the roadway surface shall be avoided.

(15) While negotiating turns, speed shall be reduced to a safe level, by means of turning the hand steering wheel in a

smooth, sweeping motion. Except when maneuvering at a very low speed, the hand steering wheel shall be turned at a moderate, even rate.

(c) *Loading.* (1) Only stable or safely arranged loads shall be handled. Caution shall be exercised when handling off-center loads which cannot be centered.

(2) Only loads within the rated capacity of the truck shall be handled.

(3) The long or high (including multi-tiered) loads which may affect capacity shall be adjusted.

(4) When attachments are used, particular care should be taken in securing, manipulating, positioning, and transporting the load. Trucks equipped with attachments shall be operated as partially loaded trucks when not handling a load.

(5) A load engaging means shall be placed under the load as far as possible; the mast shall be carefully tilted backward to stabilize the load.

(6) Extreme care shall be used when tilting the load forward or backward, particularly when high tiering. Tilting forward with load engaging means elevated shall be prohibited except to pick up a load. An elevated load shall not be tilted forward except when the load is in a deposit position over a rack or stack. When stacking or tiering, only enough backward tilt to stabilize the load shall be used.

(p) *Operation of the truck.* (1) If at any time a powered industrial truck is found to be in need of repair, defective, or in any way unsafe, the truck shall be taken out of service until it has been restored to safe operating condition.

(2) Fuel tanks shall not be filled while the engine is running. Spillage shall be avoided.

(3) Spillage of oil or fuel shall be carefully washed away or completely evaporated and the fuel tank cap replaced before restarting engine.

(4) No truck shall be operated with a leak in the fuel system until the leak has been corrected.

(5) Open flames shall not be used for checking electrolyte level in storage batteries or gasoline level in fuel tanks.

(q) *Maintenance of industrial trucks.* (1) Any power-operated industrial truck not in safe operating condition shall be removed from service. All repairs shall be made by authorized personnel.

(2) No repairs shall be made in Classes I, II, and III locations.

(3) Those repairs to the fuel and ignition systems of industrial trucks which involve fire hazards shall be conducted only in locations designated for such repairs.

(4) Trucks in need of repairs to the electrical system shall have the battery disconnected prior to such repairs.

(5) All parts of any such industrial truck requiring replacement shall be replaced only by parts equivalent as to safety with those used in the original design.

(6) Industrial trucks shall not be altered so that the relative positions of the various parts are different from what

they were when originally received from the manufacturer, nor shall they be altered either by the addition of extra parts not provided by the manufacturer or by the elimination of any parts, except as provided in subparagraph (12) of this paragraph. Additional counterweighting of fork trucks shall not be done unless approved by the truck manufacturer.

(7) Industrial trucks shall be examined before being placed in service, and shall not be placed in service if the examination shows any condition adversely affecting the safety of the vehicle. Such examination shall be made at least daily.

Where industrial trucks are used on a round-the-clock basis, they shall be examined after each shift. Defects when found shall be immediately reported and corrected.

(8) Water mufflers shall be filled daily or as frequently as is necessary to prevent depletion of the supply of water below 75 percent of the filled capacity. Vehicles with mufflers having screens or other parts that may become clogged shall not be operated while such screens or parts are clogged. Any vehicle that emits hazardous sparks or flames from the exhaust system shall immediately be removed from service, and not returned to service until the cause for the emission of such sparks and flames has been eliminated.

(9) When the temperature of any part of any truck is found to be in excess of its normal operating temperature, thus creating a hazardous condition, the vehicle shall be removed from service and not returned to service until the cause for such overheating has been eliminated.

(10) Industrial trucks shall be kept in a clean condition, free of lint, excess oil, and grease. Noncombustible agents should be used for cleaning trucks. Low flash point (below 100° F.) solvents shall not be used. High flash point (at or above 100° F.) solvents may be used. Precautions regarding toxicity, ventilation, and fire hazard shall be consonant with the agent or solvent used.

(11) Where it is necessary to use antifreeze in the engine cooling system, only those products having a glycol base shall be used.

(12) Industrial trucks originally approved for the use of gasoline for fuel may be converted to liquefied petroleum gas fuel provided the complete conversion results in a truck which embodies the features specified for LP or LPS designated trucks. Such conversion equipment shall be approved. The description of the component parts of this conversion system and the recommended method of installation on specific trucks are contained in the "Listed by Report."

§ 1910.179 Overhead and gantry cranes.

(a) *Definitions applicable to this section.* (1) A "crane" is a machine for lifting and lowering a load and moving it horizontally, with the hoisting mechanism an integral part of the machine. Cranes whether fixed or mobile are driven manually or by power.

(2) An "automatic crane" is a crane which when activated operates through a preset cycle or cycles.

(3) A "cab-operated crane" is a crane controlled by an operator in a cab located on the bridge or trolley.

(4) "Cantilever gantry crane" means a gantry or semigantry crane in which the bridge girders or trusses extend transversely beyond the crane runway on one or both sides.

(5) "Floor-operated crane" means a crane which is pendant or nonconductive rope controlled by an operator on the floor or an independent platform.

(6) "Gantry crane" means a crane similar to an overhead crane except that the bridge for carrying the trolley or trolleys is rigidly supported on two or more legs running on fixed rails or other runway.

(7) "Hot metal handling crane" means an overhead crane used for transporting or pouring molten material.

(8) "Overhead crane" means a crane with a movable bridge carrying a movable or fixed hoisting mechanism and traveling on an overhead fixed runway structure.

(9) "Power-operated crane" means a crane whose mechanism is driven by electric, air, hydraulic, or internal combustion means.

(10) A "pulpit-operated crane" is a crane operated from a fixed operator station not attached to the crane.

(11) A "remote-operated crane" is a crane controlled by an operator not in a pulpit or in the cab attached to the crane, by any method other than pendant or rope control.

(12) A "semigantry crane" is a gantry crane with one end of the bridge rigidly supported on one or more legs that run on a fixed rail or runway, the other end of the bridge being supported by a truck running on an elevated rail or runway.

(13) "Storage bridge crane" means a gantry type crane of long span usually used for bulk storage of material; the bridge girders or trusses are rigidly or nonrigidly supported on one or more legs. It may have one or more fixed or hinged cantilever ends.

(14) "Wall crane" means a crane having a jib with or without trolley and supported from a side wall or line of columns of a building. It is a traveling type and operates on a runway attached to the side wall or columns.

(15) "Appointed" means assigned specific responsibilities by the employer or the employer's representative.

(16) "ANSI" means the American National Standards Institute.

(17) An "auxiliary hoist" is a supplemental hoisting unit of lighter capacity and usually higher speed than provided for the main hoist.

(18) A "brake" is a device used for retarding or stopping motion by friction or power means.

(19) A "drag brake" is a brake which provides retarding force without external control.

(20) A "holding brake" is a brake that automatically prevents motion when power is off.

(21) "Bridge" means that part of a crane consisting of girders, trucks, end ties, footwalks, and drive mechanism which carries the trolley or trolleys.

(22) "Bridge travel" means the crane movement in a direction parallel to the crane runway.

(23) A "bumper" (buffer) is an energy absorbing device for reducing impact when a moving crane or trolley reaches the end of its permitted travel; or when two moving cranes or trolleys come in contact.

(24) The "cab" is the operator's compartment on a crane.

(25) "Clearance" means the distance from any part of the crane to a point of the nearest obstruction.

(26) "Collectors" (current) are contacting devices for collecting current from runway or bridge conductors.

(27) "Conductors, bridge" are the electrical conductors located along the bridge structure of a crane to provide power to the trolley.

(28) "Conductors, runway" (main) are the electrical conductors located along a crane runway to provide power to the crane.

(29) The "control braking means" is a method of controlling crane motor speed when in an overhauling condition.

(30) "Countertorque" means a method of control by which the power to the motor is reversed to develop torque in the opposite direction.

(31) "Dynamic" means a method of controlling crane motor speeds when in the overhauling condition to provide a retarding force.

(32) "Regenerative" means a form of dynamic braking in which the electrical energy generated is fed back into the power system.

(33) "Mechanical" means a method of control by friction.

(34) "Controller, spring return" means a controller which when released will return automatically to a neutral position.

(35) "Designated" means selected or assigned by the employer or the employer's representative as being qualified to perform specific duties.

(36) A "drift point" means a point on a travel motion controller which releases the brake while the motor is not energized. This allows for coasting before the brake is set.

(37) The "drum" is the cylindrical member around which the ropes are wound for raising or lowering the load.

(38) An "equalizer" is a device which compensates for unequal length or stretch of a rope.

(39) "Exposed" means capable of being contacted inadvertently. Applied to hazardous objects not adequately guarded or isolated.

(40) "Fall-safe" means a provision designed to automatically stop or safely control any motion in which a malfunction occurs.

(41) "Footwalk" means the walkway with handrail, attached to the bridge or trolley for access purposes.

(42) A "hoist" is an apparatus which may be a part of a crane, exerting a force for lifting or lowering.

(43) "Hoist chain" means the load bearing chain in a hoist.

NOTE: Chain properties do not conform to those shown in ANSI B30.9-1971, Safety Code for Slings.

(44) "Hoist motion" means that motion of a crane which raises and lowers a load.

(45) "Load" means the total superimposed weight on the load block or hook.

(46) The "load block" is the assembly of hook or shackle, swivel, bearing, sheaves, pins, and frame suspended by the hoisting rope.

(47) "Magnet" means an electromagnetic device carried on a crane hook to pick up loads magnetically.

(48) "Main hoist" means the hoist mechanism provided for lifting the maximum rated load.

(49) A "man trolley" is a trolley having an operator's cab attached thereto.

(50) "Rated load" means the maximum load for which a crane or individual hoist is designed and built by the manufacturer and shown on the equipment nameplate(s).

(51) "Rope" refers to wire rope, unless otherwise specified.

(52) "Running sheave" means a sheave which rotates as the load block is raised or lowered.

(53) "Runway" means an assembly of rails, beams, girders, brackets, and framework on which the crane or trolley travels.

(54) "Side pull" means that portion of the hoist pull acting horizontally when the hoist lines are not operated vertically.

(55) "Span" means the horizontal distance center to center of runway rails.

(56) "Standby crane" means a crane which is not in regular service but which is used occasionally or intermittently as required.

(57) A "stop" is a device to limit travel of a trolley or crane bridge. This device normally is attached to a fixed structure and normally does not have energy absorbing ability.

(58) A "switch" is a device for making, breaking, or for changing the connections in an electric circuit.

(59) An "emergency stopswitch" is a manually or automatically operated electric switch to cut off electric power independently of the regular operating controls.

(60) A "limit switch" is a switch which is operated by some part or motion of a power-driven machine or equipment to alter the electric circuit associated with the machine or equipment.

(61) A "main switch" is a switch controlling the entire power supply to the crane.

(62) A "master switch" is a switch which dominates the operation of contractors, relays, or other remotely operated devices.

(63) The "trolley" is the unit which travels on the bridge rails and carries the hoisting mechanism.

(64) "Trolley travel" means the trolley movement at right angles to the crane runway.

(65) "Truck" means the unit consisting of a frame, wheels, bearings, and axles which supports the bridge girders or trolleys.

(b) *General requirements*—(1) *Application*. This section applies to overhead and gantry cranes, including semigantry, cantilever gantry, wall cranes, storage bridge cranes, and others having the same fundamental characteristics. These cranes are grouped because they all have trolleys and similar travel characteristics.

(2) *New and existing equipment*. All new overhead and gantry cranes installed after the effective date of the regulations in this subpart shall meet the design specifications of the American National Standard Safety Code for Overhead and Gantry Cranes, ANSI B30.2-1967. Equipment constructed and installed prior to the effective date of this subpart shall be modified to conform to these specifications.

(3) *Modifications*. Cranes may be modified and rerated provided such modifications and the supporting structure are checked thoroughly for the new rated load by a qualified engineer or the equipment manufacturer. The crane shall be tested in accordance with paragraph (k)(2) of this section. New rated load shall be displayed in accordance with subparagraph (5) of this paragraph.

(4) *Wind indicators and rail clamps*. Outdoor storage bridges shall be provided with automatic rail clamps. A wind-indicating device shall be provided which will give a visible or audible alarm to the bridge operator at a predetermined wind velocity. If the clamps act on the rail heads, any beads or weld flash on the rail heads shall be ground off.

(5) *Rated load marking*. The rated load of the crane shall be plainly marked on each side of the crane, and if the crane has more than one hoisting unit, each hoist shall have its rated load marked on it or its load block and this marking shall be clearly legible from the ground or floor.

(6) *Clearance from obstruction*. (i) Minimum clearance of 3 inches overhead and 2 inches laterally shall be provided and maintained between crane and obstructions in conformity with Crane Manufacturers Association of America, Inc., Specification No. 61 (formerly the Electric Overhead Crane Institute, Inc.).

(ii) Where passageways or walkways are provided obstructions shall not be placed so that safety of personnel will be jeopardized by movements of the crane.

(7) *Clearance between parallel cranes*. If the runways of two cranes are parallel, and there are no intervening walls or structure, there shall be adequate clearance provided and maintained between the two bridges.

(c) *Cabs*—(1) *Cab location*. (i) The general arrangement of the cab and the

location of control and protective equipment shall be such that all operating handles are within convenient reach of the operator when facing the area to be served by the load hook, or while facing the direction of travel of the cab. The arrangement shall allow the operator a full view of the load hook in all positions.

(II) The cab shall be located to afford a minimum of 3 inches clearance from all fixed structures within its area of possible movement.

(III) The clearance of the cab above the working floor or passageway should be not less than 7 feet.

(2) *Access to crane.* Access to the cab and/or bridge walkway shall be by a conveniently placed fixed ladder, stairs, or platform, requiring no step over any gap exceeding 12 inches. Fixed ladders shall be in conformance with the American National Standard Safety Code for Fixed Ladders, ANSI A14.3-1956.

(3) *Fire extinguisher.* A carbon dioxide, dry-chemical, or equivalent hand fire extinguisher should be kept in the cab. Carbon tetrachloride extinguishers shall not be used.

(4) *Lighting.* Light in the cab shall be sufficient to enable the operator to see clearly enough to perform his work.

(d) *Footwalks and ladders.* (1) *Location of footwalks.* (i) If sufficient headroom is available on cab-operated cranes, a footwalk shall be provided on the drive side along the entire length of the bridge of all cranes having the trolley running on the top of the girders. To give sufficient access to the opposite side of the trolley, there should be provided either a footwalk mounted on the trolley, a suitable footwalk or platform in the building, or a footwalk on the opposite side of the crane at least twice the length of the trolley.

(ii) Footwalks should be located to give a headroom not less than 78 inches. In no case shall less than 48 inches be provided. If 48 inches of headroom cannot be provided, footwalks should be omitted from the crane and a stationary platform or landing stage built for workmen making repairs.

(2) *Construction of footwalks.* (i) Footwalks shall be of rigid construction and designed to sustain a distributed load of at least 50 pounds per square foot.

(ii) Footwalks shall have a walking surface of antislip type.

Note: Wood will meet this requirement.

(iii) Footwalks should be continuous and permanently secured.

(iv) Footwalks should have a clear passageway at least 18 inches wide except opposite the bridge motor, where they should be not less than 15 inches. The inner edge shall extend at least to the line of the outside edge of the lower cover plate or flange of the girder.

(3) *Toeboards and handrails for footwalks.* Toeboards and handrails shall be in compliance with section 1910.23 of this part.

(4) *Ladders and stairways.* (i) Gantry cranes shall be provided with ladders or stairways extending from the ground to the footwalk or cab platform.

(ii) Stairways shall be equipped with rigid and substantial metal handrails. Walking surfaces shall be of an antislip type.

(iii) Ladders shall be permanently and securely fastened in place and shall be constructed in compliance with § 1910.27.

(e) *Stops, bumpers, rail sweeps, and guards.* (1) *Trolley stops.* (i) Stops shall be provided at the limits of travel of the trolley.

(ii) Stops shall be fastened to resist forces applied when contacted.

(iii) A stop engaging the tread of the wheel shall be of a height at least equal to the radius of the wheel.

(2) *Bridge bumpers.* (i) A crane shall be provided with bumpers capable of stopping the crane (not including the lifted load) at a rate of deceleration not to exceed 3 feet per second per second when traveling in either direction at 20 percent of the rated load speed.

(a) The bumper shall have sufficient energy absorbing capacity to stop the crane when traveling at a speed of at least 40 percent of rated load speed.

(b) The bumper shall be so mounted that there is no direct shear on bolts.

(ii) Bumpers shall be so designed and installed as to minimize parts falling from the crane in case of breakage.

(3) *Trolley bumpers.* (i) Trolley shall be provided with bumpers capable of stopping the trolley (not including the lifted load) at a rate of deceleration not to exceed 4.7 feet per second per second when traveling in either direction at one-third of the rated load speed.

(ii) When more than one trolley is operated on the same bridge, each shall be equipped with bumpers on their adjacent ends.

(iii) Bumpers shall be designed and installed to minimize parts falling from the trolley in case of breakage.

(4) *Rail sweeps.* Bridge trucks shall be equipped with sweeps which extend below the top of the rail and project in front of the truck wheels.

(5) *Guards for hoisting ropes.* (i) If hoisting ropes run near enough to other parts to make fouling or chafing possible, guards shall be installed to prevent this condition.

(ii) A guard shall be provided to prevent contact between bridge conductors and hoisting ropes if they could come into contact.

(6) *Guards for moving parts.* (i) Exposed moving parts such as gears, set screws, projecting keys, chains, chain sprockets, and reciprocating components which might constitute a hazard under normal operating conditions shall be guarded.

(ii) Guards shall be securely fastened.

(iii) Each guard shall be capable of supporting without permanent distortion the weight of a 200-pound person unless the guard is located where it is impossible for a person to step on it.

(f) *Brakes.* (1) *Brakes for hoists.* (i) Each independent hoisting unit of a crane shall be equipped with at least one self-setting brake, hereafter referred to as a holding brake, applied directly to the

motor shaft or some part of the gear train.

(ii) Each independent hoisting unit of a crane, except worm-gear hoists, the angle of whose worm is such as to prevent the load from accelerating in the lowering direction shall, in addition to a holding brake, be equipped with control braking means to prevent overspeeding.

(2) *Holding brakes.* (i) Holding brakes for hoist motors shall have not less than the following percentage of the full load hoisting torque at the point where the brake is applied.

(a) 125 percent when used with a control braking means other than mechanical.

(b) 100 percent when used in conjunction with a mechanical control braking means.

(c) 100 percent each if two holding brakes are provided.

(ii) Holding brakes on hoists shall have ample thermal capacity for the frequency of operation required by the service.

(iii) Holding brakes on hoists shall be applied automatically when power is removed.

(iv) Where necessary holding brakes shall be provided with adjustment means to compensate for wear.

(v) The wearing surface of all holding-brake drums or discs shall be smooth.

(vi) Each independent hoisting unit of a crane handling hot metal and having power control braking means shall be equipped with at least two holding brakes.

(3) *Control braking means.* (i) A power control braking means such as regenerative, dynamic or counter-torque braking, or a mechanically controlled braking means shall be capable of maintaining safe lowering speeds of rated loads.

(ii) The control braking means shall have ample thermal capacity for the frequency of operation required by service.

(4) *Brakes for trolleys and bridges.* (i) Foot-operated brakes shall not require an applied force of more than 70 pounds to develop manufacturer's rated brake torque.

(ii) Brakes may be applied by mechanical, electrical, pneumatic, hydraulic, or gravity means.

(iii) Where necessary brakes shall be provided with adjustment means to compensate for wear.

(iv) The wearing surface of all brake-drums or discs shall be smooth.

(v) All foot-brake pedals shall be constructed so that the operator's foot will not easily slip off the pedal.

(vi) Foot-operated brakes shall be equipped with automatic means for positive release when pressure is released from the pedal.

(vii) Brakes for stopping the motion of the trolley or bridge shall be of sufficient size to stop the trolley or bridge within a distance in feet equal to 10 percent of full load speed in feet per minute when traveling at full speed with full load.

(viii) If holding brakes are provided on the bridge or trolley(s), they shall not prohibit the use of a drift point in the control circuit.

(ix) Brakes on trolleys and bridges shall have ample thermal capacity for the frequency of operation required by the service to prevent impairment of functions from overheating.

(5) *Application of trolley brakes.* (i) On cab-operated cranes with cab on trolley, a trolley brake shall be required as specified under subparagraph (4) of this paragraph.

(ii) A drag brake may be applied to hold the trolley in a desired position on the bridge and to eliminate creep with the power off.

(6) *Application of bridge brakes.* (i) On cab-operated cranes with cab on bridge, a bridge brake is required as specified under subparagraph (4) of this paragraph.

(ii) On cab-operated cranes with cab on trolley, a bridge brake of the holding type shall be required.

(iii) On all floor, remote and pulpit-operated crane bridge drives, a brake or noncoasting mechanical drive shall be provided.

(g) *Electric equipment.*—(1) *General.* (i) Wiring and equipment shall comply with § 1910.401.

(ii) The control circuit voltage shall not exceed 600 volts for a.c. or d.c. current.

(iii) The voltage at pendant pushbuttons shall not exceed 150 volts for a.c. and 300 volts for d.c.

(iv) Where multiple conductor cable is used with a suspended pushbutton station, the station must be supported in some satisfactory manner that will protect the electrical conductors against strain.

(v) Pendant control boxes shall be constructed to prevent electrical shock and shall be clearly marked for identification of functions.

(2) *Equipment.* (i) Electrical equipment shall be so located or enclosed that live parts will not be exposed to accidental contact under normal operating conditions.

(ii) Electric equipment shall be protected from dirt, grease, oil, and moisture.

(iii) Guards for live parts shall be substantial and so located that they cannot be accidentally deformed so as to make contact with the live parts.

(3) *Controllers.* (i) Cranes not equipped with spring-return controllers or momentary contact pushbuttons shall be provided with a device which will disconnect all motors from the line on failure of power and will not permit any motor to be restarted until the controller handle is brought to the "off" position, or a reset switch or button is operated.

(ii) Lever operated controllers shall be provided with a notch or latch which in the "off" position prevents the handle from being inadvertently moved to the "on" position. An "off" detent or spring return arrangement is acceptable.

(iii) The controller operating handle shall be located within convenient reach of the operator.

(iv) As far as practicable, the movement of each controller handle shall be in the same general directions as the resultant movements of the load.

(v) The control for the bridge and trolley travel shall be so located that the operator can readily face the direction of travel.

(vi) For floor-operated cranes, the controller or controllers if rope operated, shall automatically return to the "off" position when released by the operator.

(vii) Pushbuttons in pendant stations shall return to the off position when pressure is released by the crane operator.

(viii) Automatic cranes shall be so designed that all motions shall fail-safe if any malfunction of operation occurs.

(ix) Remote-operated cranes shall function so that if the control signal for any crane motion becomes ineffective that crane motion shall stop.

(4) *Resistors.* (i) Enclosures for resistors shall have openings to provide adequate ventilation, and shall be installed to prevent the accumulation of combustible matter too near to hot parts.

(ii) Resistor units shall be supported so as to be free as possible from vibration.

(iii) Provision shall be made to prevent broken parts or molten metal falling upon the operator or from the crane.

(5) *Switches.* (i) The power supply to the runway conductors shall be controlled by a switch or circuit breaker located on a fixed structure, accessible from the floor, and arranged to be locked in the open position.

(ii) On cab-operated cranes a switch or circuit breaker of the enclosed type, with provision for locking in the open position shall be provided in the leads from the runway conductors. A means of opening this switch or circuit breaker shall be located within easy reach of the operator.

(iii) On floor-operated cranes, a switch or circuit breaker of the enclosed type, with provision for locking in the open position, shall be provided in the leads from the runway conductors. This disconnect shall be mounted on the bridge or footwalk near the runway collectors. One of the following types of floor operated disconnects shall be provided:

(a) Nonconductive rope attached to the main disconnect switch.

(b) An undervoltage trip for the main circuit breaker operated by an emergency stop button in the pendant pushbutton in the pendant pushbutton station.

(c) A main line contactor operated by a switch or pushbutton in the pendant pushbutton station.

(iv) The hoisting motion of all electric traveling cranes shall be provided with an overtravel limit switch in the hoisting direction.

(v) All cranes using a lifting magnet shall have a magnet circuit switch of the enclosed type with provision for locking in the open position. Means for discharg-

ing the inductive load of the magnet shall be provided.

(6) *Runway conductors.* Conductors of the open type mounted on the crane runway beams or overhead shall be so located or so guarded that persons entering or leaving the cab or crane footwalk normally could not come into contact with them.

(7) *Extension lamps.* If a service receptacle is provided in the cab or on the bridge of cab-operated cranes, it shall be a grounded three-prong type permanent receptacle, not exceeding 300 volts.

(h) *Hoisting equipment.*—(1) *Sheaves.*

(i) Sheave grooves shall be smooth and free from surface defects which could cause rope damage.

(ii) Sheaves carrying ropes which can be momentarily unloaded shall be provided with close-fitting guards or other suitable devices to guide the rope back into the groove when the load is applied again.

(iii) The sheaves in the bottom block shall be equipped with close-fitting guards that will prevent ropes from becoming fouled when the block is lying on the ground with ropes loose.

(iv) Pockets and flanges of sheaves used with hoist chains shall be of such dimensions that the chain does not catch or bind during operation.

(v) All running sheaves shall be equipped with means for lubrication. Permanently lubricated, sealed and/or shielded bearings meet this requirement.

(2) *Ropes.* (i) In using hoisting ropes, the crane manufacturer's recommendation shall be followed. The rated load divided by the number of parts of rope shall not exceed 20 percent of the nominal breaking strength of the rope.

(ii) Socketing shall be done in the manner specified by the manufacturer of the assembly.

(iii) Rope shall be secured to the drum as follows:

(a) No less than two wraps of rope shall remain on the drum when the hook is in its extreme low position.

(b) Rope end shall be anchored by a clamp securely attached to the drum, or by a socket arrangement approved by the crane or rope manufacturer.

(iv) Eye splices. [Reserved.]

(v) Rope clips attached with U-bolts shall have the U-bolts on the dead or short end of the rope. Spacing and number of all types of clips shall be in accordance with the clip manufacturer's recommendation. Clips shall be drop-forged steel in all sizes manufactured commercially. When a newly installed rope has been in operation for an hour, all nuts on the clip bolts shall be retightened.

(vi) Swaged or compressed fittings shall be applied as recommended by the rope or crane manufacturer.

(vii) Wherever exposed to temperatures, at which fiber cores would be damaged, rope having an independent wire-rope or wire-strand core, or other temperature-damage resistant core shall be used.

(viii) Replacement rope shall be the same size, grade, and construction as the original rope furnished by the crane manufacturer, unless otherwise recommended by a wire rope manufacturer due to actual working condition requirements.

(3) *Equalizers.* If a load is supported by more than one part of rope, the tension in the parts shall be equalized.

(4) *Hooks.* Hooks shall meet the manufacturer's recommendations and shall not be overloaded.

(i) *Warning device.* Except for floor-operated cranes a gong or other effective warning signal shall be provided for each crane equipped with a power traveling mechanism.

(j) *Inspection.*—(1) *Inspection classification.* (i) Initial inspection. Prior to initial use all new and altered cranes shall be inspected to insure compliance with the provisions of this section.

(ii) Inspection procedure for cranes in regular service is divided into two general classifications based upon the intervals at which inspection should be performed. The intervals in turn are dependent upon the nature of the critical components of the crane and the degree of their exposure to wear, deterioration, or malfunction. The two general classifications are herein designated as "frequent" and "periodic" with respective intervals between inspections as defined below:

(a) Frequent inspection—Daily to monthly intervals.

(b) Periodic inspection—1 to 12-month intervals.

(2) *Frequent inspection.* The following items shall be inspected for defects at intervals as defined in subparagraph (1)(i) of this paragraph or as specifically indicated, including observation during operation for any defects which might appear between regular inspections. All deficiencies such as listed shall be carefully examined and determination made as to whether they constitute a safety hazard:

(i) All functional operating mechanisms for maladjustment interfering with proper operation. Daily.

(ii) Deterioration or leakage in lines, tanks, valves, drain pumps, and other parts of air or hydraulic systems. Daily.

(iii) Hooks with deformation or cracks. Visual inspection daily; monthly inspection with signed reports. For hooks with cracks or having more than 15 percent in excess of normal throat opening or more than 10° twist from the plane of the unbent hook refer to paragraph (1)(3)(iii)(a) of this section.

(iv) Hoist or load attachment chains, including end connections, for excessive wear, twist, distorted links interfering with proper function, or stretch beyond manufacturer's recommendations. Visual inspection daily; monthly inspection with signed report.

(v) Rope slings, including end connections, for excessive wear, broken wires, stretch, kinking, or twisting. Visual inspection daily; monthly inspection with signed report.

(vi) All functional operating mechanisms for excessive wear of components.

(vii) Rope reeving for noncompliance with manufacturer's recommendations.

(3) *Periodic inspection.* Complete inspections of the crane shall be performed at intervals as generally defined in subparagraph (1)(ii)(b) of this paragraph, depending upon its activity, severity of service, and environment, or as specifically indicated below. These inspections shall include the requirements of subparagraph (2) of this paragraph and in addition, the following items. Any deficiencies such as listed shall be carefully examined and determination made as to whether they constitute a safety hazard:

(i) Deformed, cracked, or corroded members.

(ii) Loose bolts or rivets.

(iii) Cracked or worn sheaves and drums.

(iv) Worn, cracked or distorted parts such as pins, bearings, shafts, gears, rollers, locking and clamping devices.

(v) Excessive wear on brake system parts, linings, pawls, and ratchets.

(vi) Load, wind, and other indicators over their full range, for any significant inaccuracies.

(vii) Gasoline, diesel, electric, or other powerplants for improper performance or noncompliance with applicable safety requirements.

(viii) Excessive wear of chain drive sprockets and excessive chain stretch.

(ix) Crane hooks. Magnetic particle or other suitable crack detecting inspection should be performed at least once each year.

(x) Electrical apparatus, for signs of pitting or any deterioration of controller containers, limit switches and pushbutton stations.

(4) *Cranes not in regular use.* (i) A crane which has been idle for a period of 1 month or more, but less than 6 months, shall be given an inspection conforming with requirements of subparagraph (2) of this paragraph and paragraph (m)(2) of this section, before placing in service.

(ii) A crane which has been idle for a period of over 6 months shall be given a complete inspection conforming with requirements of subparagraphs (2) and (3) of this paragraph and paragraph (m)(2) of this section before placing in service.

(iii) Standby cranes shall be inspected at least semi-annually in accordance with requirements of subparagraph (2) of this paragraph and paragraph (m)(2) of this section. Standby cranes exposed to adverse environment should be inspected more frequently.

(k) *Testing.*—(1) *Operational tests.*

(i) Prior to initial use all new and altered cranes shall be tested to insure compliance with this section including the following functions:

(a) Hoisting and lowering.

(b) Trolley travel.

(c) Bridge travel.

(d) Limit switches, locking and safety devices.

(ii) The trip setting of hoist limit switches shall be determined by tests with an empty hook traveling in increasing speeds up to the maximum speed. The actuating mechanism of the limit switch shall be located so that it will trip the switch, under all conditions, in sufficient time to prevent contact of the hook or hook block with any part of the trolley.

(2) *Rated load test.* Prior to initial use all new, extensively repaired, and altered cranes should be tested by or under the direction of an appointed or authorized person, confirming the load rating of the crane. The load rating should not be more than 80 percent of the maximum load sustained during the test. Test loads shall not be more than 125 percent of the rated load unless otherwise recommended by the manufacturer. The test reports shall be placed on file where readily available to appointed personnel.

(l) *Maintenance.*—(1) *Preventive maintenance.* A preventive maintenance program based on the crane manufacturer's recommendations shall be established.

(2) *Maintenance procedure.* (i) Before adjustments and repairs are started on a crane the following precautions shall be taken:

(a) The crane to be repaired shall be run to a location where it will cause the least interference with other cranes and operations in the area.

(b) All controllers shall be at the off position.

(c) The main or emergency switch shall be open and locked in the open position.

(d) Warning or "out of order" signs shall be placed on the crane, also on the floor beneath or on the hook where visible from the floor.

(e) Where other cranes are in operation on the same runway, rail stops or other suitable means shall be provided to prevent interference with the idle crane.

(f) Where temporary protective rail stops are not available, or practical, a signalman should be placed at a visual vantage point for observing the approach of an active crane and warning its operator when reaching the limit of safe distance from the idle crane.

(ii) After adjustments and repairs have been made the crane shall not be operated until all guards have been reinstalled, safety devices reactivated and maintenance equipment removed.

(3) *Adjustments and repairs.* (i) Any unsafe conditions disclosed by the inspection requirements of paragraph (j) of this section shall be corrected before operation of the crane is resumed. Adjustments and repairs shall be done only by designated personnel.

(ii) Adjustments shall be maintained to assure correct functioning of components. The following are examples:

(a) All functional operating mechanisms.

(b) Limit switches.

(c) Control systems.

(d) Brakes.

(e) Power plants.

(iii) Repairs or replacements shall be provided promptly as needed for safe operation. The following are examples:

(a) Crane hooks showing defects described in paragraph (j)(2)(iv) of this section shall be discarded. Repairs by welding or reshaping are not generally recommended. If such repairs are attempted they shall only be done under competent supervision and the hook shall be tested to the load requirements of paragraph (k)(2) of this section before further use.

(b) Load attachment chains and rope slings showing defects described in paragraph (j)(2)(iv) and (v) of this section respectively.

(c) All critical parts which are cracked, broken, bent, or excessively worn.

(d) Pendant control stations shall be kept clean and function labels kept legible.

(m) *Rope inspection*—(1) *Running ropes*. A thorough inspection of all ropes shall be made at least once a month and a full written, dated, and signed report of rope condition kept on file where readily available to appointed personnel. Any deterioration, resulting in appreciable loss of original strength, such as described below, shall be carefully noted and determination made as to whether further use of the rope would constitute a safety hazard:

(i) Reduction of rope diameter below nominal diameter due to loss of core support, internal or external corrosion, or wear of outside wires.

(ii) A number of broken outside wires and the degree of distribution or concentration of such broken wires.

(iii) Worn outside wires.

(iv) Corroded or broken wires at end connections.

(v) Corroded, cracked, bent, worn, or improperly applied end connections.

(vi) Severe kinking, crushing, cutting, or unstranding.

(2) *Other ropes*. All rope which has been idle for a period of a month or more due to shutdown or storage of a crane on which it is installed shall be given a thorough inspection before it is placed in service. This inspection shall be for all types of deterioration and shall be performed by an appointed person whose approval shall be required for further use of the rope. A written and dated report of the rope condition shall be available for inspection.

(n) *Handling the load*—(1) *Size of load*. The crane shall not be loaded beyond its rated load except for test purposes as provided in paragraph (k) of this section.

(2) *Attaching the load*. (i) The hoist chain or hoist rope shall be free from kinks or twists and shall not be wrapped around the load.

(ii) The load shall be attached to the load block hook by means of slings or other approved devices.

(iii) Care shall be taken to make certain that the sling clears all obstacles.

(3) *Moving the load*. (i) The load shall be well secured and properly balanced in the sling or lifting device before it is lifted more than a few inches.

(ii) Before starting to hoist the following conditions shall be noted:

(a) Hoist rope shall not be kinked.

(b) Multiple part lines shall not be twisted around each other.

(c) The hook shall be brought over the load in such a manner as to prevent swinging.

(iii) During hoisting care shall be taken that:

(a) There is no sudden acceleration or deceleration of the moving load.

(b) The load does not contact any obstructions.

(iv) Cranes shall not be used for side pulls except when specifically authorized by a responsible person who has determined that the stability of the crane is not thereby endangered and that various parts of the crane will not be overstressed.

(v) While any employee is on the load or hook, there shall be no hoisting, lowering, or traveling.

(vi) The employer shall require that the operator avoid carrying loads over people.

(vii) The operator shall test the brakes each time a load approaching the rated load is handled. The brakes shall be tested by raising the load a few inches and applying the brakes.

(viii) The load shall not be lowered below the point where less than two full wraps of rope remain on the hoisting drum.

(ix) When two or more cranes are used to lift a load one qualified responsible person shall be in charge of the operation. He shall analyze the operation and instruct all personnel involved in the proper positioning, rigging of the load, and the movements to be made.

(x) The employer shall insure that the operator does not leave his position at the controls while the load is suspended.

(xi) When starting the bridge and when the load or hook approaches near or over personnel, the warning signal shall be sounded.

(4) *Hoist limit switch*. (i) At the beginning of each operator's shift, the upper limit switch of each hoist shall be tried out under no load. Extreme care shall be exercised; the block shall be "inched" into the limit or run in at slow speed. If the switch does not operate properly, the appointed person shall be immediately notified.

(ii) The hoist limit switch which controls the upper limit of travel of the load block shall never be used as an operating control.

(o) *Other requirements, general*—(1) *Ladders*. (i) The employer shall insure that hands are free from encumbrances while personnel are using ladders.

(ii) Articles which are too large to be carried in pockets or belts shall be lifted and lowered by hand line.

(2) *Cabs*. (i) Necessary clothing and personal belongings shall be stored in

such a manner as not to interfere with access or operation.

(ii) Tools, oil cans, waste, extra fuses, and other necessary articles shall be stored in the tool box, and shall not be permitted to lie loose in or about the cab.

(3) *Fire extinguishers*. The employer shall insure that operators are familiar with the operation and care of fire extinguishers provided.

§ 1910.180 Crawler locomotive and truck cranes.

(a) *Definitions applicable to this section*. (1) A "crawler crane" consists of a rotating superstructure with power plant, operating machinery, and boom, mounted on a base, equipped with crawler treads for travel. Its function is to hoist and swing loads at various radii.

(2) A "locomotive crane" consists of a rotating superstructure with power plant, operating machinery and boom, mounted on a base or car equipped for travel on railroad track. It may be self-propelled or propelled by an outside source. Its function is to hoist and swing loads at various radii.

(3) A "truck crane" consists of a rotating superstructure with powerplant, operating machinery and boom, mounted on an automotive truck equipped with a powerplant for travel. Its function is to hoist and swing loads at various radii.

(4) A "wheel mounted crane" (wagon crane) consists of a rotating superstructure with powerplant, operating machinery and boom, mounted on a base or platform equipped with axles and rubber-tired wheels for travel. The base is usually propelled by the engine in the superstructure, but it may be equipped with a separate engine controlled from the superstructure. Its function is to hoist and swing loads at various radii.

(5) An "accessory" is a secondary part or assembly of parts which contributes to the overall function and usefulness of a machine.

(6) "Appointed" means assigned specific responsibilities by the employer or the employer's representative.

(7) "ANSI" means the American National Standards Institute.

(8) An "angle indicator" (boom) is an accessory which measures the angle of the boom to the horizontal.

(9) The "axis of rotation" is the vertical axis around which the crane superstructure rotates.

(10) "Axle" means the shaft or spindle with which or about which a wheel rotates. On truck- and wheel-mounted cranes it refers to an automotive type of axle assembly including housings, gearing, differential, bearings, and mounting appurtenances.

(11) "Axle" (bogie) means two or more automotive-type axles mounted in tandem in a frame so as to divide the load between the axles and permit vertical oscillation of the wheels.

(12) The "base" (mounting) is the traveling base or carrier on which the rotating superstructure is mounted such

as a car, truck, crawlers, or wheel platform.

(13) The "boom" (crane) is a member hinged to the front of the rotating superstructure with the outer end supported by ropes leading to a gantry or "A" frame and used for supporting the hoisting tackle.

(14) The "boom angle" is the angle between the longitudinal centerline of the boom and the horizontal. The boom longitudinal centerline is a straight line between the boom foot pin (heel pin) centerline and boom point sheave pin centerline.

(15) The "boom hoist" is a hoist drum and rope reeving system used to raise and lower the boom. The rope system may be all live reeving or a combination of live reeving and pendants.

(16) The "boom stop" is a device used to limit the angle of the boom at the highest position.

(17) A "brake" is a device used for retarding or stopping motion by friction or power means.

(18) A "cab" is housing which covers the rotating superstructure machinery and/or operator's station. On truck-crane trucks a separate cab covers the driver's station.

(19) The "clutch" is a friction, electromagnetic, hydraulic, pneumatic, or positive mechanical device for engagement or disengagement of power.

(20) The "counterweight" is a weight used to supplement the weight of the machine in providing stability for lifting working loads.

(21) "Designated" means selected or assigned by the employer or the employer's representative as being qualified to perform specific duties.

(22) The "drum" is the cylindrical members around which ropes are wound for raising and lowering the load or boom.

(23) "Dynamic" (loading) means loads introduced into the machine or its components by forces in motion.

(24) The "gantry" (A-frame) is a structural frame, extending above the superstructure, to which the boom supports ropes are reeved.

(25) A "jib" is an extension attached to the boom point to provide added boom length for lifting specified loads. The jib may be in line with the boom or offset to various angles.

(26) "Load" (working) means the external load, in pounds, applied to the crane, including the weight of load-attaching equipment such as load blocks, shackles, and slings.

(27) "Load block" (upper) means the assembly of hook or shackle, swivel, sheaves, pins, and frame suspended from the boom point.

(28) "Load block" (lower) means the assembly of hook or shackle, swivel, sheaves, pins, and frame suspended by the hoisting ropes.

(29) A "load hoist" is a hoist drum and rope reeving system used for hoisting and lowering loads.

(30) "Load ratings" are crane ratings in pounds established by the manufac-

turer in accordance with paragraph (c) of this section.

(31) "Outriggers" are extendable fixed metal arms, attached to the mounting base, which rest on supports at the outer ends.

(32) "Rail clamp" means a tong-like metal device, mounted on a locomotive crane car, which can be connected to the track.

(33) "Reeving" means a rope system in which the rope travels around drums and sheaves.

(34) "Rope" refers to a wire rope unless otherwise specified.

(35) "Side loading" means a load applied at an angle to the vertical plane of the boom.

(36) A "standby crane" is a crane which is not in regular service but which is used occasionally or intermittently as required.

(37) A "standing (guy) rope" is a supporting rope which maintains a constant distance between the points of attachment to the two components connected by the rope.

(38) "Structural competence" means the ability of the machine and its components to withstand the stresses imposed by applied loads.

(39) "Superstructure" means the rotating upper frame structure of the machine and the operating machinery mounted thereon.

(40) "Swing" means the rotation of the superstructure for movement of loads in a horizontal direction about the axis of rotation.

(41) "Swing mechanism" means the machinery involved in providing rotation of the superstructure.

(42) "Tackle" is an assembly of ropes and sheaves arranged for hoisting and pulling.

(43) "Transit" means the moving or transporting of a crane from one jobsite to another.

(44) "Travel" means the functions of the machine moving from one location to another, on a jobsite.

(45) The "travel mechanism" is the machinery involved in providing travel.

(46) "Wheelbase" means the distance between centers of front and rear axles. For a multiple axle assembly the axle center for wheelbase measurement is taken as the midpoint of the assembly.

(47) The "whipline" (auxiliary hoist) is a separate hoist rope system of lighter load capacity and higher speed than provided by the main hoist.

(48) A "winch head" is a power driven spool for handling of loads by means of friction between fiber or wire rope and spool.

(b) **General requirements**—(1) **Application.** This section applies to crawler cranes, locomotive cranes, wheel mounted cranes of both truck and self-propelled wheel type, and any variations thereof which retain the same fundamental characteristics. This section includes only cranes of the above types, which are basically powered by internal combustion engines or electric motors and which utilize drums and ropes. Cranes

designed for railway and automobile wreck clearances are excepted. The requirements of this section are applicable only to machines when used as lifting cranes.

(2) **New and existing equipment.** All new crawler, locomotive, and truck cranes utilized after the effective date of this subpart shall meet the design specifications of the "American National Standard Safety Code for Crawler, Locomotive and Truck Cranes," ANSI B30.5-1968. Equipment constructed and utilized prior to the effective date of the regulations in this section shall be modified to conform to these specifications.

(c) **Load ratings**—(1) **Load ratings**—where stability governs lifting performance. (i) The margin of stability for determination of load ratings, with booms of stipulated lengths at stipulated working radii for the various types of crane mountings is established by taking a percentage of the loads which will produce a condition of tipping or balance with the boom in the least stable direction, relative to the mounting. The load ratings shall not exceed the following percentages for cranes, with the indicated types of mounting under conditions stipulated in subdivisions (ii) and (iii) of this subparagraph.

Type of crane mounting:	Maximum load ratings (percent of tipping loads)
Locomotive, without outriggers:	
Booms 60 feet or less	85
Booms over 60 feet	85
Locomotive, using outriggers fully extended	80
Crawler, without outriggers	75
Crawler, using outriggers fully extended	85
Truck and wheel mounted without outriggers or using outriggers fully extended	85

¹ Unless this results in less than 30,000 pound-feet net stabilizing moment about the rail, which shall be minimum with such booms.

(ii) The following stipulation shall govern the application of the values in subdivision (i) of this subparagraph for locomotive cranes:

(a) Tipping with or without the use of outriggers occurs when half of the wheels farthest from the load leave the rail.

(b) The crane shall be standing on track which is level within 1 percent grade.

(c) Radius of the load is the horizontal distance from a projection of the axis of rotation to the rail support surface, before loading, to the center of vertical hoist line or tackle with load applied.

(d) Tipping loads from which ratings are determined shall be applied under static conditions only, i.e., without dynamic effect of hoisting, lowering, or swinging.

(e) The weight of all auxiliary handling devices such as hoist blocks, hooks, and slings shall be considered a part of the load rating.

(iii) Stipulations governing the application of the values in subdivision (i) of this subparagraph for crawler, truck, and wheel-mounted cranes shall be in accordance with Crane Load-Stability Test Code, Society of Automotive Engineers (SAE) J765.

(iv) The effectiveness of these preceding stability factors will be influenced by such additional factors as free suspended loads, track, wind, or ground conditions, condition and inflation of rubber tires, boom lengths, proper operating speeds for existing conditions, and, in general, careful and competent operation. All of these shall be taken into account by the user.

(2) *Load rating chart.* A substantial and durable rating chart with clearly legible letters and figures shall be provided with each crane and securely fixed to the crane cab in a location easily visible to the operator while seated at his control station.

(d) *Inspection classification.*—(1) *Initial inspection.* Prior to initial use all new and altered cranes shall be inspected to insure compliance with provisions of this section.

(2) *Regular inspection.* Inspection procedure for cranes in regular service is divided into two general classifications based upon the intervals at which inspection should be performed. The intervals in turn are dependent upon the nature of the critical components of the crane and the degree of their exposure to wear, deterioration, or malfunction. The two general classifications are herein designated as "frequent" and "periodic" with respective intervals between inspections as defined below:

(i) *Frequent inspection:* Daily to monthly intervals.

(ii) *Periodic inspection:* One- to 12-month intervals, or as specifically recommended by the manufacturer.

(3) *Frequent inspections.* Items such as the following shall be inspected for defects at intervals as defined in subdivision (2) (i) of this subparagraph or as specifically indicated including observation during operation for any defects which might appear between regular inspections. Any deficiencies such as listed shall be carefully examined and determination made as to whether they constitute a safety hazard:

(i) All control mechanisms for maladjustment interfering with proper operation: Daily.

(ii) All control mechanisms for excessive wear of components and contamination by lubricants or other foreign matter.

(iii) All safety devices for malfunction.

(iv) Deterioration or leakage in air or hydraulic systems: Daily.

(v) Crane hooks with deformations or cracks. For hooks with cracks or having more than 15 percent in excess of normal throat opening or more than 10° twist from the plane of the unbent hook.

(vi) Rope reeving for noncompliance with manufacturer's recommendations.

(vii) Electrical apparatus for malfunctioning, signs of excessive deterioration, dirt, and moisture accumulation.

(4) *Periodic inspection.* Complete inspections of the crane shall be performed at intervals as generally defined in subparagraph (2) (ii) of this paragraph depending upon its activity, severity of service, and environment, or as specifically indicated below. These inspections shall include the requirements of subparagraph (3) of this paragraph and in addition, items such as the following. Any deficiencies such as listed shall be carefully examined and determination made as to whether they constitute a safety hazard:

(i) Deformed, cracked, or corroded members, in the crane structure and boom.

(ii) Loose bolts or rivets.

(iii) Cracked or worn sheaves and drums.

(iv) Worn, cracked, or distorted parts such as pins, bearings, shafts, gears, rollers and locking devices.

(v) Excessive wear on brake and clutch system parts, linings, pawls, and ratchets.

(vi) Load, boom angle, and other indicators over their full range, for any significant inaccuracies.

(vii) Gasoline, diesel, electric, or other power plants for improper performance or noncompliance with safety requirements.

(viii) Excessive wear of chain-drive sprockets and excessive chain stretch.

(ix) Travel steering, braking, and locking devices, for malfunction.

(x) Excessively worn or damaged tires.

(5) *Cranes not in regular use.* (i) A crane which has been idle for a period of one month or more, but less than 6 months, shall be given an inspection conforming with requirements of subparagraph (3) of this paragraph and paragraph (g) (2) (ii) of this section before placing in service.

(ii) A crane which has been idle for a period of six months shall be given a complete inspection conforming with requirements of subparagraphs (3) and (4) of this paragraph and paragraph (g) (2) (ii) of this section before placing in service.

(iii) Standby cranes shall be inspected at least semiannually in accordance with requirements of subparagraph (3) of this paragraph and paragraph (g) (2) (ii) of this section. Such cranes which are exposed to adverse environment should be inspected more frequently.

(6) *Inspection records.* Written, dated, and signed inspection reports and records shall be made monthly on critical items in use such as brakes, crane hooks, and ropes. Records shall be kept readily available.

(e) *Testing.*—(1) *Operational tests.* (i) In addition to prototype tests and quality-control measures, each new production crane shall be tested by the manufacturer to the extent necessary to insure compliance with the operational requirements of this paragraph including functions such as the following:

(a) Load hoisting and lowering mechanisms

(b) Boom hoisting and lower mechanisms

(c) Swinging mechanism

(d) Travel mechanism

(e) Safety devices

(ii) Where the complete production crane is not supplied by one manufacturer such tests shall be conducted at final assembly.

(iii) Certified production-crane test results shall be made available.

(2) *Rated load test.* (i) Written reports shall be available showing test procedures and confirming the adequacy of repairs or alterations.

(ii) Test loads shall not exceed 110 percent of the rated load at any selected working radius.

(iii) Where rerating is necessary:

(a) Crawler, truck, and wheel-mounted cranes shall be tested in accordance with SAE Recommended Practice, Crane Load Stability Test Code J765 (April 1961).

(b) Locomotive cranes shall be tested in accordance with paragraph (a) (1) (i) and (ii) of this section.

(c) Rerating test report shall be readily available.

(iv) No cranes shall be rerated in excess of the original load ratings unless such rating changes are approved by the crane manufacturer or final assembler.

(f) *Maintenance procedure.*—(1) *General.* After adjustments and repairs have been made the crane shall not be operated until all guards have been reinstalled, safety devices reactivated, and maintenance equipment removed.

(g) *Rope inspection.*—(1) *Running ropes.* A thorough inspection of all ropes in use shall be made at least once a month and a full written, dated, and signed report of rope condition kept on file where readily available. All inspections shall be performed by an appointed or authorized person. Any deterioration, resulting in appreciable loss of original strength, such as described below, shall be carefully noted and determination made as to whether further use of the rope would constitute a safety hazard:

(i) Reduction of rope diameter below nominal diameter due to loss of core support, internal, or external corrosion or wear of outside wires.

(ii) A number of broken outside wires and the degree of distribution of concentration of such broken wires.

(iii) Worn outside wires.

(iv) Corroded or broken wires at end connections.

(v) Corroded, cracked, bent, worn, or improperly applied end connections.

(vi) Severe kinking, crushing, cutting, or unstranding.

(2) *Other ropes.* (i) Heavy wear and/or broken wires may occur in sections in contact with equalizer sheaves or other sheaves where rope travel is limited, or with saddles. Particular care shall be taken to inspect ropes at these locations.

(ii) All rope which has been idle for a period of a month or more due to shut down or storage of a crane on which it is installed shall be given a thorough inspection before it is placed in service. This inspection shall be for all types of deterioration and shall be performed by

upon the commencement of the Walsh-Healey requirement.

§ 1910.139 Sources of standards.

Sec.	Source
1910.132	41 CFR 80-204.7.
1910.133(a)	ANSI Z87.1-1968, Eye and Face Protection.
1910.134	ANSI Z89.1-1969, Standard Practice for Respiratory Protection.
1910.134 Table I-L	ANSI K13.1-1967, Identification of Gas Mask Canister.
1910.135	ABNT Z89.1-1969, Safety Requirements for Industrial Head Protection.
1910.136	ANSI Z41.1-1967, Men's Safety-Toe Footwear.
1910.137	ANSI Z9.4-1968, Ventilation and Safe Practices of Abrasive Blasting Operations.

§ 1910.140 Standards organizations.

Specific standards of the following organization have been referenced in this part. Copies of the referenced materials may be obtained from the issuing organization.

American National Standards Institute, 1430 Broadway, New York, NY 10018.

Subpart J—General Environmental Controls

§ 1910.141 Sanitation.

(a) *General requirements*—(1) *House-keeping*. (i) All places of employment, passageways, storerooms, and service-rooms shall be kept clean and orderly and in a sanitary condition.

(ii) The floor of every workroom shall be maintained in a clean and, so far as possible, a dry condition. Where wet processes are used, drainage shall be maintained and false floors, platforms, mats, or other dry standing places should be provided where practicable.

(iii) Cleaning and sweeping shall be done in such a manner as to minimize the contamination of the air with dust and, so far as is practicable, shall be done outside of working hours.

(iv) To facilitate cleaning, every floor, working place, and passageway shall be kept free from protruding nails, splinters, holes, or loose boards.

(2) *Expectorating*. (i) Expectorating upon the walls, floors, work places, or stairs of any establishment shall not be permitted.

(ii) Cuspidors are considered undesirable, but, if used, they shall be of such construction that they are cleanable. They shall be cleaned at least daily when in use.

(3) *Waste disposal*. (i) Any receptacle used for putrescible solid or liquid waste or refuse shall be so constructed that it does not leak and may be conveniently and thoroughly cleaned, and it shall be maintained in a sanitary condition. Such a receptacle shall be equipped with a tight-fitting cover.

(ii) All sweepings, solid or liquid wastes, refuse, and garbage shall be removed in such a manner as to avoid creating a nuisance or menace to health and as often as necessary to maintain

the place of employment in a sanitary condition.

(4) *Rodent, insect, and vermin control*. Every enclosed work place and personal service room shall be constructed, equipped, and maintained, so far as reasonably practicable, in such a manner as to prevent the entrance or harborage of rodents, insects, and vermin of any kind.

(b) *Water supply*—(1) *Potable water*. (i) An adequate supply of potable water shall be provided for drinking, ablutionary, and culinary purposes in all places of employment. Drinking water should be made available within 200 feet of any location at which employees are regularly engaged in work.

(ii) *Sanitary drinking fountains* shall be of a type and construction in accordance with the Standard Specification for Drinking Fountains, ANSI Z42-1942.

(iii) In all instances where water is cooled by ice, the construction of the container shall be such that the ice does not come in direct contact with the water.

(iv) Open containers such as barrels, pails, or tanks for drinking water from which the water must be dipped or poured, whether or not they are fitted with a cover, are prohibited.

(v) The common drinking cup is prohibited.

(vi) Where single service cups (to be used but once) are supplied, both a sanitary container for the unused cups and a receptacle for disposing of the used cups shall be provided.

(2) *Nonpotable water*. (i) Outlets for nonpotable water, such as water for industrial or firefighting purposes only, shall be posted to indicate clearly that the water is unsafe and is not to be used for drinking, washing, or cooking purposes.

(ii) There shall be no cross-connection, open or potential, between a system furnishing potable water and system furnishing nonpotable water.

(iii) Construction shall be such as to prevent backflow of contaminated water into a potable water system.

(iv) Nonpotable water shall not be used for bathing or for washing any portion of the person, clothing, dishes, or premises.

(c) *Toilet facilities*—(1) *General*. (i) Every place of employment shall be provided with adequate toilet facilities which are separate for each sex. The sewage disposal method shall comply with requirements of the health or other authorities having jurisdiction.

(ii) Toilet facilities shall be provided so as to be readily accessible to all employees. Toilet facilities so located that employees must use more than one floor-to-floor flight of stairs to or from them are not considered as readily accessible. As far as is practicable, toilet facilities should be located within 200 feet of all locations at which workers are regularly employed.

(iii) Water closets shall be provided for each sex according to the following table. The number to be provided for

each sex shall in every case be based on the maximum number of persons of that sex employed at any one time at work on the premises for which the facilities are furnished. When persons other than employees are permitted the use of toilet facilities on the premises, a reasonable allowance shall be made for such other persons in estimating the minimum number of toilet facilities required.

Number of persons	Minimum number of facilities
1 to 9	1
10 to 24	2
25 to 49	3
50 to 74	4
75 to 100	5
over 100	1 for each additional 30 persons.

Where 10 or more are employed, urinals may be provided. One water closet less than the number specified in the foregoing may be provided for each urinal, except that the number of water closets in such cases may not be reduced to less than two-thirds of the number specified in the foregoing. Two feet of trough urinal shall be considered as equivalent to one individual urinal.

(iv) An adequate supply of toilet paper with holder shall be provided for every water closet.

(v) Covered receptacles shall be kept in all toilet rooms used by women.

(vi) Adequate washing facilities shall be provided in every toilet room or be adjacent thereto.

(2) *Construction of toilet rooms*. (i) Each toilet facility (closet) shall occupy a separate compartment, which should be equipped with a door, latch, and clothes hanger.

(ii) The walls of compartments or partitions between fixtures may be less than the height of room walls, but the top shall not be less than 6 feet from the floor and the bottom not more than 1 foot from the floor.

(iii) The door to every toilet room shall be fitted with an effective self-closing device, and the entrance to the toilet room shall be so screened that the interior of the toilet room is not visible from the workroom.

(iv) In all toilet rooms installed after July 1, 1971, the floors and side walls, to a height of at least 6 inches, including the angle formed by the floor and side walls, shall be of watertight construction.

(v) The floors, walls, ceilings, partitions, and doors of all toilet rooms shall be of a finish that can be easily cleaned. In installations made after July 1, 1971, cove bases shall be provided to facilitate cleaning.

(vi) Toilet rooms, except those in work places accessible to men only, shall be completely enclosed with solid material that is nontransparent from the outside.

(3) *Construction and installation of toilet facilities*. (i) Every water closet bowl shall be set entirely free and open from all enclosing structures and shall be so installed that the space around the fixture can be easily cleaned. This provision does not prohibit the use of wall-hung type water closets.

(ii) Every water closet shall have a hinged openfront seat made of substantial material having a nonabsorbent finish.

(3) *Chemical closets and privies.* Chemical closets and privies shall be constructed and maintained in accordance with § 1910.143.

(d) *Washing facilities.*—(1) *General.* Adequate facilities for maintaining personal cleanliness shall be provided in every place of employment. These shall be convenient for the employees for whom they are provided and shall be maintained in a sanitary condition.

(2) *Lavatories.* At least one lavatory with adequate hot and cold water, preferably from a combination supply fixture, shall be provided for every 10 employees (men or women) or portion thereof, up to 100 persons; and over 100 persons one lavatory for each additional 15 persons or portion thereof. Twenty-four inches of sink with individual faucet shall be considered as equal to one lavatory. In all instances, a suitable cleansing agent shall be provided at each wash place.

(3) *Towels.* Individual hand towels, or sections thereof, of cloth or paper, shall be provided and proper receptacles or other sanitary means maintained for the disposal of used towels. The provision of a towel for general or common use is prohibited.

(e) *Change rooms.*—(1) *Separate facilities.* Separate change or dressing rooms equipped with individual clothes facilities shall be provided for each sex wherever it is the practice to change from street clothes or wherever it is necessary to change because the work performed involves exposure to excessive dirt, heat, fumes, vapor, or moisture. In the event that change rooms are not provided, facilities shall be furnished for hanging outer garments.

(2) *Drying facilities.* Where the process in which the worker is engaged is such that his working clothes become wet or have to be washed between shifts, provision shall be made to insure that such clothing is dry before reuse.

(f) *Retiring rooms for women.* Where 10 or more women are employed at any one time, at least one retiring room shall be provided for rest and emergencies. Where fewer than 10 women are employed and a restroom is not furnished, some equivalent space shall be provided which can be properly screened for privacy and made suitable for the use of women employees. At least one couch or bed shall be provided in every place where more than 10 women are employed. The required number of such beds or couches follows:

10 to 100.....	1 bed.
100 to 250.....	2 beds.
1 additional bed for each additional 250 women employees. A minimum of 60 square feet of floor space per bed or couch shall be provided.	

(g) *Lunchrooms.*—(1) *General.* In all places of employment where employees are permitted to lunch on the premises, an adequate space suitable for that purpose shall be provided for the maximum

number of employees who may use such space at one time. Such space shall be physically separate from any location where there is exposure to toxic materials.

(2) *Waste disposal containers.* An adequate number of covered receptacles constructed of a smooth, corrosion-resistant, easily cleanable, or disposable material, shall be provided by the employer and used by the employees for the disposal of all waste food. Such receptacles shall be emptied not less than once daily and shall be maintained in a clean and sanitary manner.

(3) *Location.* (i) No food shall be stored or eaten where there are present any toxic materials or substances that may be injurious to health.

(ii) No food shall be stored or eaten in any toilet room.

(iii) In every establishment where there is exposure to injurious dusts or other toxic materials, a separate lunchroom shall be maintained unless it is convenient for the employees to lunch away from the premises. The following number of square feet per person, based on the maximum number of persons using the room at one time, shall be required:

Number of persons	Square feet per person
25 and less.....	13.
26-74.....	12.
75-149.....	11.
150 and over.....	10.

(h) *Food handling.* All employee food service facilities and operations shall meet the requirements of "Food Service Sanitation Ordinance and Code," Part V, "Food Service Sanitation Manual," U.S. Public Health Service Publication No. 934 (1965). In all places of employment where all or part of the food service is provided by vending machines, the food dispensed shall be prepared, and the machine operated in accordance with the requirements of "Vending of Foods and Beverages, A Sanitation Ordinance and Code," U.S. Public Health Service Publication No. 546 (1965).

§ 1910.142 Temporary labor camps.

(a) *Site.* (1) All sites used for camps shall be adequately drained. They shall not be subject to periodic flooding, nor located within 200 feet of swamps, ponds, sink holes, or other surface collections of water unless such quiescent water surfaces can be subjected to mosquito control measures. The camp shall be located so the drainage from and through the camp will not endanger any domestic or public water supply. All sites shall be graded, ditched, and rendered free from depressions in which water may become a nuisance.

(2) All sites shall be adequate in size to prevent overcrowding of necessary structures. The principal camp area in which food is prepared and served and where sleeping quarters are located shall be at least 500 feet from any area in which livestock is kept.

(3) The grounds and open areas surrounding the shelters shall be maintained in a clean and sanitary condition free from rubbish, debris, waste paper, garbage, or other refuse.

(4) Whenever the camp is closed for the season or permanently, all garbage, manure, and other refuse shall be collected and so disposed of as to prevent nuisance. All abandoned privy pits shall be filled with earth and the grounds and buildings left in a clean and sanitary condition. If privy buildings remain, they shall be locked or otherwise secured to prevent entrance.

(b) *Shelter.* (1) Every shelter in the camp shall be constructed in a manner which will provide protection against the elements.

(2) Each room used for sleeping purposes shall contain at least 50 square feet of floor space for each occupant. At least a 7-foot ceiling shall be provided.

(3) Beds, cots, or bunks, and suitable storage facilities such as wall lockers for clothing and personal articles shall be provided in every room used for sleeping purposes. Such beds or similar facilities shall be spaced not closer than 36 inches both laterally and end to end, and shall be elevated at least 12 inches from the floor. If double-deck bunks are used, they shall be spaced not less than 48 inches both laterally and end to end. The minimum clear space between the lower and upper bunk shall be not less than 27 inches. Triple-deck bunks are prohibited.

(4) The floors of each shelter shall be constructed of wood, asphalt, or concrete. Wooden floors shall be of smooth and tight construction. The floors shall be kept in good repair.

(5) All wooden floors shall be elevated not less than 1 foot above the ground level at all points to prevent dampness and to permit free circulation of air beneath.

(6) Nothing in this section shall be construed to prohibit "banking" with earth or other suitable material around the outside walls in areas subject to extreme low temperatures.

(7) All living quarters shall be provided with windows the total of which shall be not less than one-tenth of the floor area. At least one-half of each window shall be so constructed that it can be opened for purposes of ventilation.

(8) All exterior openings shall be effectively screened with 16-mesh material. All screen doors shall be equipped with self-closing devices.

(9) In a room where workers cook, live, and sleep a minimum of 100 square feet per person shall be provided. Sanitary facilities shall be provided for storing and preparing food.

(10) In camps where cooking facilities are used in common, stoves (in ratio of one stove to 10 persons or one stove to two families) shall be provided in an enclosed and screened shelter. Sanitary facilities shall be provided for storing and preparing food.

(11) All heating, cooking, and water heating equipment shall be installed in accordance with State and local ordinances, codes, and regulations governing such installations. If a camp is used during cold weather, adequate heating equipment shall be provided.

(c) *Water supply.* (1) An adequate and convenient water supply, approved by the appropriate health authority, shall be provided in each camp for drinking, cooking, bathing, and laundry purposes.

(2) A water supply shall be deemed adequate if it is capable of delivering 35 gallons per person per day to the campsite at a peak rate of 2½ times the average hourly demand.

(3) The distribution lines shall be capable of supplying water at normal operating pressures to all fixtures for simultaneous operation. Water outlets shall be distributed throughout the camp in such a manner that no shelter is more than 100 feet from a yard hydrant if water is not piped to the shelters.

(4) Where water under pressure is available, one or more drinking fountains shall be provided for each 100 occupants or fraction thereof. The construction of drinking fountains shall comply with ANSI Standard Specifications for Drinking Fountains, Z4.2-1942. Common drinking cups are prohibited.

(d) *Toilet facilities.* (1) Toilet facilities adequate for the capacity of the camp shall be provided.

(2) Each toilet room shall be located so as to be accessible without any individual passing through any sleeping room. Toilet rooms shall have a window not less than 6 square feet in area opening directly to the outside area or otherwise be satisfactorily ventilated. All outside openings shall be screened with 16-mesh material. No fixture, water closet, chemical toilet, or urinal shall be located in a room used for other than toilet purposes.

(3) A toilet room shall be located within 200 feet of the door of each sleeping room. No privy shall be closer than 100 feet to any sleeping room, dining room, lunch area, or kitchen.

(4) Where the toilet rooms are shared, such as in multifamily shelters and in barracks type facilities, separate toilet rooms shall be provided for each sex. These rooms shall be distinctly marked "for men" and "for women" by signs printed in English and in the native language of the persons occupying the camp, or marked with easily understood pictures or symbols. If the facilities for each sex are in the same building, they shall be separated by solid walls or partitions extending from the floor to the roof or ceiling.

(5) Where toilet facilities are shared, the number of water closets or privy seats provided for each sex shall be based on the maximum number of persons of that sex which the camp is designed to house at any one time, in the ratio of one such unit to each 15 persons, with a minimum of two units for any shared facility.

(6) Urinals shall be provided on the basis of one unit or 2 linear feet of urinal trough for each 25 men. The floor from the wall and for a distance not less than 15 inches measured from the outward edge of the urinals shall be constructed of materials impervious to moisture. Where water under pressure is available, urinals shall be provided

with an adequate water flush. Urinal troughs in privies shall drain freely into the pit or vault and the construction of this drain shall be such as to exclude flies and rodents from the pit.

(7) Every water closet installed after July 1, 1971, shall be located in a toilet room.

(8) Each toilet room shall be lighted naturally, or artificially by a safe type of lighting at all hours of the day and night.

(9) An adequate supply of toilet paper shall be provided in each privy, water closet, or chemical toilet compartment.

(10) Privies and toilet rooms shall be kept in a sanitary condition. They shall be cleaned at least daily.

(e) *Sewage disposal facilities.* In camps where public sewers are available, all sewer lines and floor drains from buildings shall be connected thereto.

(f) *Laundry, handwashing, and bathing facilities.* (1) Laundry, handwashing, and bathing facilities shall be provided in the following ratio:

(i) Handwash basin per family shelter or per six persons in shared facilities.

(ii) Shower head for every 10 persons.

(iii) Laundry tray or tub for every 30 persons.

(iv) Slop sink in each building used for laundry, hand washing, and bathing.

(2) Floors shall be of smooth finish but not slippery materials; they shall be impervious to moisture. Floor drains shall be provided in all shower baths, shower rooms, or laundry rooms to remove waste water and facilitate cleaning. All junctions of the curbing and the floor shall be coved. The walls and partitions of shower rooms shall be smooth and impervious to the height of splash.

(3) An adequate supply of hot and cold running water shall be provided for bathing and laundry purposes. Facilities for heating water shall be provided.

(4) Every service building shall be provided with equipment capable of maintaining a temperature of at least 70° F. during cold weather.

(5) Facilities for drying clothes shall be provided.

(6) All service buildings shall be kept clean.

(g) *Lighting.* Where electric service is available, each habitable room in a camp shall be provided with at least one ceiling-type light fixture and at least one separate floor-or wall-type convenience outlet. Laundry and toilet rooms and rooms where people congregate shall contain at least one ceiling- or wall-type fixture. Light levels in toilet and storage rooms shall be at least 20 foot-candles 30 inches from the floor. Other rooms, including kitchens and living quarters, shall be at least 30 foot-candles 30 inches from the floor.

(h) *Refuse disposal.* (1) Fly-tight, rodent-tight, impervious, cleanable or single service containers, approved by the appropriate health authority shall be provided for the storage of garbage. At least one such container shall be pro-

vided for each family shelter and shall be located within 100 feet of each shelter on a wooden, metal, or concrete stand.

(2) Garbage containers shall be kept clean.

(3) Garbage containers shall be emptied when full, but not less than twice a week.

(i) *Construction and operation of kitchens, dining hall, and feeding facilities.* (1) In all camps where central dining or multiple family feeding operations are permitted or provided, the food handling facilities shall comply with the requirements of the "Food Service Sanitation Ordinance and Code," Part V of the "Food Service Sanitation Manual," U.S. Public Health Service Publication 934 (1965).

(2) A properly constructed kitchen and dining hall adequate in size, separate from the sleeping quarters of any of the workers or their families, shall be provided in connection with all food handling facilities. There shall be no direct opening from living or sleeping quarters into a kitchen or dining hall.

(3) No person with any communicable disease shall be employed or permitted to work in the preparation, cooking, serving, or other handling of food, foodstuffs, or materials used therein, in any kitchen or dining room operated in connection with a camp or regularly used by persons living in a camp.

(j) *Insect and rodent control.* Effective measures shall be taken to prevent infestation by and harborage of animal or insect vectors or pests.

(k) *First aid.* (1) Adequate first aid facilities approved by a health authority shall be maintained and made available in every labor camp for the emergency treatment of injured persons.

(2) Such facilities shall be in charge of a person trained to administer first aid and shall be readily accessible for use at all times.

(l) *Reporting communicable disease.* (1) It shall be the duty of the camp superintendent to report immediately to the local health officer the name and address of any individual in the camp known to have or suspected of having a communicable disease.

(2) Whenever there shall occur in any camp a case of suspected food poisoning or an unusual prevalence of any illness in which fever, diarrhea, sore throat, vomiting, or jaundice is a prominent symptom, it shall be the duty of the camp superintendent to report immediately the existence of the outbreak to the health authority by telegram or telephone.

§ 1910.143 Nonwater carriage disposal systems.

(a) *Acceptable industrial disposal systems.* (1) The waste disposal systems described in subparagraphs (2), (3), (4), (5), (6), or (7) of this paragraph, may be used only where not prohibited by codes and regulations of local authorities, and where water closets are not feasible due either to the lack of an adequate

water supply or to the location or temporary nature of the operation requiring the facility. The number of units required for a place of employment shall be as specified in §§1910.141 and 1910.142.

(2) Privies constructed in conformity with paragraph (b) of this section may be used for the disposal of human excreta where their use will not contaminate ground or surface water because of privy location, type of soil, or ground-water table.

(3) Chemical toilets constructed in conformity with paragraph (c) of this section may be used in place of privies or where a privy is not permitted due to possible contamination of ground and surface water.

(4) Recirculating toilets constructed in conformity with paragraph (f) of this section may be used in place of privies or chemical toilets.

(5) Combustion toilets constructed in conformity with paragraph (e) of this section may be used in place of privies, chemical toilets, or recirculating toilets.

(6) Portable toilets constructed in conformity with paragraph (g) of this section may be used for temporary or mobile installations. Such temporary units may be:

(i) Chemical, recirculating, or combustion toilets designed for installation in or as an integral part of a skid mounted portable privy building, or in a separate toilet room, or

(ii) Portable privies designed for installation over a manhole of a sanitary or a combined waste water sewer system.

(7) A seepage pit constructed in conformity with paragraph (d) of this section may be used for the disposal of waste water from culinary activity, temporary bathing facilities, and clothes washing facilities where there is no available piped water supply. Human excreta shall not be discharged into a seepage pit. All units described in this paragraph shall comply with applicable codes and regulations of local authorities.

(b) *Privy specifications.* (1) A privy pit shall be separated by a minimum distance of 100 feet between the privy and a well, spring, or other source of water supply for drinking, bathing, or culinary purposes.

(i) At no time shall the pit bottom of a privy extend into ground water, nor shall it be constructed within 100 feet of the shoreline of any open body of water. Phreatic water, such as may be found in surface soil at depths of 10 feet or less, shall not be interpreted as ground water unless there is evidence of positive directional flow through the pit.

(ii) The privy shall be so located and so constructed that no surface water may enter into the pit either as runoff or as flood water.

(iii) The pit shall be constructed of such material and in such a manner as to prevent rapid deterioration, provide adequate capacity, and facilitate maintenance in a satisfactory manner under ordinary conditions of usage.

(iv) The pit and seat area shall be vented by a flue or vent pipe having not less than 7 square inches cross-sectional area, so as to provide a continuous escape of odors.

(v) The pit shall provide a capacity of 50 cubic feet for each seat installed in the privy building. The vault within 16 inches of the surface grade shall not be counted as part of the 50-cubic-foot capacity.

(vi) Pit cribbing shall fit firmly and be in uniform contact with the earth walls on all sides, and shall rise at least 6 inches above the original ground line and descend to the full depth of the pit. However, pit cribbing below the soil line may be omitted in rock formations.

(vii) An earth plateau shall be constructed level with the top of the pit cribbing, and extend horizontally for a distance of at least 18 inches before sloping to the original ground level.

(2) Privy building shall be firmly anchored, rigidly constructed, and free from hostile surface features, such as exposed nail points, sharp edges, rough or broken boards, etc., and shall provide privacy and protection from the elements. It shall be ventilated by leaving a 4-inch opening at the top of all the walls just beneath the roof.

(i) The building shall be of fly-tight construction, doors shall be self-closing, and vent and building openings shall be screened with 16-mesh screen of durable material. The vent shall extend 12 inches above the roof.

(ii) The seat shall be so spaced as to provide a minimum clear space of 24 inches between each seat in multiple unit installations, and shall provide 12 inches clear space from the seat opening to the side wall in single and multiple units.

(iii) The seat riser shall have an inside clearance of not less than 21 inches from the front wall and not less than 24 inches from the rear wall of the privy building.

(iv) The seat top shall be not less than 12 inches nor more than 16 inches above the floor.

(v) The seat opening shall be covered with an attached, movable toilet seat and lid, so constructed and installed that when closed it will limit access of insects, and which can be raised to allow sanitary use as a urinal.

(vi) The floor and riser shall be built of impervious material or tongue and groove lumber, and in a manner to deny access of insects.

(vii) Where electricity is available, lighting shall be provided with an intensity of not less than 10 foot-candles 30 inches above the floor.

(viii) A conveniently located receptacle or dispenser containing an adequate supply of toilet paper shall be provided for each seat in each privy building.

(c) *Chemical toilet specifications.* (1) Rooms, buildings, or shelters housing chemical toilets shall be of sound construction and easy to clean, and shall provide shelter and privacy. The toilet rooms shall be ventilated to the outside and adequately lighted, and all openings

into the toilet room shall be covered with 16-mesh screen. The minimum requirements given in subparagraphs (2) through (7) of this paragraph shall apply.

(2) Caustic receptacles shall be durable and corrosion proof, and provide a minimum capacity of 100 gallons per seat.

(3) The caustic receptacle charge per seat shall be a minimum of 25 pounds of caustic dissolved in 10 gallons of water.

(4) The chemical shall be drained and receptacle recharged every 6 months of continuous use, or at the beginning of each season of operation when in intermittent use, or when three-fourths full, whichever occurs first.

(5) Each seat in the building shall be provided with a conveniently located agitator.

(6) Receptacles shall be vented as prescribed in paragraph (b)(1)(iv) of this section.

(7) The receptacle shall be equipped with a manhole external to the privy building for cleaning and caustic removal purposes. The manhole shall be covered so as to prevent the escape of gases and odors.

(d) *Seepage pit construction.* (1) Seepage pit construction shall conform with requirements for privy pit construction in paragraph (b)(1)(i), (ii), (iii), (vi) and (vii) of this section. The seepage pit may be filled with stone or rubble of not less than nominal 1 inch diameter.

(2) Seepage pits shall be of such dimensions as to provide side wall area equal to at least 10 square feet per person served by the facility, or such greater area as may be required by the health agency having jurisdiction.

(3) Temporary piping connections from sinks or shower platforms may be discharged beneath the floor if they have traps in accordance with the provisions of American National Standard National Plumbing Code, A 40.8-1955.

(4) The platform covering the seepage pits shall be built of impervious material and in a manner to exclude insects.

(5) The platform shall be provided with an opening at least 1 foot in each dimension and have a rim at least 1 inch above the floor to prevent precipitation from accumulating on the platform floor.

(6) The platform opening shall be covered with a self-closing lid, so constructed that it can be easily opened by foot or hand, and so installed that when closed it will exclude insects and fit closely over the raised rim of the opening.

(e) *Combustion toilet.* (1) Combustion toilets and combustion toilet buildings, rooms, or shelters shall conform to the applicable specifications given for chemical toilets in paragraph (c) of this section.

(2) All external surfaces, including bowl and hopper, shall be easy to clean.

(3) The residue must be sterile and inert.

(4) The flue effluents must be free of bacteria.

(5) The combustion system and all fuel and electrical parts shall be safe

and in compliance with applicable gas and electrical codes of local authorities. Where such codes do not exist, the installations shall comply with the American National Standard National Electrical Code, C1-1968 (NFPA No. 70-1968).

(f) *Recirculating toilet specifications.*

(1) Recirculating toilet buildings, rooms, or shelters shall conform to the applicable specifications given for chemical toilets in paragraph (c) of this section.

(2) All materials, bowl, piping, and fittings shall be corrosion resistant.

(3) Waste passages shall have smooth surfaces and be free of obstructions, recesses, or chambers that would permit fouling.

(4) Flushing shall be accomplished by a single control so arranged as to be operated without special knowledge or effort.

(5) Recirculating toilets shall conform to "Self-Contained, Electrically Operated Recirculating, Chemically Controlled Toilet," International Association of Plumbing and Mechanical Officials Trailer Standard TSC 12-65.

(6) The unit shall be maintained and cleaned; and water, filter, and odor-controlling chemical shall be replaced in accordance with the instructions of the manufacturer.

(g) *Portable toilet construction.* (1) A portable toilet may comprise the seat and its treatment unit to be installed in a structure, or it may comprise an entire prefabricated, skid mounted, or otherwise portable structure containing a seat or treatment units with seat.

(2) No pit, tank, or other subsurface structure shall be construed as part of a portable toilet.

(i) Portable privies must be installed over a pit conforming to paragraph (b) (1) of this section, or a manhole that is part of a sanitary or combined waste water disposal system.

(ii) No portable toilet shall discharge into a storm sewer.

(3) A portable building shall be rigidly constructed, ventilated by a screened opening or a vent having a cross-sectional area of at least 1 square foot per seat, and equipped with a floor, riser, and seat meeting the requirements of paragraph (b) (2) of this section or an equivalent individual stool and seat in prefabricated metal, fiber glass, plastic, or ceramic material.

(i) The structure shall provide privacy and protection from the elements.

(ii) An airtight seal shall be provided between the structure base and any pit, receptacle, or manhole over which it is placed.

(iii) Ventilation of the pit, receptacle, or manhole shall conform to paragraph (b) (1) (iv) of this section.

(4) A portable toilet shall be provided with facilities, requisite to its construction, for the removal of chemicals, ash, or residue. All surfaces subject to soiling shall be readily accessible and easily cleaned.

§ 1910.144 Safety color code for marking physical hazards.

(a) *Color identification.*—(1) *Red.* Red shall be the basic color for the identification of:

(i) *Fire protection equipment and apparatus.* (a) Fire alarm boxes (pull boxes).

(b) Fire blanket boxes.

(c) Fire buckets or pails.

(d) Fire exit signs.

(e) Fire extinguishers (if painting the extinguisher is impractical or undesirable, color should be used on the housing, wall, or support to identify the location).

(f) Fire hose locations (color should be used on the reel, supports, or housing but not on the hose).

(g) Fire hydrants (industrial).

(h) Fire pumps.

(i) Fire sirens.

(j) Post indicator valves for sprinkler system (it is suggested that if a traffic hazard is involved, the top should be colored red, and the barrel or post yellow and black stripes).

(k) Sprinkler piping. (See ANSI Standard Scheme for the Identification of Piping Systems, A13.1-1956.)

(l) *Danger.* Safety cans or other portable containers of flammable liquids having a flashpoint at or below 80° F. (table containers of flammable liquids (open cup tester), excluding shipping containers, shall be painted red with some additional clearly visible identification either in the form of a yellow band around the can or the name of the contents conspicuously stenciled or painted on the can in yellow. Red lights shall be provided at barricades and at temporary obstructions, as specified in ANSI Safety Code for Building Construction, A10.2-1944. Danger signs shall be painted red.

(m) *Stop.* Emergency stop bars on hazardous machines such as rubber mills, wire blocks, flat work ironers, etc., shall be red. Stop buttons or electrical switches used for emergency stopping of machinery shall be red.

(n) *Orange.* Orange shall be used as the basic color for designating dangerous parts of machines or energized equipment which may cut, crush, shock, or otherwise injure and to emphasize such hazards when enclosure doors are open or when gear belt, or other guards around moving equipment are open or removed, exposing unguarded hazards.

(o) *Yellow.* Yellow shall be the basic color for designating caution and for marking physical hazards such as: Striking against, stumbling, falling, tripping, and "caught in between." Solid yellow, yellow and black stripes, yellow and black checkers (or yellow with suitable contrasting background) should be used interchangeably, using the combination which will attract the most attention in the particular environment.

(p) *Green.* Green shall be used as the basic color for designating "Safety" and the location of first aid equipment (other than firefighting equipment).

(q) *Blue.* Blue shall be the basic color for designating caution, limited to warning against the starting, the use of, or the movement of equipment under repair or being worked upon.

(r) *Purple.* Purple shall be the basic color for designating radiation hazards. "Radiation" as used in this subparagraph

refers to radiation types such as X-ray, alpha, beta, gamma, neutron, proton, deuteron, and meson. Yellow should be used in combination with purple for markers such as tags, labels, signs, and floor markers.

(s) *Black, white, or combinations of black and white.* Black, white, or a combination of these two, shall be the basic colors for the designation of traffic and housekeeping markings. Solid white, solid black, single color striping, alternate stripes of black and white, or black and white checkers should be used in accordance with local conditions.

(t) *Color specifications.* Colors shall meet the tests specified in section 3, Color Definitions, of ANSI Z53.1-1967, Safety Color Code for Marking Physical Hazards.

§ 1910.145 Specifications for accident prevention signs and tags.

(a) *Scope.* (1) These specifications apply to the design, application, and use of signs or symbols (as included in paragraphs (c) through (e) of this section) intended to indicate and, insofar as possible, to define specific hazards of a nature such that failure to designate them may lead to accidental injury to workers or the public, or both, or to property damage. These specifications are intended to cover all safety signs except those designed for streets, highways, railroads, and marine regulations. These specifications do not apply to plant bulletin boards or to safety posters.

(2) All new signs and replacements of old signs after July 1, 1971, shall be in accordance with these specifications.

(b) *Definitions.* As used in this section, the word "sign" refers to a surface on which letters or other markings appear, prepared for the warning of, or safety instructions of, industrial workers or members of the public who may be exposed to hazards. Excluded from this definition, however, are news releases, displays commonly known as safety posters, and bulletins used for employee education.

(c) *Classification of signs according to use.*—(1) *Danger signs.* (i) Danger signs should be used only where an immediate hazard exists. There shall be no variation in the type of design of signs posted to warn of specific dangers and radiation hazards.

(ii) All employees shall be instructed that danger signs indicate immediate danger and that special precautions are necessary.

(2) *Caution signs.* (i) Caution signs shall be used only to warn against potential hazards or to caution against unsafe practices.

(ii) All employees shall be instructed that caution signs indicate a possible hazard against which proper precaution should be taken.

(3) *Safety instruction signs.* Safety instruction signs shall be used where there is a need for general instructions and suggestions relative to safety measures.

(d) *Sign design and colors.*—(1) *Design features.* The colors, proportions, and location of the identification panels on each sign shall be in accordance with

this paragraph. All signs shall be furnished with rounded or blunt corners and shall be free from sharp edges, burrs, splinters, or other sharp projections. The ends or heads of bolts or other fastening devices shall be located in such a way that they do not constitute a hazard. When conditions warrant the use of a sign size not covered in the following tables, the ratio of the depth of the identifying panel (Danger, Caution, etc.) to the width of the sign shall be as established in Tables J-1 to J-4.

(2) *Danger signs.* (i) The colors red, black, and white shall be those of opaque

glossy samples as specified in Table 1 of Fundamental Specification of Safety Colors for CIE Standard Source "C", American National Standard Z53.1-1967.

(ii) Standard Proportions shall be as indicated in Table J-1, and format shall be as in Fig. J-1.



Fig. J-1
Danger Sign

TABLE J-1—STANDARD PROPORTIONS FOR DANGER SIGNS

Sign size, inches Height Width	Black rectangular panel, inches Height Width	Red oval, inches Height Width	Word danger, height inches	Maximum space available for sign wording, inches
HORIZONTAL PATTERN				
7 x 10	2 1/4 x 9 1/4	2 1/4 x 8 1/4	1 1/4	2 1/4 x 9 1/4
10 x 14	3 1/4 x 12 1/4	3 1/4 x 11 1/4	2 1/4	3 1/4 x 12 1/4
14 x 20	4 1/4 x 16 1/4	4 1/4 x 15 1/4	3 1/4	4 1/4 x 16 1/4
20 x 28	6 1/4 x 22 1/4	6 1/4 x 21 1/4	4 1/4	6 1/4 x 22 1/4
UPRIGHT PATTERN				
10 x 7	2 1/4 x 9 1/4	2 1/4 x 8 1/4	1 1/4	2 1/4 x 9 1/4
14 x 10	3 1/4 x 12 1/4	3 1/4 x 11 1/4	2 1/4	3 1/4 x 12 1/4
20 x 14	4 1/4 x 16 1/4	4 1/4 x 15 1/4	3 1/4	4 1/4 x 16 1/4
28 x 20	6 1/4 x 22 1/4	6 1/4 x 21 1/4	4 1/4	6 1/4 x 22 1/4

(3) *Radiation warning signs.* (i) Standard color of the background shall be yellow; the panel, reddish purple with yellow letters; the symbol, reddish purple; any letters used against the yellow background shall be black. The colors shall be those of opaque glossy samples as specified in Table 1 of American National Standard, Z53.1-1967.



Fig. J-2
Radiation Warning Sign

(ii) The standard symbol shall be as in Figure J-3. Method of dimensioning, design, and orientation of the standard symbol (one blade pointed downward and centered on the vertical axis) shall be executed as illustrated. The symbol shall be prominently displayed, and of a

size consistent with the size of the equipment or material or area to which it is attached.

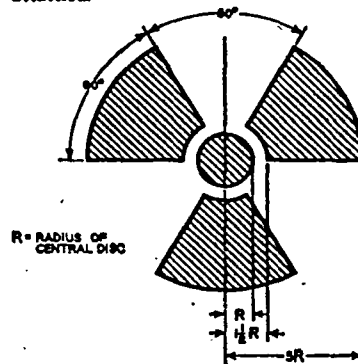


Fig. J-3
Standard Radiation Symbol

(iii) Format shall be as in Figure J-2. Sign proportions shall be the same as those for danger signs in Table J-1.

(4) *Caution signs.* (i) Standard color of the background shall be yellow; and the panel, black with yellow letters. Any letters used against the yellow background shall be black. The colors shall be those of opaque glossy samples as specified in Table 1 of American National Standard Z53.1-1967.

(ii) Standard proportions shall be as indicated in Table J-2, and format shall be as in Figure J-4.



Fig. J-4
Caution Sign

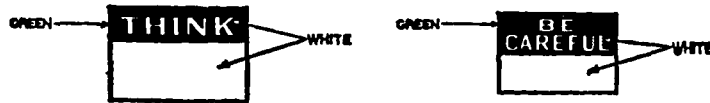
TABLE J-2—STANDARD PROPORTIONS FOR CAUTION SIGNS

Sign size, inches height width	Black rectangular panel, inches height width	Word "Caution", height of letter, inches	Maximum space avail- able for sign wording below panel, inches height width
HORIZONTAL PATTERN			
7 x 10	2 1/4 x 9 1/4	1 1/4	2 1/4 x 9 1/4
10 x 14	3 1/4 x 12 1/4	2 1/4	3 1/4 x 12 1/4
14 x 20	4 1/4 x 16 1/4	3 1/4	4 1/4 x 16 1/4
20 x 28	6 1/4 x 22 1/4	4 1/4	6 1/4 x 22 1/4
UPRIGHT PATTERN			
10 x 7	2 1/4 x 9 1/4	1 1/4	2 1/4 x 9 1/4
14 x 10	3 1/4 x 12 1/4	2 1/4	3 1/4 x 12 1/4
20 x 14	4 1/4 x 16 1/4	3 1/4	4 1/4 x 16 1/4
28 x 20	6 1/4 x 22 1/4	4 1/4	6 1/4 x 22 1/4

(5) *Exit signs.* Exit signs shall be in accordance with § 1910.37(g).

(6) *Safety instruction signs.* (i) Standard color of the background shall be white; and the panel, green with white letters. Any letters used against the white background shall be black. The colors shall be those of opaque glossy samples as specified in Table 1 of American National Standard, Z53.1-1967.

(ii) Standard proportions shall be as indicated in Table J-3, and format shall be as in Figure J-5.



(Note: The words "Think" and "Be Careful," given here, are only illustrations. Other wordings may be used.)

Fig. J-5
Safety Instruction Signs

TABLE J-3—STANDARD PROPORTIONS FOR SAFETY INSTRUCTION SIGNS

Sign size, inches, height, width	Green rectangular panel, inches, height, width	Word "Think," height of letters, inches	Maximum space available for sign wording below panel, inches, height, width	Sign size, inches, height, width	Green panel, inches, height, width	Word "Be," height of letters, inches	Word "Careful," height of letters, inches	Maximum space available for sign wording below panel, inches, height, width
7 x 10	2 3/4 x 9 1/4	1 1/4	3 1/4 x 9 1/4	7 x 10	2 3/4 x 9 1/4	1 1/4	1 3/4	2 1/4 x 9 1/4
10 x 14	3 1/4 x 12 1/4	2 1/4	4 1/4 x 12 1/4	10 x 14	4 1/4 x 12 1/4	1 3/4	2 1/4	4 x 12 1/4
14 x 20	4 1/4 x 16 1/4	2 3/4	5 x 16 1/4	14 x 20	5 1/4 x 16 1/4	2 1/4	3 1/4	5 x 16 1/4
20 x 28	6 1/4 x 22 1/4	3 1/4	7 1/4 x 22 1/4	20 x 28	7 1/4 x 22 1/4	3 1/4	4 1/4	7 1/4 x 22 1/4

(7) *Directional signs.* (1) Standard color of the background shall be white; and the panel, black with white directional symbol. Any letters used against the white background shall be black. The colors shall be those of opaque glossy samples as specified in Table 1 of American National Standard Z53.1-1967.

(2) Standard proportions shall be as indicated in Table J-4, and format shall be as in Figure J-6.



Fig. J-6
Directional Signs

Table J-4—Standard Proportions for Directional Signs

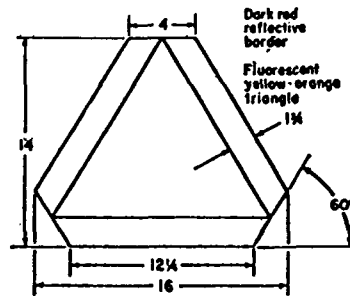
Sign size, inches, height, width	Black rectangular panel, inches, height, width	White arrow, inches				Maximum space for sign wording below panel height
		Overall length	Arrow head height, width	Arrow shaft height	Arrow tail height, width	
6 1/4 x 14	3 1/4 x 12 1/4	12 1/4	2 1/4 x 3	1 1/4	2 1/4 x 3 1/4	2 1/4 x 12 1/4
8 x 20	4 1/4 x 16 1/4	16 1/4	3 1/4 x 4 1/4	1 3/4	3 1/4 x 4 1/4	3 1/4 x 16 1/4
12 x 28	6 x 22 1/4	22 1/4	5 1/4 x 6 1/4	2 1/4	5 1/4 x 6 1/4	5 1/4 x 22 1/4
15 x 36	7 1/4 x 29 1/4	29 1/4	6 1/4 x 8 1/4	2 3/4	6 1/4 x 7 1/4	6 1/4 x 29 1/4

(8) *In-Plant traffic signs.* Regulatory and control signs required for the safe movement of vehicles and pedestrians on thoroughfares on plant property shall conform to the standards established in American National Standard Manual on Uniform Traffic Control Devices for Streets and Highways, D6.1-1961.

(9) *Informational signs.* Blue shall be the standard color for informational signs. It may be used as the background color for the complete sign or as a panel at the top of such types of "Notice" signs, which have a white background. The colors shall be those of opaque glossy samples as specified in Table 1 of American National Standard Z53.1-1967.

(10) *Slow-moving vehicle emblem.* This emblem (see Fig. J-7) consists of a fluorescent yellow-orange triangle with a dark red reflective border. The yellow-orange fluorescent triangle is a highly visible color for daylight exposure. The reflective border defines the shape of the fluorescent color in daylight and creates a hollow red triangle in the path of motor vehicle headlights at night. The emblem is intended as a unique identification for, and it shall be used only on, vehicles which by design move slowly (25 m.p.h. or less) on the public roads. The emblem is not a

clearance marker for wide machinery nor is it intended to replace required lighting or marking of slow-moving vehicles. Neither the color film pattern and its dimensions nor the backing shall be altered to permit use of advertising or other markings. The material, location, mounting, etc., of the emblem shall be in accordance with the American Society of Agricultural Engineers Emblem for Identifying Slow-Moving Vehicles, ASAE R276, 1967.



NOTE: All dimensions are in inches.

Fig. J-7
Slow-Moving Vehicle Emblem

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(11) *Symbols.* Symbols used on signs shall follow recognized practices, such as in Figure J-8. For radioactive materials, see symbol in Figure J-3.

POISON:



ELECTRICITY:



Fig. J-8
Symbols Used on Signs

(e) *Sign wordings.* (1) *Examples of wordings.* The lists in subparagraphs (3) through (7) of this paragraph are intended to serve as a guide for choosing the correct sign design for the message to be displayed.

(2) *Nature of wording.* The wording of any sign should be easily read and concise. The sign should contain sufficient information to be easily understood. The wording should make a positive, rather than negative suggestion and should be accurate in fact.

(3) *Danger signs.*

Danger—Keep Off, Electric Current.
Danger—No Smoking, Matches, or Open Lights.
Danger—Men Working Above.
Danger—Not Room Enough Here to Clear Men on Cars.
Danger—Keep Away.
Danger—Men in Boiler.
Danger—Insufficient Clearance.
Danger—2,500 Volts.
Danger—Keep Out.
Danger—Crane Overhead.
Danger—Keep Off.

(4) *Biological hazard signs.* The biological hazard warning shall be used to signify the actual or potential presence of a biohazard and to identify equipment, containers, rooms, materials, experimental animals, or combinations thereof, which contain, or are contaminated with, viable hazardous agents. For the purpose of this subparagraph the term "biological hazard," or "biohazard," shall include only those infectious agents presenting a risk or potential risk to the well-being of man. The biohazard symbol shall be designed and proportioned as illustrated in figure J-9.

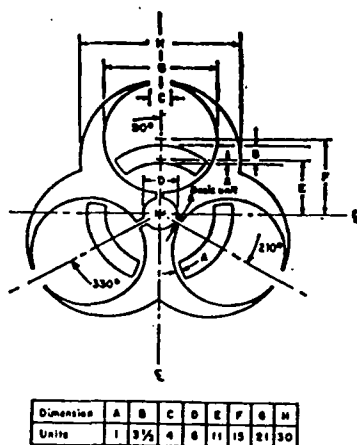


Fig. J-9
Symbol for Biological Hazard

The symbol design shall be a fluorescent orange or orange-red color. Background color is optional as long as there is sufficient contrast for the symbol to be clearly defined. Appropriate wording may be used in association with the symbol to indicate the nature or identity of the hazard, name of individual responsible for its control, precautionary information, etc., but never should this information be superimposed on the symbol.

(5) **Caution signs.**

Caution—Do Not operate, Men Working on Repairs.
Caution—Hands Off Switch, Men Working on Line.
Caution—Working on Machines, Do Not Start.
Caution—Goggles Must Be Worn When Operating This Machine.
Caution—This Door Must Be Kept Closed.
Caution—Electric Trucks, Go Slow.
Caution—This Space Must Be Kept Clear at All Times.
Caution—Stop Machinery to Clean, Oil, or Repair.
Caution—Keep Aisles Clear.
Caution—Operators of This Machine Shall Wear Snug Fitting Clothing—No Gloves.
Caution—Close Clearance.
Caution—Watch Your Step.
Caution—Electric Fence.

(6) **Safety instruction signs.**

Report All Injuries to the First-Aid Room at Once.
Walk—Don't Run.
Report All Injuries No Matter How Slight. Think, If Safe Go Ahead.
Make Your Work Place Safe Before Starting the Job.
Report All Unsafe Conditions to Your Foreman.
Help Keep This Plant Safe and Clean.

(7) **Directional signs.**

This Way Out (below arrow panel).
This Way (inside arrow) Out (below arrow panel).
Fire Exit (below arrow panel).
Fire (inside arrow) Extinguisher (below arrow panel).

To the (inside arrow) Fire Escape (below arrow panel).
To the (inside arrow) First Aid (below arrow panel).
Manway (below arrow panel).
This Way to (inside arrow) First-Aid Room (below arrow panel).

(8) **Informational signs.**

No Trespassing Under Penalty of the Law.
This Elevator Is for Freight Only, Not for Passengers.
No Admittance Except to Employees on Duty.
No Admittance.
No Admittance, Apply at Office.
No Trespassing.
Men.
Women.
For Employees Only.
Office.

Note: When sign wordings such as those listed in this section are contemplated, care should be taken to be sure that they are suitable for the particular location at which the sign is to be placed and that wording meets the requirements of the intended purpose. When there is a reasonable doubt, a sign of a standard design should be used.

(i) **Accident prevention tags.** (1) **Scope and purpose.** (i) The tags are a temporary means of warning all concerned of a hazardous condition, defective equipment, radiation hazards, etc. The tags are not to be considered as a complete warning method, but should be used until a positive means can be employed to eliminate the hazard; for example, a "Do Not Start" tag on power equipment shall be used for a few moments or a very short time until the switch in the system can be locked out; a "Defective Equipment" tag shall be placed on a damaged ladder and immediate arrangements made for the ladder to be taken out of service and sent to the repair shop.

(ii) The purpose of this paragraph is to establish a set of specifications for tags based on experience and previous

use. The tags are to be used in industry, mercantile establishments, or wherever such tags can be utilized to help prevent accidental injury to personnel or damage to property, or both.

(2) **Definitions.** The word "tag" as used in this paragraph refers to a surface (usually card, paper, pasteboard, or some temporary or nonpermanent material) on which letters or markings, or both, appear. These letters or markings, or both, are for warning (cautioning) or safety instruction of employees who may be exposed to hazards. They are to be affixed to the device in question by string, wire, or adhesive.

(3) **Do not start tags.** (i) The standard background color for Do Not Start tags shall be red. (See Fig. J-10.)

(ii) Letters shall be white or grey or etched, provided that a long lasting and sharp contrast results.

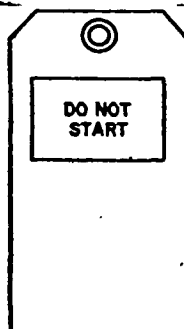
(iii) Do Not Start tags shall be placed in a conspicuous location or shall be placed in such a manner that they effectively block the starting mechanism which would cause hazardous conditions should the equipment be energized.

(4) **Danger tags.** (i) Danger tags should be used only where an immediate hazard exists. There should be no variation in the type of design of tags posted or hung to warn of specific dangers. (See Fig. J-11.)

(ii) All employees should be instructed that Danger tags indicate immediate danger and that special precautions are necessary.

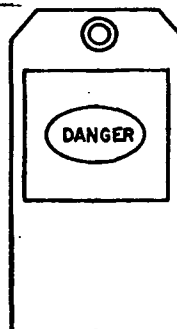
(5) **Caution tags.** (i) Caution tags should be used only to warn against potential hazards or to caution against unsafe practices. (See Fig. J-12.)

(ii) All employees should be instructed that Caution tags indicate a possible hazard against which proper precautions should be taken.



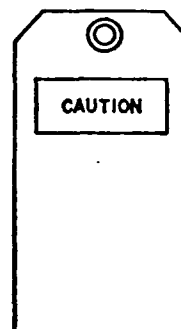
White tag
white letters on
red square

Fig. J-10
Do Not Start Tag



White tag
white letters on
red oval with a
black square

Fig. J-11
Danger Tag



Yellow tag
yellow letters on a
black background

Fig. J-12
Caution Tag

(6) **Out of order tags.** Out of Order tags should be used only for the specific purpose of indicating that a piece of equipment, machinery, etc., is out of order and to attempt to use it might present a hazard. (See Fig. J-13.)

(7) **Radiation tags.** (i) The standard background for Radiation tags shall be yellow; the panel shall be reddish purple. Any letters used against the yellow background shall be black. The colors shall be those of opaque glossy samples as

specified in Table 1, Fundamental Specification of Safety Colors for CIE Standard Source "C" American National Standard Safety Color Code for Marking Physical Hazards and the Identification of Certain Equipment, Z53.1-1967.

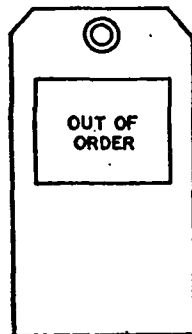
(ii) The method of dimension, design, and orientation of the standard symbol (one blade pointed downward and centered on the vertical axis) shall be executed as illustrated in Figure J-14. The symbol shall be prominently displayed and of a size consistent with the size of the equipment or area in which it is to be used.

(8) **Biological hazard tags.** (i) The standard background color for the Bio-

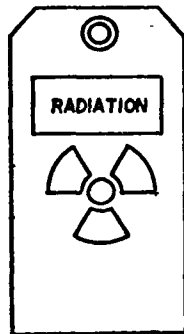
logical Hazard symbol is optional as long as there is sufficient contrast for the symbol to be clearly defined. The symbol design (see Fig. J-15) shall be a fluorescent orange or orange-red color.

(ii) The biological Hazard tag shall be used to signify the actual or potential presence of a biohazard, to identify equipment, containers, rooms, materials, experimental animals, or combinations thereof, which contain or are contaminated with viable hazardous agents.

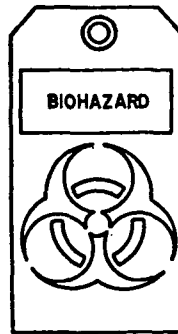
(iii) For the purpose of this subparagraph the term "biological hazard" shall include only those infectious agents presenting a risk or potential risk to the well-being of man.



White tag
white letters on
black background



Yellow tag
yellow letters in
reddish-purple panel
(Added wording in block
on yellow background)



White tag
black letters on
fluorescent-orange
background and
symbol

Fig. J-13
Out of Order Tag

Fig. J-14
Radiation Tag

Fig. J-15
Biological Hazard Tag

§ 1910.147- Sources of standards.

The standards in this Subpart J are derived from the following sources:

Sec.	Source
1910.141	ANSI Z4.1-1968, Minimum Requirements for Sanitation in Places of Employment.
1910.142	ANSI Z4.4-1968, Minimum Requirements for Sanitation in Temporary Labor Camps.
1910.143	ANSI Z4.3-1970, Minimum Requirements for Non-Water Carriage Disposal Systems.
1910.144	ANSI Z53.1-1967, Safety Color Code for Marking Physical Hazards.
1910.145	ANSI Z53.1-1968, Specifications for Accident Prevention signs.
1910.145(f)	ANSI Z53.2-1968, Specifications for Accident Prevention Tags.

§ 1910.148 Standards organizations.

Standards and specifications of the following organizations have been referenced in this Subpart J:

American National Standards Institute, 1430 Broadway, New York, NY 10018.
National Association of Plumbing and Mechanical Officials, 8032 Alhambra Avenue, Los Angeles, CA 90032.

American Society of Agricultural Engineers, 2980 Miller Road, Post Office Box 229, St. Joseph, MO 64508.

Subpart K—Medical and First Aid

§ 1910.151 Medical services and first aid.

(a) Employer shall insure the ready availability of medical personnel for advice and consultation on matters of plant health.

(b) In the absence of an infirmary, clinic, or hospital in near proximity to the workplace which is used for the treatment of all injured employees, a person or persons shall be adequately trained to render first aid. First aid supplies approved by the consulting physician shall be readily available.

(c) Where the eyes or body of any person may be exposed to injurious corrosive materials, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use.

§ 1910.152 [Reserved]

§ 1910.153 Sources of standards.

The standard in § 1910.151 is derived from 41 CFR 50-204.6.

Subpart L—Fire Protection

§ 1910.156 Definitions applicable to this subpart.

(a) "Class A fires" are fires in ordinary combustible materials, such as wood, cloth, paper, and rubber.

(b) "Class B fires" are fires in flammable liquids, gases, and greases.

(c) "Class C fires" are fires which involve energized electrical equipment where the electrical nonconductivity of the extinguishing media is of importance. (When electrical equipment is deenergized, extinguishers for Class A or B fires may be used safely.)

(d) "Class D fires" are fires in combustible metals, such as magnesium, titanium, zirconium, sodium, and potassium.

(e) Classification of portable fire extinguishers: "Portable fire extinguishers" are classified for use on certain classes of fires and rated for relative extinguishing effectiveness at a temperature of plus 70° F. by nationally recognized testing laboratories. This is based upon the preceding classification of fires and the fire extinguishment potentials as determined by fire tests.

Note: The classification and rating system described in this section is that used by Underwriters Laboratories, Inc. and Underwriters Laboratories of Canada and is based on extinguishing preplanned fires of determined size and description as follows:

(i) Class A rating—Wood and excelsior fires excluding deep-seated conditions.

(ii) Class B rating—Two-inch depth gasoline fires in square pans.

(iii) Class C rating—No fire test. Agent must be a nonconductor of electricity.

(iv) Class D rating—Special tests on specific combustible metal fires.

(f) A "light hazard" is a situation where the amount of combustibles or flammable liquids present is such that fires of small size may be expected. These may include offices, schoolrooms, churches, assembly halls, telephone exchanges, etc.

(g) An "ordinary hazard" is a situation where the amount of combustibles or flammable liquids present is such that fires of moderate size may be expected. These may include mercantile storage and display, auto showrooms, parking garages, light manufacturing, warehouses not classified as extra hazard, school shop areas, etc.

(h) An "extra hazard" is a situation where the amount of combustibles or flammable liquids present is such that fires of severe magnitude may be expected. These may include woodworking, auto repair, aircraft servicing, warehouses with high-piled (14 feet or higher) combustibles, and processes such as flammable liquid handling, painting, dipping, etc.

(i) Sprinkler system: A "sprinkler system," for fire protection purposes, is an integrated system of underground and overhead piping designed in accordance with fire protection engineering standards. The system includes a suitable water supply, such as a gravity tank, fire pump, reservoir, or pressure tank and/or connection by underground piping to a city main. The portion of the

sprinkler system above ground is a network of specially sized or hydraulically designed piping installed in a building, structure or area, generally overhead, and to which sprinklers are connected in a systematic pattern. The system includes a controlling valve and a device for actuating an alarm when the system is in operation. The system is usually activated by heat from a fire and discharges water over the fire area.

Notes: The design and installation of water supply facilities such as gravity tanks, fire pumps, reservoirs, or pressure tanks, and underground piping are covered by NFPA Standards No. 22-1970, Water Tanks For Private Fire Protection; No. 20-1970, Installation of Centrifugal Fire Pumps and No. 24-1970, Outside Protection.

(j) **Sprinkler alarms:** A "sprinkler alarm" unit is an assembly of apparatus approved for the service and so constructed and installed that any flow of water from a sprinkler system equal to or greater than that from a single automatic sprinkler will result in an audible alarm signal on the premises.

(k) **Class of service—standpipe systems:** "Standpipe systems" are grouped into three general classes of service for the intended use in the extinguishment of fire.

(1) **Class I:** For use by fire departments and those trained in handling heavy fire streams (2½-inch hose).

(2) **Class II:** For use primarily by the building occupants until the arrival of the fire department (small hose).

(3) **Class III:** For use by either fire departments and those trained in handling heavy hose streams or by the building occupants.

(l) **Class I service:** "Class I service" is a standpipe system capable of furnishing the effective fire streams required during the more advanced stages of fire on the inside of buildings or for exposure fire.

(m) **Class II service:** "Class II service" is a standpipe system which affords a ready means for the control of incipient fires by the occupants of buildings during the nighttime and holidays.

(n) **Class III service:** "Class III service" is a standpipe system capable of furnishing the effective fire streams required during the more advanced stages of fire on the inside of buildings as well as providing a ready means for the control of fires by the occupants of the building.

(o) **Standpipe systems:** "Standpipe systems" are usually of the following types:

(1) A wet standpipe system having a supply valve open and water pressure maintained at all times.

(2) A standpipe system so arranged through the use of approved devices as to admit water to the system automatically by opening a hose valve.

(3) A standpipe system arranged to admit water to the system through manual operation of approved remote control devices located at each hose station.

(4) Dry standpipe having no permanent water supply.

See also paragraph (k) of this section.

(p) **Type I storage:** "Type I storage" is that in which combustible commodities or noncombustible commodities involving combustible packaging or storage aids are stored not over 15 feet high in solid piles or not over 12 feet high in piles that contain horizontal channels. Minor quantities of commodities of hazard greater than ordinary combustibles may be included without affecting this general classification.

(q) **Type II storage:** "Type II storage" is that in which the stored commodities, packaging, and storage aids are noncombustible or contain only a small concentration of combustibles which are incapable of producing a fire that would cause appreciable damage to the commodities stored or to noncombustible wall, floor or roof construction. Ordinary combustible commodities in completely sealed noncombustible containers may qualify in this classification. General commodity storage that is subject to frequent changing and storage of combustible packaging and storage aids is excluded from this category.

(r) **Type I storage:** "Type I storage" is that in which combustible commodities or noncombustible commodities involving combustible packaging or storage aids are stored over 15 feet but not more than 21 feet high in solid piles or over 12 feet but not more than 21 feet high in piles that contain horizontal channels. Minor quantities of commodities of hazard greater than ordinary combustibles may be included without affecting this general classification.

(s) **"Approved":** "Approved" means listed or approved by: (1) At least one of the following nationally recognized testing laboratories: Factory Mutual Engineering Corp.; Underwriters' Laboratories, Inc.; or (2) Federal agencies such as Bureau of Mines, Department of the Interior; Department of Transportation; or U.S. Coast Guard, which issue approvals for such equipment.

PORTABLE FIRE SUPPRESSION EQUIPMENT § 1910.157 Portable fire extinguishers.

(a) **General requirements—(1) Operable condition.** Portable extinguishers shall be maintained in a fully charged and operable condition, and kept in their designated places at all times when they are not being used.

(2) **Location.** Extinguishers shall be conspicuously located where they will be readily accessible and immediately available in the event of fire. They shall be located along normal paths of travel.

(3) **Marking of location.** Extinguishers shall not be obstructed or obscured from view. In large rooms, and in certain locations where visual obstruction cannot be completely avoided, means shall be provided to indicate the location and intended use of extinguishers conspicuously.

(4) **Marking of extinguishers.** If extinguishers intended for different classes of fire are grouped, their intended use shall be marked conspicuously to insure choice of the proper extinguisher at the time of a fire.

(5) **Mounting of Extinguishers.** Extinguishers shall be installed on the hangers

or in the brackets supplied, mounted in cabinets, or set on shelves unless the extinguishers are of the wheeled type.

(6) **Height of mounting.** Extinguishers having a gross weight not exceeding 40 pounds shall be installed so that the top of the extinguisher is not more than 5 feet above the floor. Extinguishers having a gross weight greater than 40 pounds (except wheeled types) shall be so installed that the top of the extinguisher is not more than 3½ feet above the floor.

(7) **Cabinet mounting.** Extinguisher mounted in cabinets or wall recesses or set on shelves shall be placed in a manner such that the extinguisher operating instructions face outward. The location of such extinguishers shall be marked conspicuously.

(8) **Vibrating locations.** Extinguishers installed under conditions where they are subject to severe vibration shall be installed in brackets specifically designed to cope with this vibration.

(9) **Temperature range.** Extinguishers shall be suitable for use within a temperature range of at least plus 40° to 120° Fahrenheit.

(10) **Extreme temperature exposure.** When extinguishers are installed in locations subjected to temperatures outside the range prescribed in this § 1910.157

(a) (10), they shall be of a type approved or listed for the temperature to which they will be exposed, or placed in an enclosure capable of maintaining the temperature within the range prescribed in this § 1910.157(a) (10).

(b) **Selection of extinguishers—(1) General.** The selection of extinguishers for a given situation will depend upon the character of the fires anticipated, the construction and occupancy of the individual property, the vehicle or hazard to be protected, ambient-temperature conditions, and other factors. The number of extinguishers required shall be determined by reference to paragraph (c) of this section.

(2) **Selection by hazard.** (i) Extinguishers shall be selected for the specific class or classes of hazards to be protected in accordance with the following paragraphs.

(ii) Extinguishers for protecting Class A hazards shall be selected from among the following: foam, loaded stream, multipurpose dry chemical, and water types. Certain smaller extinguishers which are charged with multipurpose dry chemical are rated on Class B and Class C fires, but have insufficient effectiveness to earn the minimum 1-A rating even though they have value in extinguishing smaller Class A fires.

Such smaller extinguishers shall not be used to meet the requirements of paragraph (c) (2) (i) of this section.

(iii) Extinguishers for protection of Class B hazards shall be selected from the following: Bromotrifluoromethane, carbon dioxide, dry chemical, foam, loaded stream, and multipurpose dry chemical. Extinguishers with ratings less than 1-B shall not be considered in determining suitability.

(iv) Extinguishers for protection of Class C hazards shall be selected from the

Personal Protective Equipment

We have all protective equipment we need now in the plant. But the employees are not wearing them. One: 3^m Dust mask is being used every place in the plant. We should be using the snow mask no # 600A for $\frac{3}{4}$ of our plant operation. The 3^m Dust mask should only be used in clay or on front of the machine, when the bagging is done. It is only good for non Toxic dusts. We don't have a maintenance or respiratory protective program.

General Environmental Controls

51910.141 Sanitation - B-1

Drinking water should be available within 200 feet of location of employee easily.

V1 where single service cups (to be used but once) are supplied, both a sanitary container for used cups and a receptacle for disposing of the used cups. (Shipping Dept.)

H. where food service is provided by vending machines vending machines are not kept clean

Bad heat in lunch Room, and doorway is built so it can't close. Trouble with late garbage cans must closed with lids. must be dump once a day. windows broke B-10 + Take machine area

Portable Fire Suppression Equipment

we have the necessary fire Ext.
needed for our plant. Our light mounting in a few places are
higher than five ft. Some places are not painted red marking
fire Ext. Some of our storage items like some bags and
boxes are stacked too high and no room between rows. We
have no sprinkler system at all.

Powered Industrial Trucks Safety

This is our haul area. There isn't
much safety in the shipping area at all. We should pass
some rules on safety use in the shipping area.

Occupational Noise Standards (Pinner volume 15)

This is a haul area too. we have
no noise control or checking program. Personal protective equipment
is not being worn by some people in this area.

we need more safety signs around
the plant like, Danger, Hard Hat Area and etc.

ese

Sweet Dands - 250

Hard Hats - 20

Vinylite sleeves style # 880 (30 pairs)

Smocks style # 407 (75)

285 Socks Brown for male (8)

Mens Socks white for (31)

Mens ~~socks~~ underwear 36

First Aid Kits (2)

First Aid Kits (2)

4th A.M. Mens MASH Respirator - 100 (20)

4th A.M. Mens MASH Respirator - 100 (20)

4th A.M. Mens MASH Respirator - 100 (2-5)

4th A.M. Mens MASH Respirator - 100 (3) (11pa)

Dust mask for MASH Respirator (2200)

First Aid Kits for MASH Respirator

5th A.M. Mens MASH Respirator (10)

✓ 1st A.M. Mens MASH Respirator (10)

1st A.M. Mens MASH Respirator (10)

7 dozen Socks for male

4 dozen Socks for male

1st A.M. Mens MASH Respirator

1st A.M. Mens MASH Respirator

2nd A.M. Mens MASH Respirator

1st A.M. Mens MASH Respirator

Any solid powders such as ammonium nitrate must be dry and shall be stored in a dry place or bins which are moisture-resistant or waterproof. Solid fuels shall be used in such manner as to minimize dust explosion hazards.

(f) Ingressions shall not be stored with incompatible materials.

(g) Peroxides and chlorates shall not be used.

(h) Mixing equipment shall comply with the requirements of this subdivision.

(i) The design of the processing equipment, including mixing and conveying equipment, shall be compatible with the relative sensitivity of the materials being handled. Equipment shall be designed to minimize the possibility of frictional heating, compaction, overloading, and confinement.

(j) Both equipment and handling procedures shall be designed to prevent the introduction of foreign objects or materials.

(k) Mixers, pumps, valves, and related equipment shall be designed to permit regular and periodic flushing, cleaning, dismantling, and inspection.

(l) All electrical equipment including wiring, switches, controls, motors, and lights, shall conform to the requirements of Subpart S of this part.

(m) All electric motors and generators shall be provided with suitable overload protection devices. Electrical generators, motors, proportioning devices, and all other electrical enclosures shall be electrically bonded. The grounding conductor to all such electrical equipment shall be effectively bonded to the service-entrance ground connection and to all equipment ground connections in a manner so as to provide a continuous path to ground.

(n) Mixing facilities shall comply with the fire prevention requirements of this subdivision.

(o) The mixing, loading, and ingredient transfer areas where residues or spilled materials may accumulate shall be cleaned periodically. A cleaning and collection system for dangerous residues shall be provided.

(p) A daily visual inspection shall be made of the mixing, conveying, and electrical equipment to establish that such equipment is in good operating condition. A program of systematic maintenance shall be conducted on regular schedule.

(q) Heaters which are not dependent on the combustion process within the heating unit may be used within the confines of processing buildings, or compartments, if provided with temperature and safety controls and located away from combustible materials and the finished product.

(4) Bulk delivery and mixing vehicles. (i) The design of vehicles shall comply with the requirements of this subdivision.

(a) Vehicles used over public highways for the bulk transportation of water gels or of ingredients classified as dan-

gerous substances shall meet the requirements of the Department of Transportation, and shall meet the requirements of paragraphs (d) and (e) of this section.

(b) When electric power is supplied by a self-contained motor generator located on the vehicle the generator shall be at a point separate from where the water gel is discharged.

(c) The design of processing equipment and general requirements shall conform to subparagraphs (3) (ii) and (iv) of this paragraph.

(d) A positive action parking brake which will set the wheel brakes on at least one axle shall be provided on vehicles when equipped with air brakes and shall be used during bulk delivery operations. Wheel chocks shall supplement parking brakes whenever conditions may require.

(e) Operation of bulk delivery and mixing vehicles shall comply with the requirements of this subdivision.

(f) The placarding requirements contained in DOT regulations apply to vehicles carrying water gel explosives or blasting agents.

(g) The operator shall be trained in the safe operation of the vehicle together with its mixing, conveying, and related equipment. He shall be familiar with the commodities being delivered and the general procedure for handling emergency situations.

(h) The handling of either blasting caps or other explosives, but not both, shall be permitted on bulk trucks provided that a special wood or nonferrous-lined container is installed for the explosives. Such blasting caps or other explosives shall be in DOT-specified shipping containers; see 49 CFR Chapter I.

(i) No person shall be allowed to smoke, carry matches or any flame-producing device, or carry any firearms while in or about bulk vehicles effecting the mixing, transfer, or down-the-hole loading of water gels at or near the blasting site.

(j) Caution shall be exercised in the movement of the vehicle in the blasting area to avoid driving the vehicle over or dragging hoses over firing lines, cap wires, or explosive materials. The employer shall furnish the driver the assistance of a second person to guide the driver's movements.

(k) No intransit mixing of materials shall be performed.

(l) The location chosen for water gel or ingredient transfer from a support vehicle into the borehole loading vehicle shall be away from the blasthole site when the boreholes are loaded or in the process of being loaded.

(1) Storage of ammonium nitrate—

(i) Scope and definitions. (i) (a) Except as provided in subdivision (d) of this subdivision this paragraph applies to the storage of ammonium nitrate in the form of crystals, flakes, grains, or prills including fertilizer grade, dynamite grade, nitrous oxide grade, technical grade, and other mixtures containing 60 percent or more ammonium nitrate by weight but does not apply to blasting.

(b) Storage of ammonium nitrate shall be in accordance with the requirements of the U.S. Coast Guard (see 49 CFR Part 149).

(c) This paragraph shall not apply to storage under the jurisdiction of the U.S. Coast Guard (see 49 CFR Part 149).

(d) The storage of ammonium nitrate and ammonium nitrate mixtures that are more sensitive than allowed by the "Definition of Test Procedures for Ammonium Nitrate Fertilizer" is prohibited.

(e) Nothing in this paragraph shall apply to the production of ammonium nitrate or to the storage of ammonium nitrate on the premises of the producing plant, provided that no distinct undue hazard to the public is created.

(f) (i) (a) The definition and test procedures for ammonium nitrate fertilizer are those found in the Bulletin, "Definition and Test Procedures for Ammonium Nitrate Fertilizer", available from the National Plant Food Institute, 1700 K Street NW, Washington, DC 20006. This definition limits the amount of organic materials, metals, sulfur, etc., in a product that may be classified ammonium nitrate fertilizer.

(b) The standards for ammonium nitrate (fertilizer grade) are those found in the "Specifications, Properties, and Recommendations for Fertilizers", Transportation, Storage, and Use of Ammonium Nitrate, available from the Compressed Gas Association, 1230 Fifth Avenue, New York, NY 10020.

(2) General provisions. (i) This paragraph applies to all persons storing, having, or keeping ammonium nitrate, and to the owner or lessee of any building, premises, or structure in which ammonium nitrate is stored in quantities of 1,000 pounds or more.

(ii) Approval of large quantity storage shall be subject to determination of the fire and explosion hazard, including exposure to toxic vapors from burning or decomposing ammonium nitrate.

(iii) (a) Storage buildings shall not have basements unless the basements are open on at least one side. Storage buildings shall not be over one story in height.

(b) Storage buildings shall have adequate ventilation or be of a construction that will be self-ventilating in the event of fire.

(c) The wall on the exposed side of a storage building within 50 feet of a combustible building, forest, piles of combustible materials and similar exposure hazards shall be of fire-resistant construction. In lieu of the fire-resistant wall, other suitable means of exposure protection such as a free standing wall may be used. The roof coverings shall be class C or better, as defined in Roof Coverings, NFPA 203-1970.

(d) All flooring in storage and handling areas, shall be of noncombustible material or protected against impregnation by ammonium nitrate and shall be

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without open drains, traps, tunnels, pits, or passages into which the molten ammonium nitrate could flow and be confined in the event of fire.

(e) The height of any existing storage building or structure not in strict conformity with this paragraph may be approved in cases where such continued use will not constitute a hazard to life or adjoining property.

(f) Buildings and structures shall be dry and free from water seepage through the roof, walls, and floors.

(3) *Storage of ammonium nitrate in bags, drums, or other containers.* (i) (a) Bags and containers used for ammonium nitrate must comply with specifications and standards required for use in interstate commerce (see 49 CFR Chapter I).

(b) Containers used on the premises in the actual manufacturing or processing need not comply with provisions of subdivision (a) of this subdivision.

(ii) (a) Containers of ammonium nitrate shall not be accepted for storage when the temperature of the ammonium nitrate exceeds 130° F.

(b) Bags of ammonium nitrate shall not be stored within 30 inches of the storage building walls and partitions.

(c) The height of piles shall not exceed 20 feet. The width of piles shall not exceed 30 feet and the length 50 feet except that where the building is of non-combustible construction or is protected by automatic sprinklers the length of piles shall not be limited. In no case shall the ammonium nitrate be stacked closer than 36 inches below the roof or supporting and spreader beams overhead.

(d) Aisles shall be provided to separate piles by a clear space of not less than 3 feet in width. At least one service or main aisle in the storage area shall be not less than 4 feet in width.

(4) *Storage of bulk ammonium nitrate.* (i) (a) Warehouses shall have adequate ventilation or be capable of adequate ventilation in case of fire.

(b) Unless constructed of noncombustible material or unless adequate facilities for fighting a roof fire are available, bulk storage structures shall not exceed a height of 40 feet.

(ii) (a) Bins shall be clean and free of materials which may contaminate ammonium nitrate.

(b) Due to the corrosive and reactive properties of ammonium nitrate, and to avoid contamination, galvanized iron, copper, lead, and zinc shall not be used in a bin construction unless suitably protected. Aluminum bins and wooden bins protected against impregnation by ammonium nitrate are permissible. The partitions dividing the ammonium nitrate storage from other products which would contaminate the ammonium nitrate shall be of tight construction.

(c) The ammonium nitrate storage bins or piles shall be clearly identified by signs reading "Ammonium Nitrate" with letters at least 2 inches high.

(iii) (a) Piles or bins shall be so sized and arranged that all material in the pile is moved out periodically in order to

minimize possible caking of the stored ammonium nitrate.

(b) Height or depth of piles shall be limited by the pressure-setting tendency of the product. However, in no case shall the ammonium nitrate be piled higher at any point than 36 inches below the roof or supporting and spreader beams overhead.

(c) Ammonium nitrate shall not be accepted for storage when the temperature of the product exceeds 130° F.

(d) Dynamite, other explosives, and blasting agents shall not be used to break up or loosen caked ammonium nitrate.

(5) *Contaminants.* (i) (a) Ammonium nitrate shall be in a separate building or shall be separated by approved type firewalls of not less than 1 hour fire-resistance rating from storage of organic chemicals, acids, or other corrosive materials, materials that may require blasting during processing or handling, compressed flammable gases, flammable and combustible materials or other contaminating substances, including but not limited to animal fats, baled cotton, baled rags, baled scrap paper, bleaching powder, burrap or cotton bags, caustic soda, coal, coke, charcoal, cork, camphor, excelsior, fibers of any kind, fish oils, fish meal, foam rubber, hay, lubricating oil, lined oil, or other oxidizable or drying oils, naphthalene, oakum, oiled clothing, oiled paper, oiled textiles, paint, straw, sawdust, wood shavings, or vegetable oils. Walls referred to in this subdivision need extend only to the underside of the roof.

(b) In lieu of separation walls, ammonium nitrate may be separated from the materials referred to in subdivision (a) of this subdivision by a space of at least 30 feet.

(c) Flammable liquids such as gasoline, kerosene, solvents, and light fuel oils shall not be stored on the premises except when such storage conforms to § 1910.106, and when walls and sills or curbs are provided in accordance with subdivisions (a) or (b) of this subdivision.

(d) LP-Gas shall not be stored on the premises except when such storage conforms to § 1910.110.

(ii) (a) Sulfur and finely divided metals shall not be stored in the same building with ammonium nitrate except when such storage conforms to paragraphs (a) through (h) of this section.

(b) Explosives and blasting agents shall not be stored in the same building with ammonium nitrate except on the premises of makers, distributors, and user-compounders of explosives or blasting agents.

(c) Where explosives or blasting agents are stored in separate buildings, other than on the premises of makers, distributors, and user-compounders of explosives or blasting agents, they shall be separated from the ammonium nitrate by the distances and/or barricades specified in Table H-22 of this subpart, but by not less than 50 feet.

(d) Storage and/or operations on the premises of makers, distributors, and

user-compounders of explosives or blasting agents shall be in conformity with paragraphs (a) through (h) of this section.

(6) *General precautions.* (i) (a) Electrical installations shall conform to the requirements of subpart S of this part, for ordinary locations. They shall be designed to minimize damage from corrosion.

(vi) In areas where lightning storms are prevalent, lightning protection shall be provided. (See the Lightning Protection Code, NFPA 78-1968.)

(vii) Provisions shall be made to prevent unauthorized personnel from entering the ammonium nitrate storage area.

(7) *Fire protection.* (i) Not more than 2,500 tons of bagged ammonium nitrate shall be stored in a building or structure not equipped with an automatic sprinkler system. Sprinkler systems shall be of approved type and installed in accordance with the Standard for the Installation of Sprinkler Systems, NFPA 13-1968.

(ii) (a) Suitable fire control devices such as small hose or portable extinguishers shall be provided throughout the warehouse and in the loading and unloading areas. See the Standard for the Installation of Portable Fire Extinguishers, NFPA 10-1970, and the Standard for the Installation of Standpipe and Hose Systems, NFPA 14-1970.

(b) Water supplies and fire hydrants shall be available in accordance with recognized good practices.

§ 1910.110 *Storage and handling of liquefied petroleum gases.*

(a) *Definitions applicable to this section.* As used in this section:

(1) *API-ASME container*—A container constructed in accordance with the requirements of paragraph (b) (3) (iii) of this section.

(2) *ASME container*—A container constructed in accordance with the requirements of paragraph (b) (3) (iii) of this section.

(3) *Container assembly*—An assembly consisting essentially of the container and fittings for all container openings, including shut-off valves, excess flow valves, liquid-level gaging devices, safety relief devices, and protective housing.

(4) *Containers*—All vessels, such as tanks, cylinders, or drums, used for transportation or storing liquefied petroleum gases.

(5) *DOT*—Department of Transportation.

(6) *DOT container*—A container constructed in accordance with the applicable requirements of 49 CFR Chapter 1.

(7) *"Liquefied petroleum gases"*—"LPG" and "LP-Gas"—Any material which is composed predominantly of any of the following hydrocarbons, or mixtures of them: propane, propylene, butanes (normal butane or iso-butane), and butylenes.

(8) *Movable fuel storage tenders or farm carts*—Containers not in excess of 1,200 gallons water capacity, equipped with wheels not to be towed from one

location of usage to another. They are basically nonhighway vehicles, but may occasionally be moved over public roads or highways. They are used as a fuel supply for farm tractors, construction machinery and similar equipment.

(9) P.S.I.G.—pounds per square inch gauge.

(10) P.S.I.A.—pounds per square inch absolute.

(11) Systems—an assembly of equipment consisting essentially of the container or containers, major devices such as vaporizers, safety relief valves, excess flow valves, regulators, and piping connecting such parts.

(12) Vaporizer-burner—an integral vaporizer-burner unit, dependent upon the heat generated by the burner as the source of heat to vaporize the liquid used for dehydrators or dryers.

(13) Ventilation, adequate—when specified for the prevention of fire during normal operation, ventilation shall be considered adequate when the concentration of the gas in a gas-air mixture does not exceed 25 percent of the lower flammable limit.

(14) Approved—unless otherwise indicated, listing or approval by the following nationally recognized testing laboratories: Underwriters Laboratories, Inc.; Factory Mutual Engineering Corp.

(15) Listed—see "approved" in § 1910.110(14).

(16) DOT Specifications—regulations of the Department of Transportation published in 49 CFR Chapter I.

(17) DOT regulations—see § 1910.110(a)(16).

(18) DOT requirements—see § 1910.110(a)(16).

(19) DOT cylinders—cylinders meeting the requirements of 49 CFR Chapter I.

(b) *Basic rules.*—(1) *Odorizing gases.* (i) All liquefied petroleum gases shall be effectively odorized by an approved agent of such character as to indicate positively, by distinct odor, the presence of gas down to concentration in air of not over one-fifth the lower limit of flammability. Odorization, however, is not required if harmful in the use of further processing of the liquefied petroleum gas, or if odorization will serve no useful purpose as a warning agent in such use or further processing.

(ii) The odorization requirement of subdivision (i) of this subparagraph shall be considered to be met by the use of 1.0 pounds of ethyl mercaptan, 1.0 pounds of thiophane or 1.4 pounds of amyl mercaptan per 10,000 gallons of LP-Gas. However, this listing of odorants and quantities shall not exclude the use of other odorants that meet the odorization requirements of subdivision (i) of this subparagraph.

(2) *Approval of equipment and systems.* (i) Each system utilizing DOT containers in accordance with 49 CFR Part 178 shall have its container valves, connectors, manifold valve assemblies, and regulators approved.

(ii) Each system for domestic or commercial use utilizing containers of 2,000 gallons or less water capacity, other than

those constructed in accordance with 49 CFR Part 178, shall consist of a container assembly and one or more regulators, and may include other parts. The system as a unit or the container assembly as a unit, and the regulator or regulators, shall be individually listed.

(iv) The provisions of subdivision (i) of this subparagraph shall not be construed as prohibiting the continued use or reinstallation of containers constructed and maintained in accordance with the standard for the Storage and Handling of Liquefied Petroleum Gases NFPA No. 58 in effect at the time of fabrication.

(v) Containers used with systems embodied in paragraph (b), (d)(3)(iii), and (f) of this section, shall be constructed, tested, and stamped in accordance with DOT specifications effective at the date of their manufacture.

(4) *Welding of containers.* (i) Welding to the shell, head, or any other part of the container subject to internal pressure, shall be done in compliance with the code under which the tank was fabricated. Other welding is permitted only on saddle plates, lugs, or brackets attached to the container by the tank manufacturer.

(ii) Where repair or modification involving welding of DOT containers is required, the container shall be returned to a qualified manufacturer making containers of the same type, and the repair or modification made in compliance with DOT regulations.

(5) *Markings on containers.* (i) Each container covered in subparagraph (3) (i) of this paragraph, except as provided in subparagraph (3)(iv) of this paragraph shall be marked as specified in the following:

(a) With a marking identifying compliance with, and other markings required by, the rules of the reference under which the container is constructed; or with the stamp and other markings required by the National Board of Boiler and Pressure Vessel Inspectors.

(iii) In systems utilizing containers of over 2,000 gallons water capacity, each regulator, container valve, excess flow valve, gaging device, and relief valve installed on or at the container, shall have its correctness as to design, construction, and performance determined by listing by Underwriters Laboratories, Inc., or Factory Mutual Engineering Corp.

(3) *Requirements for construction and original test of containers.* (i) Containers used with systems embodied in paragraphs (d), (e), (f), and (h) of this section, except as provided in paragraphs (e)(3)(iii) and (g)(2)(i) of this section, shall be designed, constructed, and tested in accordance with the Rules for Construction of Unfired Pressure Vessels, section VIII, Division 1, American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, 1968 edition.

(ii) Containers constructed according to the 1949 and earlier editions of the ASME Code do not have to comply with paragraphs U-2 through U-10 and U-19 thereof. Containers constructed accord-

ing to paragraph U-70 in the 1949 and earlier editions are not authorized.

(iii) Containers designed, constructed, and tested prior to July 1, 1961, according to the Code for Unfired Pressure Vessels for Petroleum Liquids and Gases, 1961 edition with 1964 Addenda, of the American Petroleum Institute and the American Society of Mechanical Engineers shall be considered in conformance. Containers constructed according to API-ASME Code do not have to comply with section I or with appendix to section I, Paragraphs W-601 to W-606 inclusive in the 1943 and earlier editions do not apply.

(b) With notation as to whether the container is designed for underground or aboveground installation or both. If intended for both and different style hoods are provided, the marking shall indicate the proper hood for each type of installation.

(c) With the name and address of the supplier of the container, or with the trade name of the container.

(d) With the water capacity of the container in pounds or gallons, U.S. Standard.

(e) With the pressure in p.s.i.g., for which the container is designed.

(f) With the wording "This container shall not contain a product having a vapor pressure in excess of — p.s.i.g. at 100° F." as a subparagraph (14) (viii) of this paragraph.

(g) With the tare weight in pounds or other identified unit of weight for containers with a water capacity of 300 pounds or less.

(h) With marking indicating the maximum level to which the container may be filled with liquid at temperatures between 20° F. and 130° F., except on containers provided with fixed maximum level indicators or which are filled by weighing. Markings shall be increments of not more than 20° F. This marking may be located on the liquid level gaging device.

(i) With the outside surface area in square feet.

(ii) Markings specified shall be on a metal nameplate attached to the container and located in such a manner as to remain visible after the container is installed.

(iii) When LP-Gas and one or more other gases are stored or used in the same area, the containers shall be marked to identify their content. Marking shall be in compliance with American National Standard Z48.1-1964, "Method of Marking Portable Compressed Gas Containers To Identify the Material Contained."

(6) *Location of containers and regulating equipment.* (i) Containers, and first stage regulating equipment if used, shall be located outside of buildings, except under one or more of the following:

(a) In buildings used exclusively for container charging, vaporization pressure reduction, gas mixing, gas manufacturing, or distribution.

(b) When portable use is necessary and in accordance with paragraph (c) (5) of this section.

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(a) LP-Gas fueled stationary or portable engines in accordance with paragraph (e) (11) or (12) of this section.

(d) LP-Gas fueled industrial trucks used in accordance with paragraph (e) (13) of this section.

(e) LP-Gas fueled vehicles garaged in accordance with paragraph (e) (14) of this section.

(f) Containers awaiting use or resale when stored in accordance with paragraph (f) of this section.

(ii) Each individual container shall be located with respect to the nearest important building or group of buildings or line of adjoining property which may be built on in accordance with Table H-23.

TABLE H-23

Water capacity per container	Minimum distances		
	Containers Under-ground	Containers Above-ground	Between above-ground containers
Less than 125 gal.	10 feet	None	None
125 to 250 gallons	10 feet	10 feet	None
251 to 500 gallons	10 feet	10 feet	5 feet
501 to 1,000 gallons	25 feet	25 feet	5 feet
1,001 to 2,000 gallons	30 feet	30 feet	5 feet
2,001 to 70,000 gallons	50 feet	75 feet	10 feet
70,001 to 90,000 gallons	50 feet	100 feet	10 feet

1 If the aggregate water capacity of a multi-container installation at a consumer site is 125 gallons or greater, the minimum distances shall comply with the appropriate portion of this table, applying the aggregate capacity rather than the capacity per container. If more than one installation is made, each installation shall be separated from another installation by at least 25 feet. Do not apply the MINIMUM DISTANCES BETWEEN ABOVE-GROUND CONTAINERS to such installations.

2 NOTE: The above distance requirements may be reduced to not less than 10 feet for a single container of 1,200 gallons water capacity or less, providing such a container is at least 25 feet from any other LP-Gas container of more than 125 gallons water capacity.

(iii) Containers installed for use shall not be stacked one above the other.

(iv) In industrial installations involving containers of 180,000 gallons aggregate water capacity or more, where serious mutual exposures between the container and adjacent properties prevail, firewalls or other means of special protection designed and constructed in accordance with good engineering practices are required.

(v) In the case of buildings devoted exclusively to gas manufacturing and distributing operations, the distances required by Table H-23 may be reduced provided that in no case shall containers of water capacity exceeding 500 gallons be located closer than 10 feet to such gas manufacturing and distributing buildings.

(vi) Readily ignitable material such as weeds and long dry grass shall be removed within 10 feet of any container.

(vii) The minimum separation between liquefied petroleum gas containers and flammable liquid tanks shall be 20 feet, and the minimum separation between a container and the centerline of the dike shall be 10 feet. The foregoing provision shall not apply when LP-Gas containers of 125 gallons or less capacity are installed adjacent to Class III flammable liquid tanks of 275 gallons or less capacity.

(viii) Suitable means shall be taken to prevent the accumulation of flammable liquids under adjacent liquefied petroleum gas containers, such as by diking, diversion curbs, or grading.

(ix) When dikes are used with flammable liquid tanks, no liquefied petroleum gas containers shall be located within the diked area.

(7) Container valves and container accessories. (i) Valves, fittings, and accessories connected directly to the container including primary shutoff valves, shall have a rated working pressure of at least 250 p.s.i.g. and shall be of material and design suitable for LP-Gas service. Cast iron shall not be used for container valves, fittings, and accessories. This does not prohibit the use of container valves made of malleable or nodular iron.

(ii) Connections to containers, except safety relief connections, liquid level gaging devices, and plugged openings, shall have shutoff valves located as close to the container as practicable.

(iii) Excess flow valves, where required shall close automatically at the rated flows of vapor or liquid as specified by the manufacturer. The connections or line including valves, fittings, etc., being protected by an excess flow valve shall have a greater capacity than the rated flow of the excess flow valve.

(iv) Liquid level gaging devices which are so constructed that outward flow of container contents shall not exceed that passed by a No. 54 drill size opening, need not be equipped with excess flow valves.

(v) Openings from container or through fittings attached directly on container to which pressure gage connection is made, need not be equipped with shutoff or excess flow valves if such openings are restricted to not larger than No. 54 drill size opening.

(vi) Except as provided in paragraph (c) (5) (i) (b) of this section, excess flow and back pressure check valves where required by this section shall be located inside of the container or at a point outside where the line enters the container; in the latter case, installation shall be made in such manner that any undue strain beyond the excess flow or back pressure check valve will not cause breakage between the container and such valve.

(vii) Excess flow valves shall be designed with a bypass, not to exceed a No. 50 drill size opening to allow equalization of pressures.

(viii) Containers of more than 30 gallons water capacity and less than 2,000 gallons water capacity, filled on a volumetric basis, and manufactured after December 1, 1963, shall be equipped for filling into the vapor space.

(8) Piping—including pipe, tubing, and fittings. (i) Pipe, except as provided in paragraphs (e) (5) (i) and (g) (10) (iii), of this section shall be wrought iron or steel (black or galvanized), brass, copper, or aluminum alloy. Aluminum alloy pipe shall be at least Schedule 40 in

accordance with the specifications for Aluminum Alloy Pipe, American National Standards Institute (ANSI) H38-7-1969 (ASTM B241-69), except that the use of alloy 5456 is prohibited and shall be suitably marked at each end of each length indicating compliance with American National Standard Institute Specifications. Aluminum Alloy pipe shall be protected against external corrosion when it is in contact with dissimilar metals other than galvanized steel, or its location is subject to repeated wetting by such liquids as water (except rain water), detergents, sewage, or leaking from other piping, or it passes through flooring, plaster, masonry, or insulation. Galvanized sheet steel or pipe, galvanized inside and out, may be considered suitable protection. The maximum nominal pipe size for aluminum pipe shall be three-fourths inch and shall not be used for pressures exceeding 20 p.s.i.g. Aluminum alloy pipe shall not be installed within 6 inches of the ground.

(a) Vapor piping with operating pressures not exceeding 125 p.s.i.g. shall be suitable for a working pressure of at least 125 p.s.i.g. Pipe shall be at least Schedule 40 ASTM A-53-69, Grade B Electric Resistance Welded and Electric Flash Welded Pipe or equal.

(b) Vapor piping with operating pressures over 125 p.s.i.g. and all liquid piping shall be suitable for a working pressure of at least 250 p.s.i.g. Pipe shall be at least Schedule 80 if joints are threaded or threaded and back welded. At least Schedule 40 (ASTM A-53-69 Grade B Electric Resistance Welded and Electric Flash Welded Pipe or equal) shall be used if joints are welded, or welded and flanged.

(ii) Tubing shall be seamless and of copper, brass, steel, or aluminum alloy. Copper tubing shall be of type K or L or equivalent as covered in the Specification for Seamless Copper Water Tube, ANSI H23.1-1970 (ASTM B88-69). Aluminum alloy tubing shall be of Type A or B or equivalent as covered in Specification ASTM B210-68 and shall be suitably marked every 18 inches indicating compliance with ASTM Specifications. The minimum nominal wall thickness of copper tubing and aluminum alloy tubing shall be as specified in Table H-24 and Table H-25.

TABLE H-24—WALL THICKNESS OF COPPER TUBING 1

NOTE: The standard size by which tube is designated is 1/8-inch smaller than its nominal outside diameter.

Standard size (inches)	Nominal O.D. (inches)	Nominal wall thickness (inches)	
		Type K	Type L
1/8	0.375	0.035	0.030
1/4	0.500	0.049	0.035
3/8	0.625	0.049	0.040
1/2	0.750	0.049	0.042
5/8	0.875	0.055	0.045
3/4	1.125	0.055	0.050
7/8	1.375	0.055	0.055
1	1.625	0.072	0.060
1 1/8	2.125	0.083	0.070

1 Based on data in Specification for Seamless Copper Water Tube, ANSI H23.1-1970 (ASTM B-88-69).

TABLE H-25—WALL THICKNESS OF ALUMINUM ALLOY TUBES¹

Outside diameter (inches)	Nominal wall thickness (inches)	
	Type A	Type B
1/2	0.035	0.035
3/4	0.035	0.035
1	0.035	0.035
1 1/4	0.035	0.035

¹ Based on data in Standard Specification for Aluminum-Alloy Drawn Seamless Cooled Tubes for Special Purpose Applications, ASTM B310-68.

Aluminum alloy tubing shall be protected against external corrosion when it is in contact with dissimilar metals other than galvanized steel, or its location is subject to repeated wetting by liquids such as water (except rainwater), detergents, sewage, or leakage from other piping, or it passes through flooring, plaster, masonry, or insulation. Galvanized sheet steel or pipe, galvanized inside and out, may be considered suitable protection. The maximum outside diameter for aluminum alloy tubing shall be three-fourths inch and shall not be used for pressures exceeding 20 p.s.i.g. Aluminum alloy tubing shall not be installed within 6 inches of the ground.

(iii) In systems where the gas in liquid form without pressure reduction enters the building, only heavy walled seamless brass or copper tubing with an internal diameter not greater than three thirty-seconds inch, and a wall thickness of not less than three sixty-fourths inch shall be used. This requirement shall not apply to research and experimental laboratories, buildings, or separate fire divisions of buildings used exclusively for housing internal combustion engines, and to commercial gas plants or bulk stations where containers are charged, nor to industrial vaporizer buildings, nor to buildings, structures, or equipment under construction or undergoing major renovation.

(iv) Pipe joints may be screwed, flanged, welded, soldered, or brazed with a material having a melting point exceeding 1,000° F. Joints on seamless copper, brass, steel, or aluminum alloy gas tubing shall be made by means of approved gas tubing fittings, or soldered or brazed with a material having a melting point exceeding 1,000° F.

(v) For operating pressures of 125 p.s.i.g. or less, fittings shall be designed for a pressure of at least 125 p.s.i.g. For operating pressures above 125 p.s.i.g., fittings shall be designed for a minimum of 250 p.s.i.g.

(vi) The use of threaded cast iron pipe fittings such as elbows, tees, crosses, couplings, and unions is prohibited. Aluminum alloy fittings shall be used with aluminum alloy pipe and tubing. Insulated fittings shall be used where aluminum alloy pipe or tubing connects with a dissimilar metal.

(vii) Strainers, regulators, meters, compressors, pumps, etc., are not to be considered as pipe fittings. This does not prohibit the use of malleable, nodular, or higher strength gray iron for such equipment.

(viii) All materials such as valve seats, packing, gaskets, diaphragms, etc., shall be of such quality as to be resistant to the action of liquefied petroleum gas under the service conditions to which they are subjected.

(ix) All piping, tubing, or hose shall be tested after assembly and proved free from leaks at not less than normal operating pressures. After installation, piping and tubing of all domestic and commercial systems shall be tested and proved free of leaks using a manometer or equivalent device that will indicate a drop in pressure. Test shall not be made with a flame.

(x) Provision shall be made to compensate for expansion, contraction, jarring, and vibration, and for settling. This may be accomplished by flexible connections.

(xi) Piping outside buildings may be buried, above ground, or both, but shall be well supported and protected against physical damage. Where soil conditions warrant, all piping shall be protected against corrosion. Where condensation may occur, the piping shall be pitched back to the container, or suitable means shall be provided for revaporization of the condensate.

(9) *Hose specifications.* (i) Hose shall be fabricated of materials that are resistant to the action of LP-Gas in the liquid and vapor phases. If wire braid is used for reinforcing the hose, it shall be of corrosion-resistant material such as stainless steel.

(ii) Hose subject to container pressure shall be marked "LP-Gas" or "LPG" at not greater than 10-foot intervals.

(iii) Hose subject to container pressure shall be designed for a bursting pressure of not less than 1,250 p.s.i.g.

(iv) Hose subject to container pressure shall have its correctness as to design construction and performance determined by being listed (see § 1910.110 (a) (15)).

(v) Hose connections subject to container pressure shall be capable of withstanding, without leakage, a test pressure of not less than 500 p.s.i.g.

(vi) Hose and hose connections on the low-pressure side of the regulator or reducing valve shall be designed for a bursting pressure of not less than 125 p.s.i.g. or five times the set pressure of the relief devices protecting that portion of the system, whichever is higher.

(vii) Hose may be used on the low-pressure side of regulators to connect to other than domestic and commercial gas appliances under the following conditions:

(a) The appliances connected with hose shall be portable and need a flexible connection.

(b) For use inside buildings the hose shall be of minimum practical length, but shall not exceed 6 feet except as provided in paragraph (c) (5) (i) (f) of this section and shall not extend from one room to another, nor pass through any walls, partitions, ceilings, or floors. Such hose shall not be concealed from view or used in a concealed location. For

use outside of buildings, the hose may exceed this length but shall be kept as short as practical.

(c) The hose shall be approved and shall not be used where it is likely to be subjected to temperatures above 125° F. The hose shall be securely connected to the appliance and the use of rubber slip ends shall not be permitted.

(d) The shutoff valve for an appliance connected by hose shall be in the metal pipe or tubing and not at the appliance end of the hose. When shutoff valves are installed close to each other, precautions shall be taken to prevent operation of the wrong valve.

(e) Hose used for connecting to wall outlets shall be protected from physical damage.

(10) *Safety devices.* (i) Every container except those constructed in accordance with DOT specifications and every vaporizer (except motor fuel vaporizers and except vaporizers described in subparagraph (11) (ii) (c) of this paragraph and paragraph (d) (4) (v) (a) of this section) whether heated by artificial means or not, shall be provided with one or more safety relief valves of spring-loaded or equivalent type. These valves shall be arranged to afford free vent to the outer air with discharge not less than 6 feet horizontally away from any opening into the building which is below such discharge. The rate of discharge shall be in accordance with the requirements of subdivision (ii) of this subparagraph or subdivision (iii) of this subparagraph in the case of vaporizers.

(ii) Minimum required rate of discharge in cubic feet per minute of air at 120 percent of the maximum permitted start to discharge pressure for safety relief valves to be used on containers other than those constructed in accordance with DOT specification shall be as follows:

Surface area (sq. ft.)	Flow rate CFM air
20 or less	626
25	751
30	872
35	990
40	1,100
45	1,220
50	1,330
55	1,430
60	1,540
65	1,640
70	1,750
75	1,850
80	1,950
85	2,050
90	2,150
95	2,240
100	2,340
105	2,440
110	2,530
115	2,630
120	2,720
125	2,810
130	2,900
135	2,990
140	3,080
145	3,170
150	3,260
155	3,350
160	3,440

TABLE H-26

Surface area (sq. ft.)	Flow rate (CFM)
100	3,500
125	3,600
150	3,700
175	3,800
200	3,900
225	4,000
250	4,100
275	4,200
300	4,300
325	4,400
350	4,500
375	4,600
400	4,700
425	4,800
450	4,900
475	5,000
500	5,100
525	5,200
550	5,300
575	5,400
600	5,500
625	5,600
650	5,700
675	5,800
700	5,900
725	6,000
750	6,100
775	6,200
800	6,300
825	6,400
850	6,500
875	6,600
900	6,700
925	6,800
950	6,900
975	7,000
1,000	7,100
1,050	7,200
1,100	7,300
1,150	7,400
1,200	7,500
1,250	7,600
1,300	7,700
1,350	7,800
1,400	7,900
1,450	8,000
1,500	8,100
1,550	8,200
1,600	8,300
1,650	8,400
1,700	8,500
1,750	8,600
1,800	8,700
1,850	8,800
1,900	8,900
1,950	9,000
2,000	9,100

Surface area = total outside surface area of container in square feet.

When the surface area is not stamped on the nameplate or when the marking is not legible, the area can be calculated by using one of the following formulas:

(1) Cylindrical container with hemispherical heads:

$$\text{Area} = \text{Overall length} \times \text{outside diameter} \times 3.1416$$

(2) Cylindrical container with other than hemispherical heads:

$$\text{Area} = (\text{Overall length} + 0.5 \text{ outside diameter}) \times \text{outside diameter} \times 3.1416$$

NOTE: This formula is not exact, but will give results within the limits of practical accuracy for the sole purpose of sizing relief valves.

(3) Spherical container:

$$\text{Area} = \text{Outside diameter squared} \times 3.1416$$

Flow Rate-CFM Air = Required flow capacity

In cubic feet per minute of air at standard conditions, 60° F. and atmospheric pressure (14.7 p.s.i.a.).

The rate of discharge may be interpolated for intermediate values of surface area. For containers with total outside surface area greater than 2,000 square feet, the required flow rate can be calculated using the formula, Flow Rate-CFM Air = 39.827 A^{0.825}.

A = total outside surface area of the container in square feet.

Valves not marked "Air" have flow rate marking in cubic feet per minute of liquefied petroleum gas. These can be converted to ratings in cubic feet per minute of air by multiplying the liquefied petroleum gas ratings by factors listed below. Air flow ratings can be converted to ratings in cubic feet per minute of liquefied petroleum gas by dividing the air ratings by the factors listed below.

AIR CONVERSION FACTORS

Container type	100	125	150	175	200
Air conversion factor	1.183	1.183	1.183	1.095	1.095

(iii) Minimum Required Rate of Discharge for Safety Relief Valves for Liquefied Petroleum Gas Vaporizers (Steam Heated, Water Heated, and Direct Fired).

The minimum required rate of discharge for safety relief valves shall be determined as follows:

(a) Obtain the total surface area by adding the surface area of vaporizer shell in square feet directly in contact with LP-Gas and the heat exchanger surface area in square feet directly in contact with LP-Gas.

(b) Obtain the minimum required rate of discharge in cubic feet of air per minute, at 60° F. and 14.7 p.s.i.a. from subdivision (ii) of this subparagraph, for this total surface area.

(iv) Container and vaporizer safety relief valves shall be set to start-to-discharge, with relation to the design pressure of the container, in accordance with Table H-26.

TABLE H-26

Containers	Minimum (percent)	Maximum (percent)
ASME Code, Par. U-28, U-29—1940 and earlier editions	110	125
ASME Code, Par. U-28, U-29—1940 edition	85	100
ASME Code—1950, 1955, 1960, 1965, 1970 editions	85	100
API—API 520 Code—all editions	85	100
DOT—As prescribed in 49 CFR Chapter I		

Manufacturers of safety relief valves are allowed a plus tolerance not exceeding 10 percent of the set pressure marked on the valve.

(v) Safety relief devices used with systems employing containers other than those constructed according to DOT specifications shall be so constructed as to discharge at not less than the rates shown in subdivision (ii) of this subparagraph, before the pressure is in excess of 120 percent of the maximum (not including the 10 percent referred to in subdivision (iv) of this subparagraph) permitted start to discharge pressure setting of the device.

(vi) In certain conditions sufficiently sustained high temperatures prevail which require the use of a lower vapor pressure product to be stored or the use of a higher designed pressure vessel in order to prevent the safety valves opening as the result of these temperatures. As an alternative the tanks may be protected by cooling devices such as by spraying, by shading, or other effective means.

(vii) Safety relief valves shall be arranged so that the possibility of tampering will be minimized. If pressure setting or adjustment is external, the relief valves shall be provided with approved means for sealing adjustment.

(viii) Shutoff valves shall not be installed between the safety relief devices and the container, or the equipment or piping to which the safety relief device is connected except that a shutoff valve may be used where the arrangement of this valve is such that full required capacity flow through the safety relief device is always afforded.

(ix) Safety relief valves shall have direct communication with the vapor space of the container at all times.

(x) Each container safety relief valve used with systems covered by paragraphs (d), (e), (g), and (h) of this section, except as provided in paragraph (e)(3) (iii) of this section shall be plainly and permanently marked with the following:

"Container Type" of the pressure vessel on which the valve is designed to be installed; the pressure in p.s.i.g. at which the valve is set to discharge; the actual rate of discharge of the valve in cubic feet per minute of air at 60° F. and 14.7 p.s.i.a.; and the manufacturer's name and catalog number, for example: "7200-250-4050 AIR—indicating that the valve is suitable for use on a Type 200 container, that it is set to start to discharge at 250 p.s.i.g.; and that its rate of discharge is 4,050 cubic feet per minute of air as determined in subdivision (ii) of this subparagraph.

(xi) Safety relief valve assemblies, including their connections, shall be of sufficient size so as to provide the rate of flow required for the container on which they are installed.

(xii) A hydrostatic relief valve shall be installed between each pair of shutoff valves on liquefied petroleum gas liquid piping so as to relieve into a safe atmosphere. The start-to-discharge pressure setting of such relief valves shall not be in excess of 500 p.s.i.g. The minimum setting on relief valves installed in piping connected to other than DOT containers shall not be lower than 140 percent of the container relief valve setting and in piping connected to DOT containers not lower than 400 p.s.i.g. Such a relief valve should not be installed in the pump discharge if the same protection can be provided by installing the relief valve in the suction piping. The start-to-discharge pressure setting of such a relief valve, if installed on the discharge side of a pump, shall be greater than the maximum pressure permitted by the recirculation device in the system.

(xiii) The discharge from any safety relief device shall not terminate in or beneath any building, except relief devices covered by subparagraphs (6) (i) (a)-(f) of this paragraph, or paragraphs (c) (4) (i) or (5) of this section.

(xiv) Container safety relief devices and regulator relief vents shall be located not less than five (5) feet in any direction from air openings into sealed combustion system appliances or mechanical ventilation air intakes.

(1) Vaporizer and housing. (i) Indirect fired vaporizers utilizing steam, water, or other heating medium shall be constructed and installed as follows:

(a) Vaporizers shall be constructed in accordance with the requirements of subparagraph (3) (i)-(iii) of this paragraph and shall be permanently marked as follows:

(1) With the code marking signifying the specifications to which the vaporizer is constructed.

(2) With the allowable working pressure and temperature for which the vaporizer is designed.

(3) With the sum of the outside surface area and the inside heat exchange surface area expressed in square feet.

(4) With the name or symbol of the manufacturer.

(b) Vaporizers having an inside diameter of 6 inches or less exempted by the ASME Unfired Pressure Vessel Code, Section VIII of the ASME Boiler and Pressure Vessel Code—1968 shall have a design pressure not less than 250 p.s.i.g. and need not be permanently marked.

(c) Heating or cooling coils shall not be installed inside a storage container.

(d) Vaporizers may be installed in buildings, rooms, sheds, or lean-tos used exclusively for gas manufacturing or distribution, or in other structures of light, noncombustible construction or equivalent, well ventilated near the floor line and roof.

When vaporizing and/or mixing equipment is located in a structure or building not used exclusively for gas manufacturing or distribution, either attached to or within such a building, such structure or room shall be separated from the remainder of the building by a wall designed to withstand a static pressure of at least 100 pounds per square foot. This wall shall have no openings or pipe or conduit passing through it. Such structure or room shall be provided with adequate ventilation and shall have a roof or at least one exterior wall of lightweight construction.

(e) Vaporizers shall have, at or near the discharge, a safety relief valve providing an effective rate of discharge in accordance with subparagraph (10)(iii) of this paragraph, except as provided in paragraph (d) (4) (v) (a), of this section.

(f) The heating medium lines into and leaving the vaporizer shall be provided with suitable means for preventing the flow of gas into the heat systems in the event of tube rupture in the vaporizer. Vaporizers shall be provided with suitable automatic means to prevent liquid passing through the vaporizers to the gas discharging pipe.

(g) The device that supplies the necessary heat for producing steam, hot water, or other heating medium may be installed in a building, compartment, room, or lean-to which shall be ventilated near the floorline and roof to the outside. The device location shall be separated from all compartments or rooms containing liquefied petroleum gas vaporizers, pumps, and central gas mixing devices by a well designed to withstand a static pressure of at least 100 pounds per square foot. This wall shall have no openings or pipes or conduit passing through it. This requirement does not apply to the domestic water heaters which may supply heat for a vaporizer in a domestic system.

(h) Gas-fired heating systems supplying heat exclusively for vaporization purposes shall be equipped with automatic safety devices to shut off the flow of gas to main burners, if the pilot light should fail.

(i) Vaporizers may be an integral part of a fuel storage container directly connected to the liquid section or gas section or both.

(j) Vaporizers shall not be equipped with fusible plugs.

(k) Vaporizer houses shall not have unprotected drains to sewers or sump pits.

(1) Atmospheric vaporizers employing heat from the ground or surrounding air shall be installed as follows:

(a) Buried underground, or

(b) Located inside the building close to a point at which pipe enters the building provided the capacity of the unit does not exceed 1 quart.

(c) Vaporizers of less than 1 quart capacity heated by the ground or surrounding air, need not be equipped with safety relief valves provided that adequate tests demonstrate that the assembly is safe without safety relief valves.

(iii) Direct gas-fired vaporizers shall be constructed, marked, and installed as follows:

(a) (1) In accordance with the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code—1968 that are applicable to the maximum working conditions for which the vaporizer is designed.

(2) With the name of the manufacturer; rated BTU input to the burner; the area of the heat exchange surface in square feet; the outside surface of the vaporizer in square feet; and the maximum vaporizing capacity in gallons per hour.

(b) (1) Vaporizers may be connected to the liquid section or the gas section of the storage container, or both; but in any case there shall be at the container a manually operated valve in each connection to permit completely shutting off when desired, of all flow of gas or liquid from container to vaporizer.

(2) Vaporizers with capacity not exceeding 35 gallons per hour shall be located at least 5 feet from container shutoff valves. Vaporizers having capacity of more than 35 gallons but not exceeding 100 gallons per hour shall be

located at least 10 feet from the container shutoff valves. Vaporizers having a capacity greater than 100 gallons per hour shall be located at least 15 feet from container shutoff valves.

(c) Vaporizers may be installed in buildings, rooms, housings, sheds, or lean-tos used exclusively for vaporizing or mixing of liquefied petroleum gas. Vaporizing housing structures shall be of noncombustible construction, well ventilated near the floorline and the highest point of the roof. When vaporizer and/or mixing equipment is located in a structure or room attached to or within a building, such structure or room shall be separated from the remainder of the building by a wall designed to withstand a static pressure of at least 100 pounds per square foot. This wall shall have no openings or pipes or conduit passing through it. Such structure or room shall be provided with adequate ventilation, and shall have a roof or at least one exterior wall of lightweight construction in accordance with DOT specifications.

(d) Vaporizers shall have at or near the discharge, a safety relief valve providing an effective rate of discharge in accordance with subparagraph (10)(iii) of this paragraph. The relief valve shall be so located as not to be subjected to temperatures in excess of 140° F.

(e) Vaporizers shall be provided with suitable automatic means to prevent liquid passing from the vaporizer to the gas discharge piping of the vaporizer.

(f) Vaporizers shall be provided with means for manually turning off the gas to the main burner and pilot.

(g) Vaporizers shall be equipped with automatic safety devices to shut off the flow of gas to main burners if the pilot light should fail. When the flow through the pilot exceeds 2,000 B.t.u. per hour, the pilot also shall be equipped with an automatic safety device to shut off the flow of gas to the pilot should the pilot flame be extinguished.

(h) Pressure regulating and pressure reducing equipment if located within 10 feet of a direct fired vaporizer shall be separated from the open flame by a substantially airtight noncombustible partition or partitions.

(i) Except as provided in (c) of this subdivision, the following minimum distances shall be maintained between direct fired vaporizers and the nearest important building or group of buildings or line of adjoining property which may be built upon:

Ten feet for vaporizers having a capacity of 15 gallons per hour or less vaporizing capacity.

Twenty-five feet for vaporizers having a vaporizing capacity of 16 to 100 gallons per hour.

Fifty feet for vaporizers having a vaporizing capacity exceeding 100 gallons per hour.

(j) Direct fired vaporizers shall not raise the product pressure above the design pressure of the vaporizer equipment nor shall they raise the product pressure within the storage container above the pressure shown in the second column of Table 30-H.

(k) Vaporizers shall not be provided with fusible plugs.

These vaporizers shall not have exposed flames to covers or pump pits. Vaporizer gas-fired tank heaters shall be constructed and installed as follows:

(a) Direct gas-fired tank heaters, and tanks to which they are applied, shall only be installed above ground.

(b) Tank heaters shall be permanently marked with the name of the manufacturer, the rated B.T.U. input to the burner, and the maximum vaporizing capacity in gallons per hour.

(c) Tank heaters may be an integral part of a fuel storage container directly connected to the container liquid section, or vapor section, or both.

(d) Tank heaters shall be provided with a means for manually turning off the gas to the main burner and pilot.

(e) Tank heaters shall be equipped with an automatic safety device to shut off the flow of gas to main burners, if the pilot light should fail. When flow through pilot exceeds 3,000 B.T.U. per hour, the pilot also shall be equipped with an automatic safety device to shut off the flow of gas to the pilot should the pilot flame be extinguished.

(f) Pressure regulating and pressure reducing equipment if located within 10 feet of a direct fired tank heater shall be separated from the open flame by a substantially airtight noncombustible partition.

(g) The following minimum distances shall be maintained between a storage tank heated by a direct fired tank heater and the nearest important building or group of buildings or line of adjoining property which may be built upon:

Ten feet for storage containers of less than 500 gallons water capacity.

Twenty-five feet for storage containers of 500 to 1,200 gallons water capacity.

Fifty feet for storage containers of over 1,200 gallons water capacity.

(h) No direct fired tank heater shall raise the product pressure within the storage container over 75 percent of the pressure set out in the second column of Table H-30.

(i) The vaporizer section of vaporizer-burners used for dehydrators or dryers shall be located outside of buildings; they shall be constructed and installed as follows:

(a) Vaporizer-burners shall have a minimum design pressure of 250 p.s.i.g. with a factor of safety of five.

(b) Manually operated positive shut-off valves shall be located at the containers to shut off all flow to the vaporizer-burners.

(c) Minimum distances between storage containers and vaporizer-burners shall be as follows:

Water capacity per container (gallons)	Minimum distances (feet)
Less than 501.....	10
501 to 2,000.....	25
Over 2,000.....	50

(d) The vaporizer section of vaporizer-burners shall be protected by a hydrostatic relief valve. The relief valve shall be located so as not to be subjected to temperatures in excess of 140° F. The start-to-discharge pressure setting shall

be such as to protect the components involved, but not less than 250 p.s.i.g. The discharge shall be directed upward and away from component parts of the equipment and away from operating personnel.

(e) Vaporizer-burners shall be provided with means for manually turning off the gas to the main burner and pilot.

(f) Vaporizer-burners shall be equipped with automatic safety devices to shut off the flow of gas to the main burner and pilot in the event the pilot is extinguished.

(g) Pressure regulating and control equipment shall be located or protected so that the temperatures surrounding this equipment shall not exceed 140° F. except that equipment components may be used at higher temperatures if designed to withstand such temperatures.

(h) Pressure regulating and control equipment when located downstream of the vaporizer shall be designed to withstand the maximum discharge temperature of the vapor.

(i) The vaporizer section of vaporizer-burners shall not be provided with fusible plugs.

(j) Vaporizer coils or jackets shall be made of ferrous metal or high temperature alloys.

(k) Equipment utilizing vaporizer-burners shall be equipped with automatic shutoff devices upstream and downstream of the vaporizer section connected so as to operate in the event of excessive temperature, flame failure, and, if applicable, insufficient airflow.

(12) *Filling densities.* (i) The "filling density" is defined as the percent ratio of the weight of the gas in a container to the weight of water the container will hold at 60° F. All containers shall be filled according to the filling densities shown in Table H-37.

TABLE H-37—MAXIMUM PERMITTED FILLING DENSITY

Specific gravity at 60° F. (U.S. C.)	Aboveground containers		Underground containers, all capacities
	9 to 1,200 U.S. gal. (1,000 imp. gal., 4,546 liters) total water cap.	Over 1,200 U.S. gal. (1,000 imp. gal., 4,546 liters) total water cap.	
0.400-0.500	Percent 41	Percent 41	Percent 45
0.501-0.610	42	43	46
0.611-0.710	43	44	47
0.711-0.820	44	47	48
0.821-0.930	45	48	49
0.931-1.040	46	49	50
1.041-1.150	47	50	51
1.151-1.260	48	51	52
1.261-1.370	49	52	53
1.371-1.480	50	53	54
1.481-1.590	51	54	55
1.591-1.700	52	55	56
1.701-1.800	53	56	57

(ii) Except as provided in subdivision (iii) of this subparagraph, any container including mobile cargo tanks and portable tank containers regardless of size or construction, shipped under DOT jurisdiction or constructed in accordance with 49 CFR Chapter I Specifications shall be charged according to 49 CFR Chapter I requirements.

(iii) Portable containers not subject to DOT jurisdiction (such as, but not limited to, motor fuel containers on industrial and lift trucks, and farm trac-

tors covered in paragraph (e) of this section, or containers recharged at the installation) may be filled either by weight, or by volume using a fixed length dip tube gaging device.

(13) *LP-Gas in buildings.* (i) Vapor shall be piped into buildings at pressures in excess of 20 p.s.i.g. only if the buildings or separate areas thereof, (a) are constructed in accordance with this section; (b) are used exclusively to house equipment for vaporization, pressure reduction, gas mixing, gas manufacturing, or distribution, or to house internal combustion engines, industrial processes, research and experimental laboratories, or equipment and processes using such gas and having similar hazard; (c) buildings, structures, or equipment under construction or undergoing major renovation.

(ii) Liquid may be permitted in buildings as follows:

(a) Buildings, or separate areas of buildings, used exclusively to house equipment for vaporization, pressure reduction, gas mixing, gas manufacturing, or distribution, or to house internal combustion engines, industrial processes, research and experimental laboratories, or equipment and processes using such gas and having similar hazard; and when such buildings, or separate areas thereof are constructed in accordance with this section.

(b) Buildings, structures, or equipment under construction or undergoing major renovation provided the temporary piping meets the following conditions:

(i) Liquid piping inside the building shall conform to the requirements of subparagraph (8) of this paragraph, and shall not exceed three-fourths the iron pipe size. Copper tubing with an outside diameter of three-fourths inch or less may be used provided it conforms to Type K of Specifications for Seamless Water Tube, ANSI H23.1-1970 (ASTM B88-69) (see Table H-24). All such piping shall be protected against construction hazards. Liquid piping inside buildings shall be kept to a minimum. Such piping shall be securely fastened to walls or other surfaces so as to provide adequate protection from breakage and so located as to subject the liquid line to lowest ambient temperatures.

(2) A shutoff valve shall be installed in each intermediate branch line where it takes off the main line and shall be readily accessible. A shutoff valve shall also be placed at the appliance end of the intermediate branch line. Such shutoff valve shall be upstream of any flexible connector used with the appliance.

(3) Suitable excess flow valves shall be installed in the container outlet line supplying liquid LP-Gas to the building. A suitable excess flow valve shall be installed immediately downstream of each shutoff valve. Suitable excess flow valves shall be installed where piping size is reduced and shall be sized for the reduced size piping.

(4) Hydrostatic relief valves shall be installed in accordance with subparagraph (10) (iii) of this paragraph.

(5) The use of hose to carry liquid between the container and the building or at any point in the liquid line, except at the appliance connector, shall be prohibited.

(6) Where flexible connectors are necessary for appliance installation, such connectors shall be as short as practicable and shall comply with subparagraph (8) (ii) or (9) of this paragraph.

(7) Release of fuel when any section of piping or appliances is disconnected shall be minimized by either of the following methods:

(i) Using an approved automatic quick-closing coupling (a type closing in both directions when coupled in the fuel line); or

(ii) Closing the valve nearest to the appliance and allowing the appliance to operate until the fuel in the line is consumed.

(iii) Portable containers shall not be taken into buildings except as provided in subparagraph (6) (i) of this paragraph.

(14) *Transfer of Liquids.* The employer shall assure that (i) at least one attendant shall remain close to the transfer connection from the time the connections are first made until they are finally disconnected, during the transfer of the product.

(ii) Containers shall be filled or used only upon authorization of the owner.

(iii) Containers manufactured in accordance with specifications of 49 CFR Part 178 and authorized by 49 CFR Chapter 1 as a "single trip" or "non-refillable container" shall not be refilled or reused in LP-Gas service.

(iv) Gas or liquid shall not be vented to the atmosphere to assist in transferring contents of one container to another, except as provided in paragraph (e) (5) (iv) of this section and except that this shall not preclude the use of listed pump utilizing LP-Gas in the vapor phase as a source of energy and venting such gas to the atmosphere at a rate not to exceed that from a No. 31 drill size opening and provided that such venting and liquid transfer shall be located not less than 50 feet from the nearest important building.

(v) Filling of fuel containers for industrial trucks or motor vehicles from industrial bulk storage containers shall be performed not less than 10 feet from the nearest important masonry-walled building or not less than 25 feet from the nearest important building or other construction and, in any event, not less than 25 feet from any building opening.

(vi) Filling of portable containers, containers mounted on skids, fuel containers on farm tractors, or similar applications, from storage containers used in domestic or commercial service, shall be performed not less than 50 feet from the nearest important building.

(vii) The filling connection and the vent from the liquid level gages in containers, filled at point of installation, shall not be less than 10 feet in any di-

rection from air openings into sealed combustion system appliances or mechanical ventilation air intakes.

(viii) Fuel supply containers shall be gaged and charged only in the open air or in buildings especially provided for that purpose.

(ix) The maximum vapor pressure of the product at 100° F. which may be transferred into a container shall be in accordance with paragraphs (d) (2) and (e) (3) of this section. (For DOT containers use DOT requirements.)

(x) Marketers and users shall exercise precaution to assure that only those gases for which the system is designed, examined, and listed, are employed in its operation, particularly with regard to pressures.

(xi) Pumps or compressors shall be designed for use with LP-Gas. When compressors are used they shall normally take suction from the vapor space of the container being filled and discharge to the vapor space of the container being emptied.

(xii) Pumping systems, when equipped with a positive displacement pump, shall include a recirculating device which shall limit the differential pressure on the pump under normal operating conditions to the maximum differential pressure rating of the pump. The discharge of the pumping system shall be protected so that pressure does not exceed 350 p.s.i.g. If a recirculation system discharges into the supply tank and contains a manual shutoff valve, an adequate secondary safety recirculation system shall be incorporated which shall have no means of rendering it inoperative. Manual shutoff valves in recirculation systems shall be kept open except during an emergency or when repairs are being made to the system.

(xiii) When necessary, unloading piping or hoses shall be provided with suitable bleeder valves for relieving pressure before disconnection.

(xvi) Agricultural air moving equipment, including crop dryers, shall be shut down when supply containers are being filled unless the air intakes and sources of ignition on the equipment are located 50 feet or more from the container.

(xv) Agricultural equipment employing open flames or equipment with integral containers, such as flame cultivators, weed burners, and, in addition, tractors, shall be shut down during refueling.

(15) *Tank car or transport truck loading or unloading points and operations.* (i) The track of tank car siding shall be relatively level.

(ii) A "Tank Car Connected" sign, as covered by DOT rules, shall be installed at the active end or ends of the siding while the tank car is connected.

(iii) While cars are on sidetrack for loading or unloading, the wheels at both ends shall be blocked on the rails.

(iv) The employer shall insure that an employee is in attendance at all times while the tank car, cars, or trucks are being loaded or unloaded.

(v) A backflow check valve, excess-flow valve, or a shutoff valve with means of remote closing, to protect against uncontrolled discharge of LP-Gas from storage tank piping shall be installed close to the point where the liquid piping and hose or swing joint pipe is connected.

(vi) Except as provided in subdivision (vii) of this subparagraph, when the size (diameter) of the loading or unloading hoses and/or piping is reduced below the size of the tank car or transport truck loading or unloading connections, the adaptors to which lines are attached shall be equipped with either a backflow check valve, a properly sized excess flow valve, or shutoff valve with means of remote closing, to protect against uncontrolled discharge from the tank car or transport truck.

(vii) The requirement of subdivision (vi) of this subparagraph shall not apply if the tank car or transport is equipped with a quick-closing internal valve that can be remotely closed.

(viii) The tank car or transport truck loading or unloading point shall be located with due consideration to the following:

(a) Proximity to railroads and highway traffic.

(b) The distance of such unloading or loading point from adjacent property.

(c) With respect to buildings on installer's property.

(d) Nature of occupancy.

(e) Topography.

(f) Type of construction of buildings.

(g) Number of tank cars or transport trucks that may be safely loaded or unloaded at one time.

(h) Frequency of loading or unloading.

(ix) Where practical, the distance of the unloading or loading point shall conform to the distances in subparagraph (6) (ii) of this paragraph.

(16) *Instructions.* Personnel performing installation, removal, operation, and maintenance work shall be properly trained in such function.

(17) *Electrical equipment and other sources of ignition.* (i) Electrical equipment and wiring shall be of a type specified by and shall be installed in accordance with Subpart S of this part, for ordinary locations except that fixed electrical equipment in classified areas shall comply with subparagraph (18) of this paragraph.

(ii) Open flames or other sources of ignition shall not be permitted in vaporizer rooms (except those housing direct-fired vaporizers), pumphouses, container charging rooms or other similar locations. Direct-fired vaporizers shall not be permitted in pumphouses or container charging rooms.

(iii) Liquefied petroleum gas storage containers do not require lightning protection.

(iv) Since liquefied petroleum gas is contained in a closed system of piping and equipment, the system need not be bonded for protection against static electrically conductive or electrically electricity.

HAZARD AREAS

Open flames (except as provided for in subparagraph (ii) of this paragraph), cutting or welding, portable electric tools, and extension lights capable of igniting LP-Gas, shall not be permitted within classified areas specified in Table H-28 unless the LP-Gas facilities have been freed of all liquid and vapor, or special precautions observed under carefully controlled conditions.

TABLE H-28

Part	Location	Extent of classified area ¹	Equipment shall be suitable for National Electrical Code, Class 1, Group D ²
A	Storage containers other than DOT cylinders.	Within 15 feet in all directions from connections, except connections otherwise covered in Table H-28.	Division 2.
B	Tank vehicle and tank car loading and unloading. ³	Within 5 feet in all directions from connections regularly made or disconnected for product transfer. Beyond 5 feet but within 15 feet in all directions from a point where connections are regularly made or disconnected and within the cylindrical volume between the horizontal equator of the sphere and grade. (See Figure H-1.)	Division 1. Division 2.
C	Gas vent openings other than those on DOT cylinders.	Within 5 feet in all directions from point of discharge.	Division 1.
D	Relief valve discharge other than those on DOT cylinders.	Beyond 5 feet but within 15 feet in all directions from point of discharge. Within direct path of discharge.	Division 2. Division 1. <i>Note</i> —Fixed electrical equipment should preferably not be installed.
E	Pumps, compressors, gas-air mixers and vaporizers other than direct fired. Indoors without ventilation.	Within 5 feet in all directions from point of discharge. Beyond 5 feet but within 15 feet in all directions from point of discharge except within the direct path of discharge.	Division 2. Division 2.
F	Service Station Dispensing Units.	Entire room and any adjacent room not separated by a gas-tight partition. Within 15 feet of the exterior side of any exterior wall or roof that is not vaportight or within 15 feet of any exterior opening. Entire room and any adjacent room not separated by a gas-tight partition. Within 15 feet in all directions from this equipment and within the cylindrical volume between the horizontal equator of the sphere and grade. (See Figure H-1.) Entire space within dispenser enclosure, and 18 inches horizontally from enclosure exterior up to an elevation 4 ft. above dispenser base. Entire pit or open space beneath dispenser. Up to 18 inches abovegrade within 20 ft. horizontally from any edge of enclosure. <i>Note:</i> For pits within this area, see Part F of this table.	Division 1. Division 2. Division 2. Division 2. Division 1. Division 2.
G	Pits or trenches containing or located beneath LP-Gas valves, pumps, compressors, regulators, and similar equipment. Without mechanical ventilation.	Entire pit or trench.	Division 1.
	With adequate mechanical ventilation.	Entire room and any adjacent room not separated by a gas-tight partition. Within 15 feet in all directions from pit or trench when located outdoors. Entire pit or trench.	Division 2. Division 2. Division 2.
H	Special buildings or rooms for storage of portable containers.	Entire room and any adjacent room not separated by a gas-tight partition. Within 15 feet in all directions from pit or trench when located outdoors.	Division 2. Division 2.
I	Pipelines and connections containing operational bleeds, drips, vents or drains.	Within 5 ft. in all directions from point of discharge.	Division 1.
J	Container filling: Indoors without ventilation. Indoors with adequate ventilation. ⁴ Outdoors in open air.	Beyond 5 ft. from point of discharge, same as Part E of this table. Entire room. Within 5 feet in all directions from connections regularly made or disconnected for product transfer. Beyond 5 feet and entire room. Within 5 feet in all directions from connections regularly made or disconnected for product transfer. Beyond 5 feet but within 15 feet in all directions from a point where connections are regularly made or disconnected and within the cylindrical volume between the horizontal equator of the sphere and grade. (See Figure H-1.)	Division 2. Division 1. Division 1. Division 2. Division 1. Division 2.

¹ The classified area shall not extend beyond an unpierced wall, roof, or solid vaportight partition.

² See Subpart 8 of this part.

³ When classifying extent of hazardous area, consideration shall be given to possible variations in the spotting of tank cars and tank vehicles at the unloading points and the effect these variations of actual spotting point may have on the point of connection.

⁴ Ventilation, either natural or mechanical, is considered adequate when the concentration of the gas in a gas-air mixture does not exceed 25 percent of the lower flammable limit under normal operating conditions.

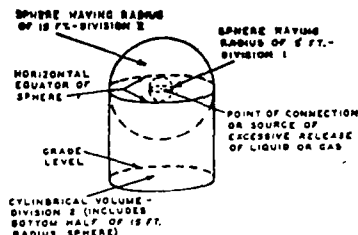


Figure H-1

(18) Fixed electrical equipment in classified areas. Fixed electrical equipment and wiring installed within classified areas specified in Table H-28 shall comply with Table H-28 and shall be installed in accordance with Subpart 8 of this part. This provision does not apply to fixed electrical equipment at residential or commercial installations of LP-Gas systems or to systems covered by paragraph (e) or (g) of this section.

(19) Liquid-level gaging device. (i) Each container manufactured after December 31, 1965, and filled on a volumetric basis shall be equipped with a fixed liquid-level gage to indicate the maximum permitted filling level as provided in subdivision (v) of this subparagraph. Each container manufactured after December 31, 1969, shall have permanently attached to the container adjacent to the fixed level gage a marking showing the percentage full that will be shown by that gage. When a variable liquid-level gage is also provided, the fixed liquid-level gage will also serve as a means for checking the variable gage. These gages shall be used in charging containers as required in subparagraph (12) of this paragraph.

(ii) All variable gaging devices shall be arranged so that the maximum liquid level for butane, for a 50-50 mixture of butane and propane, and for propane, to which the container may be charged is readily determinable. The markings indicating the various liquid levels from empty to full shall be on the system nameplate or gaging device or part may be on the system nameplate and part on the gaging device. Dials of magnetic or rotary gages shall show whether they are for cylindrical or spherical containers and whether for aboveground or underground service. The dials of gages intended for use only on aboveground containers of over 1,200 gallons water capacity shall be so marked.

(iii) Gaging devices that require bleeding of the product to the atmosphere, such as the rotary tube, fixed tube, and slip tube, shall be designed so that the bleed valve maximum opening is not larger than a No. 54 drill size, unless provided with excess flow valve.

(iv) Gaging devices shall have a design working pressure of at least 250 p.s.i.g.

(v) Length of tube or position of fixed liquid-level gage shall be designed to indicate the maximum level to which the container may be filled for the product

contained. This level shall be based on the volume of the product at 40° F. at its maximum permitted filling density for aboveground containers and at 50° F. for underground containers. The employer shall calculate the filling point for which the fixed liquid level gage shall be designed according to the method in this subdivision.

(d) It is impossible to set out in a table the length of a fixed dip tube for various capacity tanks because of the varying tank diameters and lengths and

because the tank may be installed either in a vertical or horizontal position. Knowing the maximum permitted filling volume in gallons, however, the length of the fixed tube can be determined by the use of a strapping table obtained from the container manufacturer. The length of the fixed tube should be such that when its lower end touches the surface of the liquid in the container, the contents of the container will be the maximum permitted volume as determined by the following formula:

$$\text{Water capacity (gals.) of container} \times \text{filling density}^{**} = \text{Maximum volume of LP-Gas}$$

$$\text{Specific gravity of LP-Gas} \times \text{volume correction factor}^{*} \times 100$$

*Measured at 60° F.
 **From subparagraph (12) of this paragraph "Filling Densities."
 †For aboveground containers the liquid temperature is assumed to be 40° F. and for underground containers the liquid temperature is assumed to be 50° F. To correct the liquid volumes at these temperatures to 60° F. the following factors shall be used.

(b) Formula for determining maximum volume of liquefied petroleum gas for which a fixed length of dip tube shall be set:

TABLE E-29—VOLUME CORRECTION FACTORS

Specific gravity	Aboveground	Underground
0.880	1.088	1.017
0.910	1.081	1.016
0.920	1.079	1.016
0.930	1.078	1.016
0.940	1.076	1.015
0.950	1.075	1.015
0.960	1.074	1.015
0.970	1.072	1.011
0.980	1.071	1.011
0.990	1.070	1.010

(c) The maximum volume of LP-Gas which can be placed in a container when

Example: Assume a 100-gallon total water capacity tank for aboveground storage of propane having a specific gravity of 0.510 at 60° F.

$$100 \text{ (gals.)} \times 42 \text{ (filling density from subparagraph (12) of this paragraph)} = 4200$$

$$0.510 \times 1.081 \text{ (correction factor from Table E-29)} \times 100 = 55.2$$

4200
 — = 79.8 gallons propane, the maximum amount permitted to be placed in a 100-gallon
 55.2 total water capacity aboveground container equipped with a fixed dip tube.
 Maximum volume of LP-Gas (from formula in subdivision
 (b) of this subdivision) $\times 100$

— = Maximum percent of LP-Gas

	Aboveground, pounds per gallon	Underground, pounds per gallon
Propane.....	4.37	4.31
N Butane.....	4.97	4.92

(vi) Fixed liquid-level gages used on containers other than DOT containers shall be stamped on the exterior of the gage with the letters "DT" followed by the vertical distance (expressed in inches and carried out to one decimal place) from the top of container to the end of the dip tube or to the centerline of the gage when it is located at the maximum permitted filling level. For portable containers that may be filled in the horizontal and/or vertical position the letters "DT" shall be followed by "V" with the vertical distance from the top of the container to the end of the dip tube for

determining the length of the dip tube expressed as a percentage of total water content of the container is calculated by the following formula.

(d) The maximum weight of LP-Gas which may be placed in a container for determining the length of a fixed dip tube is determined by multiplying the maximum volume of liquefied petroleum gas obtained by the formula in (b) of this subdivision by the pounds of liquefied petroleum gas in a gallon at 40° F. for aboveground and at 50° F. for underground containers. For example, typical pounds per gallon are specified below:

vertical filling and with "H" followed by the proper distance for horizontal filling. For DOT containers the stamping shall be placed both on the exterior of the gage and on the container. On aboveground or cargo containers where the gages are positioned at specific levels, the marking may be specified in percent of total tank contents and the marking shall be stamped on the container.

(vii) Gage glasses of the columnar type shall be restricted to charging plants where the fuel is withdrawn in the liquid phase only. They shall be equipped with valves having metallic handwheels, with excess flow valves, and with extra-heavy glass adequately protected with a metal housing applied by the gage manufacturer. They shall be shielded against the direct rays of the sun. Gage glasses of the columnar type are prohibited on tank trucks, and on

motor fuel tanks, and on containers used in domestic, commercial, and industrial installations.

(viii) Gaging devices of the float or equivalent type which do not require flow for their operation and having connections extending to a point outside the container do not have to be equipped with excess flow valves provided the piping and fittings are adequately designed to withstand the container pressure and are properly protected against physical damage and breakage.

(20) Requirements for appliances. (i) Except as provided in subdivision (ii) of this subparagraph, new commercial and industrial gas consuming appliances shall be approved.

(ii) Any appliance that was originally manufactured for operation with a gaseous fuel other than LP-Gas and is in good condition may be used with LP-Gas only after it is properly converted, adapted, and tested for performance with LP-Gas before the appliance is placed in use.

(iii) Unattended heaters used inside buildings for the purpose of animal or poultry production or care shall be equipped with an approved automatic device designed to shut off the flow of gas to the main burners, and shut if used, in the event of flame extinguishment.

(iv) All commercial, industrial, and agricultural appliances or equipment shall be installed in accordance with the requirements of this section and in accordance with the following:

(a) Domestic and commercial appliances—NFPA 54-1969, Standard for the Installation of Gas Appliances and Gas Piping.

(b) Industrial appliances—NFPA 54A-1969, Standard for the Installation of Gas Piping and Gas Equipment on Industrial Premises and Certain Other Premises.

(c) Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines—NFPA 37-1970.

(d) Standard for the Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment, NFPA 96-1970.

(e) Cylinder systems—(1) Application. This paragraph applies specifically to systems utilizing containers constructed in accordance with DOT Specifications. All requirements of paragraph (b) of this section apply to this paragraph unless otherwise noted in paragraph (b) of this section.

(2) Marking of containers. (i) Containers shall be marked in accordance with DOT regulations. Additional markings not in conflict with DOT regulations may be used.

(ii) Except as provided in subdivision (iii) of this subparagraph each container shall be marked with its water capacity in pounds or other identified unit of weight.

(iii) If a container is filled and maintained only by the owner or his representative and if the water capacity of each container is identified by a code.

compliance with subdivision (H) of this subparagraph is not required.

(iv) Each container shall be marked with its tare weight in pounds or other identified unit of weight including all permanently attached fittings but not the cap.

(3) *Description of a system.* A system shall include the container base or bracket, containers, container valves, connectors, manifold valve assembly, regulators, and relief valves.

(4) *Containers and regulating equipment installed outside of buildings or structures.* (i) Containers shall not be buried below ground. However, this shall not prohibit the installation in a compartment or recess below grade level, such as a niche in a slope or terrace wall which is used for no other purpose, providing that the container and regulating equipment are not in contact with the ground and the compartment or recess is drained and ventilated horizontally to the outside air from its lowest level with the outlet at least 3 feet away from any building opening which is below the level of such outlet.

Except as provided in paragraph (b) (10) (iii) of this section, the discharge from safety relief devices shall be located not less than 3 feet horizontally away from any building opening which is below the level of such discharge and shall not terminate beneath any building unless such space is well ventilated to the outside and is not enclosed on more than two sides.

(ii) Containers shall be set upon firm foundation or otherwise firmly secured; the possible effect on the outlet piping of settling shall be guarded against by a flexible connection or special fitting.

(5) *Containers and equipment used inside of buildings or structures.* (i) When operational requirements make portable use of containers necessary and their location outside of buildings or structure is impracticable, containers and equipment are permitted to be used inside of buildings or structures in accordance with (a) through (i) of this subdivision, and, in addition, such other provisions of this subparagraph as are applicable to the particular use or occupancy.

(a) Containers in use shall mean connected for use.

(b) *Systems utilizing containers having a water capacity greater than 2½ pounds (nominal 1 pound LP-Gas capacity).* shall be equipped with excess flow valves. Such excess flow valves shall be either integral with the container valves or in the connections to the container valve outlets. In either case, an excess flow valve shall be installed in such a manner that any undue strain beyond the excess flow valve will not cause breakage between the container and the excess flow valve. The installation of excess flow valves shall take into account the type of valve protection provided.

(c) *Regulators.* if used, shall be either directly connected to the container valves or to manifolds connected to the container valves. The regulator shall be suitable for use with LP-Gas. Manifolds and

fittings connecting containers to pressure regulator inlets shall be designed for at least 250 p.s.i.g. service pressure.

(d) *Valves on containers having a water capacity greater than 50 pounds (nominal 20 pounds LP-Gas capacity)* shall be protected while in use.

(e) Containers shall be marked in accordance with paragraph (b) (8) (iii) of this section and subparagraph (2) of this paragraph.

(f) *Pipe or tubing shall conform to paragraph (b) (8) of this section except that aluminum pipe or tubing shall not be used.*

(g) (1) *Hose shall be designed for a working pressure of at least 250 p.s.i.g.* Hose and hose connections shall have their correctness as to design, construction and performance determined by listing by Underwriters Laboratories, Inc., or Factory Mutual Engineering Corp. The hose length may exceed the length specified in paragraph (b) (9) (vii) (b) of this section, but shall be as short as practicable.

(2) *Hose shall be long enough to permit compliance with spacing provisions of this subparagraph without kinking or straining or causing hose to be so close to a burner as to be damaged by heat.*

(h) *Portable heaters, including salamanders, shall be equipped with an approved automatic device to shut off the flow of gas to the main burner, and pilot if used, in the event of flame extinguishment.* Such heaters having inputs above 50,000 B.t.u. manufactured on or after May 17, 1967, and such heaters having inputs above 100,000 B.t.u. manufactured before May 17, 1967, shall be equipped with either:

(i) A pilot which must be lighted and proved before the main burner can be turned on; or

(2) *An electric ignition system.* The provisions of (g) of this subdivision do not apply to tar kettle burners, torches, melting pots, nor do they apply to portable heaters under 7,500 B.t.u. input when used with containers having a maximum water capacity of 2½ pounds. Container valves, connectors, regulators, manifolds, piping, and tubing shall not be used as structural supports for heaters.

(i) *Containers, regulating equipment, manifolds, pipe, tubing, and hose shall be located so as to minimize exposure to abnormally high temperatures (such as may result from exposure to convection or radiation from heating equipment or installation in confined spaces), physical damage, or tampering by unauthorized persons.*

(j) *Heat-producing equipment shall be located and used so as to minimize the possibility of ignition of combustibles.*

(k) *Containers having a water capacity greater than 2½ pounds (nominal 1 pound LP-Gas capacity) connected for use, shall stand on a firm and substantially level surface and, when necessary, shall be secured in an upright position.*

(l) *Containers, including the valve protective devices, shall be installed so as to minimize the probability of im-*

pingement of discharge of safety relief devices upon containers.

(ii) Containers having a maximum water capacity of 2½ pounds (nominal 1 pound LP-Gas capacity) are permitted to be used inside of buildings as part of approved self-contained hand torch assemblies or similar appliances.

(iii) Containers having a maximum water capacity of 12 pounds (nominal 5 pounds LP-Gas capacity) are permitted to be used temporarily inside of buildings for public exhibition or demonstration purposes, including use for classroom demonstrations.

(iv) (a) When buildings frequented by the public are open to the public, containers are permitted to be used for repair or minor renovation as follows:

(1) The maximum water capacity of individual containers shall be 50 pounds (nominal 20 pounds LP-Gas capacity).

(2) The number of LP-Gas containers shall not exceed the number of workmen assigned to using the LP-Gas.

(3) Containers having a water capacity greater than 2½ pounds (nominal 1 pound LP-Gas capacity) shall not be left unattended in such buildings.

(b) When buildings frequented by the public are not open to the public, containers are permitted to be used for repair or minor renovations, as follows:

The provisions of subdivision (v) of this subparagraph shall apply except that containers having a water capacity greater than 2½ pounds (nominal 1 pound LP-Gas capacity) shall not be left unattended in such buildings.

(v) Containers are permitted to be used in buildings or structures under construction or undergoing major renovation when such buildings or structures are not occupied by the public, as follows:

(a) The maximum water capacity of individual containers shall be 245 pounds (nominal 100 pounds LP-Gas capacity).

(b) For temporary heating such as curing concrete, drying plaster and similar applications, heaters (other than integral heater-container units) shall be located at least 6 feet from any LP-Gas container. This shall not prohibit the use of heaters specifically designed for attachment to the container or to a supporting standard, provided they are designed and installed so as to prevent direct or radiant heat application from the heater onto the container. Blower and radiant type heaters shall not be directed toward any LP-Gas container within 20 feet.

(c) If two or more heater-container units, of either the integral or nonintegral type, are located in an unpartitioned area on the same floor, the container or containers of each unit shall be separated from the container or containers of any other unit by at least 20 feet.

(d) When heaters are connected to containers for use in an unpartitioned area on the same floor, the total water capacity of containers manifolded together for connection to a heater or heaters shall not be greater than 735 pounds (nominal 300 pounds LP-Gas

capacity). Such manifolds shall be separated by at least 20 feet.

(e) On floors on which heaters are not connected for use, containers are permitted to be manifolded together for connection to a heater or heaters on another floor. *Provided:*

(1) The total water capacity of containers connected to any one manifold is not greater than 2,450 pounds (nominal 1,000 pounds LP-Gas capacity) and;

(2) Where more than one manifold having a total water capacity greater than 735 pounds (nominal 300 pounds LP-Gas capacity) are located in the same unpartitioned area, they shall be separated by at least 50 feet.

(f) Storage of containers awaiting use shall be in accordance with paragraph (f) of this section.

(vi) Containers are permitted to be used in industrial occupancies for processing, research, or experimental purposes as follows:

(a) The maximum water capacity of individual containers shall be 245 pounds (nominal 100 pounds LP-Gas capacity).

(b) Containers connected to a manifold shall have a total water capacity not greater than 735 pounds (nominal 300 pounds LP-Gas capacity) and not more than one such manifold may be located in the same room unless separated at least 20 feet from a similar unit.

(c) The amount of LP-Gas in containers for research and experimental use shall be limited to the smallest practical quantity.

(vii) (a) Containers are permitted to be used in industrial occupancies with essentially noncombustible contents where portable equipment for space heating is essential and where a permanent heating installation is not practical, as follows:

(b) Containers and heaters shall comply with and be used in accordance with subdivision (v) of this subparagraph.

(viii) Containers are permitted to be used in buildings for temporary emergency heating purposes, if necessary to prevent damage to the buildings or contents, when the permanent heating system is temporarily out of service, as follows:

(a) Containers and heaters shall comply with and be used in accordance with subdivision (v) of this subparagraph.

(b) The temporary heating equipment shall not be left unattended.

(ix) Containers are permitted to be used temporarily in buildings for training purposes related in installation and use of LP-gas systems, as follows:

(a) The maximum water capacity of individual containers shall be 245 pounds (nominal 100 pounds LP-Gas capacity), but the maximum quantity of LP-Gas that may be placed in each container shall be 20 pounds.

(b) If more than one such container is located in the same room, the containers shall be separated by at least 20 feet.

(c) Containers shall be removed from the building when the training class has terminated.

(6) Container valves and accessories.

(i) Valves in the assembly of multiple container systems shall be arranged so that replacement of containers can be made without shutting off the flow of gas in the system.

Note: This provision is not to be construed as requiring an automatic changeover device.

(ii) Regulators and low-pressure relief devices shall be rigidly attached to the cylinder valves, cylinders, supporting standards, the building walls or otherwise rigidly secured and shall be so installed or protected that the elements (sleet, snow, or ice) will not affect their operation.

(iii) Valves and connections to the containers shall be protected while in transit, in storage, and while being moved into final utilization, as follows:

(a) By setting into the recess of the container to prevent the possibility of their being struck if the container is dropped upon a flat surface, or

(b) By ventilated cap or collar, fastened to the container capable of withstanding a blow from any direction equivalent to that of a 30-pound weight dropped 4 feet. Construction must be such that a blow will not be transmitted to the valve or other connection.

(iv) When containers are not connected to the system, the outlet valves shall be kept tightly closed or plugged, even though containers are considered empty.

(v) Containers having a water capacity in excess of 50 pounds (approximately 21 pounds LP-Gas capacity), recharged at the installation, shall be provided with excess flow or backflow check valves to prevent the discharge of container contents in case of failure of the filling or equalizing connection.

(7) *Safety devices.* (i) Containers shall be provided with safety devices as required by DOT regulations.

(ii) A final stage regulator of an LP-Gas system (excluding any appliance regulator) shall be equipped on the low-pressure side with a relief valve which is set to start to discharge within the limits specified in Table H-30.

TABLE H-30

Regulator delivery pressure	Relief valve start-to-discharge pressure setting (percent of regulator delivery pressure)	
	Minimum	Maximum
1 p.s.i.g. or less	200	300
Above 1 p.s.i.g. but not over 2 p.s.i.g.	140	200
Above 2 p.s.i.g.	125	200

(iii) When a regulator or pressure relief valve is used inside a building for other than purposes specified in paragraph (b) (6) (i) (a)-(g) of this section, the relief valve and the space above the regulator and relief valve diaphragms shall be vented to the outside air with the discharge outlet located not less than 3 feet horizontally away from any building opening which is below such discharge. These provisions do not apply to indi-

vidual appliance regulators when protection is otherwise provided nor to subparagraph (5) of this paragraph and paragraph (b) (10) (xii) of this section. In buildings devoted exclusively to gas distribution purposes, the space above the diaphragm need not be vented to the outside.

(8) *Reinstallation of containers.* Containers shall not be reinstalled unless they are requalified in accordance with DOT regulations.

(9) *Permissible product.* A product shall not be placed in a container marked with a service pressure less than four-fifths of the maximum vapor pressure of product at 130° F.

(d) *Systems utilizing containers other than DOT containers.*

(1) *Application.* This paragraph applies specifically to systems utilizing storage containers other than those constructed in accordance with DOT specifications. Paragraph (b) of this section applies to this paragraph unless otherwise noted in paragraph (b) of this section.

(2) *Design pressure and classification of storage containers.* Storage containers shall be designed and classified in accordance with Table H-31.

TABLE H-31

Container type	For gases with vapor press. not to exceed 100° F. (37.8° C.)	Minimum design pressure of container, lb. per sq. in. gage	
		1949 and earlier editions of ASME Code (Par. U-201, U-202, U-203, U-204, U-205, U-206, U-207, U-208, U-209, U-210, U-211, U-212, U-213, U-214, U-215, U-216, U-217, U-218, U-219, U-220, U-221, U-222, U-223, U-224, U-225, U-226, U-227, U-228, U-229, U-230, U-231, U-232, U-233, U-234, U-235, U-236, U-237, U-238, U-239, U-240, U-241, U-242, U-243, U-244, U-245, U-246, U-247, U-248, U-249, U-250, U-251, U-252, U-253, U-254, U-255, U-256, U-257, U-258, U-259, U-260, U-261, U-262, U-263, U-264, U-265, U-266, U-267, U-268, U-269, U-270, U-271, U-272, U-273, U-274, U-275, U-276, U-277, U-278, U-279, U-280, U-281, U-282, U-283, U-284, U-285, U-286, U-287, U-288, U-289, U-290, U-291, U-292, U-293, U-294, U-295, U-296, U-297, U-298, U-299, U-300, U-301, U-302, U-303, U-304, U-305, U-306, U-307, U-308, U-309, U-310, U-311, U-312, U-313, U-314, U-315, U-316, U-317, U-318, U-319, U-320, U-321, U-322, U-323, U-324, U-325, U-326, U-327, U-328, U-329, U-330, U-331, U-332, U-333, U-334, U-335, U-336, U-337, U-338, U-339, U-340, U-341, U-342, U-343, U-344, U-345, U-346, U-347, U-348, U-349, U-350, U-351, U-352, U-353, U-354, U-355, U-356, U-357, U-358, U-359, U-360, U-361, U-362, U-363, U-364, U-365, U-366, U-367, U-368, U-369, U-370, U-371, U-372, U-373, U-374, U-375, U-376, U-377, U-378, U-379, U-380, U-381, U-382, U-383, U-384, U-385, U-386, U-387, U-388, U-389, U-390, U-391, U-392, U-393, U-394, U-395, U-396, U-397, U-398, U-399, U-400, U-401, U-402, U-403, U-404, U-405, U-406, U-407, U-408, U-409, U-410, U-411, U-412, U-413, U-414, U-415, U-416, U-417, U-418, U-419, U-420, U-421, U-422, U-423, U-424, U-425, U-426, U-427, U-428, U-429, U-430, U-431, U-432, U-433, U-434, U-435, U-436, U-437, U-438, U-439, U-440, U-441, U-442, U-443, U-444, U-445, U-446, U-447, U-448, U-449, U-450, U-451, U-452, U-453, U-454, U-455, U-456, U-457, U-458, U-459, U-460, U-461, U-462, U-463, U-464, U-465, U-466, U-467, U-468, U-469, U-470, U-471, U-472, U-473, U-474, U-475, U-476, U-477, U-478, U-479, U-480, U-481, U-482, U-483, U-484, U-485, U-486, U-487, U-488, U-489, U-490, U-491, U-492, U-493, U-494, U-495, U-496, U-497, U-498, U-499, U-500, U-501, U-502, U-503, U-504, U-505, U-506, U-507, U-508, U-509, U-510, U-511, U-512, U-513, U-514, U-515, U-516, U-517, U-518, U-519, U-520, U-521, U-522, U-523, U-524, U-525, U-526, U-527, U-528, U-529, U-530, U-531, U-532, U-533, U-534, U-535, U-536, U-537, U-538, U-539, U-540, U-541, U-542, U-543, U-544, U-545, U-546, U-547, U-548, U-549, U-550, U-551, U-552, U-553, U-554, U-555, U-556, U-557, U-558, U-559, U-560, U-561, U-562, U-563, U-564, U-565, U-566, U-567, U-568, U-569, U-570, U-571, U-572, U-573, U-574, U-575, U-576, U-577, U-578, U-579, U-580, U-581, U-582, U-583, U-584, U-585, U-586, U-587, U-588, U-589, U-590, U-591, U-592, U-593, U-594, U-595, U-596, U-597, U-598, U-599, U-600, U-601, U-602, U-603, U-604, U-605, U-606, U-607, U-608, U-609, U-610, U-611, U-612, U-613, U-614, U-615, U-616, U-617, U-618, U-619, U-620, U-621, U-622, U-623, U-624, U-625, U-626, U-627, U-628, U-629, 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U-201, U-202, U-203, U-204, U-205, U-206, U-207, U-208, U-209, U-210, U-211, U-212, U-213, U-214, U-215, U-216, U-217, U-218, U-219, U-220, U-221, U-222, U-223, U-224, U-225, U-226, U-227, U-228, U-229, U-230, U-231, U-232, U-233, U-234, U-235, U-236, U-237, U-238, U-239, U-240, U-241, U-242, U-243, U-244, U-245, U-246, U-247, U-248, U-249, U-250, U-251, U-252, U-253, U-254, U-255, U-256, U-257, U-258, U-259, U-260, U-261, U-262, U-263, U-264, U-265, U-266, U-267, U-268, U-269, U-270, U-271, U-272, U-273, U-274, U-275, U-276, U-277, U-278, U-279, U-280, U-281, U-282, U-283, U-284, U-285, U-286, U-287, U-288, U-289, U-290, U-291, U-292, U-293, U-294, U-295, U-296, U-297, U-298, U-299, U-300, U-301, U-302, U-303, U-304, U-305, U-306, U-307, U-308, U-309, U-310, U-311, U-312, U-313, U-314, U-315, U-316, U-317, U-318, U-319, U-320, U-321, U-322, U-323, U-324, U-325, U-326, U-327, U-328, U-329, U-330, U-331, U-332, U-333, U-334, U-335, U-336, U-337, U-338, U-339, U-340, U-341, U-342, U-343, 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1 80	1 80	1 80	1 100
100	100	100	128
125	125	125	154
150	150	150	177
175	175	175	219
200	215	200	250

¹ New storage containers of the 80 type have not been authorized since Dec. 31, 1947.

² Container type may be increased by increments of 25. The minimum design pressure of containers shall be 100% of the container type designation when constructed under 1949 or earlier editions of the ASME Code (Par. U-201 and U-202). The minimum design pressure of containers shall be 125% of the container type designation when constructed under: (1) the 1949 ASME Code (Par. U-201 and U-202), (2) 1950, 1952, 1956, 1959, 1962, 1965, and 1968 (Division I) editions of the ASME Code, and (3) all editions of the API-ASME Code.

³ Construction of containers under the API-ASME Code is not authorized after July 1, 1961.

(3) *Container valves and accessories, filler pipes, and discharge pipes.* (i) The filling pipe inlet terminal shall not be located inside a building. For containers with a water capacity of 125 gallons or more, such terminals shall be located not less than 10 feet from any building (see paragraph (b) (6) (ii) of this section), and preferably not less than 5 feet from any driveway, and shall be located in a protective housing built for the purpose.

(ii) The filling connection shall be fitted with one of the following:

(a) Combination back-pressure check valve and excess flow valve.

(b) One double or two single back-pressure check valves.

(c) A positive shutoff valve, in conjunction with either:

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any backflow preventer valve, or any internal excess flow valve.

(b) All openings in a container shall be equipped with approved automatic excess flow valves except in the following: fitting connections as provided in subdivisions (iv) of this subparagraph; safety relief connections, liquid-level gaging devices as provided in paragraphs (b) (7) (iv), (19) (iv), and (19) (vii) of this section; pressure gage connections as provided in paragraph (b) (7) (v) of this section, as provided in subdivisions (iv), (iv), and (vii) of this subparagraph.

(c) An excess flow valve is not required in the withdrawal service line providing the following are complied with: (a) Such systems' total water capacity does not exceed 3,000 U.S. gallons.

(b) The discharge from the service outlet is controlled by a suitable manually operated shutoff valve and is:

(1) Threaded directly into the service outlet of the container; or

(2) Is an integral part of a substantial fitting threaded into or on the service outlet of the container; or

(3) Threaded directly into a substantial fitting threaded into or on the service outlet of the container.

(c) The shutoff valve is equipped with an attached handwheel or the equivalent.

(d) The controlling orifice between the contents of the container and the outlet of the shutoff valve does not exceed five-sixteenths inch in diameter for vapor withdrawal systems and one-eighth inch in diameter for liquid withdrawal systems.

(e) An approved pressure-reducing regulator is directly attached to the outlet of the shutoff valve and is rigidly supported, or that an approved pressure-reducing regulator is attached to the outlet of the shutoff valve by means of a suitable flexible connection, provided the regulator is adequately supported and properly protected on or at the tank.

(f) All inlet and outlet connections except safety relief valves, liquid level gaging devices and pressure gages on containers of 3,000 gallons water capacity, or more, and on any container used to supply fuel directly to an internal combustion engine, shall be labeled to designate whether they communicate with vapor or liquid space. Labels may be on valves.

(vi) In lieu of an excess flow valve openings may be fitted with a quick-closing internal valve which, except during operating periods shall remain closed. The internal mechanism for such valves may be provided with a secondary control which shall be equipped with a fusible plug (not over 220° F. melting point) which will cause the internal valve to close automatically in case of fire.

(vii) Not more than two plugged openings shall be permitted on a container of 2,000 gallons or less water capacity.

(viii) Containers of 125 gallons water capacity or more manufactured after July 1, 1961, shall be provided with an approved device for liquid evacuation, the size of which shall be three-fourths inch national pipe thread minimum. A

plugged opening will not satisfy this requirement.

(9) Safety devices. (a) All safety devices shall comply with the following:

(i) All container safety relief devices shall be located on the containers and shall have direct communication with the vapor space of the container.

(b) In industrial and gas manufacturing plants, discharge pipe from safety relief valves on pipe lines within a building shall discharge vertically upward and shall be piped to a point outside a building.

(c) Safety relief device discharge terminals shall be so located as to provide protection against physical damage and such discharge pipes shall be fitted with loose raincaps. Return bends and restrictive pipe fittings shall not be permitted.

(d) If desired, discharge lines from two or more safety relief devices located on the same unit, or similar lines from two or more different units, may be run into a common discharge header, provided that the cross-sectional area of such header be at least equal to the sum of the cross-sectional area of the individual discharge lines, and that the setting of safety relief valves are the same.

(e) Each storage container of over 2,000 gallons water capacity shall be provided with a suitable pressure gage.

(f) A final stage regulator of an LP-Gas system (excluding any appliance regulator) shall be equipped on the low-pressure side with a relief valve which is set to start to discharge within the limits specified in Table H-30.

(g) When a regulator or pressure relief valve is installed inside a building, the relief valve and the space above the regulator and relief valve diaphragms shall be vented to the outside air with the discharge outlet located not less than 3 feet horizontally away from any opening into the building which is below such discharge. (These provisions do not apply to individual appliance regulators when protection is otherwise provided. In buildings devoted exclusively to gas distribution purposes, the space above the diaphragm need not be vented to the outside.)

(ii) Safety devices for aboveground containers shall be provided as follows:

(a) Containers of 1,200 gallons water capacity or less which may contain liquid fuel when installed above ground shall have the rate of discharge required by paragraph (b) (10) (ii) of this section provided by a spring-loaded relief valve or valves. In addition to the required spring-loaded relief valve(s), suitable fuse plug(s) may be used provided the total discharge area of the fuse plug(s) for each container does not exceed 0.25 square inch.

(b) The fusible metal of the fuse plugs shall have a yield temperature of 208° F. minimum and 220° F. maximum. Relief valves and fuse plugs shall have direct communication with the vapor space of the container.

(c) On a container having a water capacity greater than 125 gallons, but not over 2,000 gallons, the discharge from

the safety relief valve shall be vented away from the container vertically upwards and unobstructed to the open air in such a manner as to prevent any impingement of escaping gas upon the container; loose-fitting rain caps shall be used. Suitable provision shall be made for draining condensate which may accumulate in the relief valve or its discharge pipe.

(d) On containers of 125 gallons water capacity or less, the discharge from safety relief devices shall be located not less than 5 feet horizontally away from any opening into the building below the level of such discharge.

(e) On a container having a water capacity greater than 3,000 gallons, the discharge from the safety relief valves shall be vented away from the container vertically upwards to a point at least 7 feet above the container, and unobstructed to the open air in such a manner as to prevent any impingement of escaping gas upon the container; loose-fitting rain caps shall be used. Suitable provision shall be made so that any liquid or condensate that may accumulate inside of the safety relief valve or its discharge pipe will not render the valve inoperative. If a drain is used, a means shall be provided to protect the container, adjacent containers, piping, or equipment against impingement of flame resulting from ignition of product escaping from the drain.

(iii) On all containers which are installed underground and which contain no liquid fuel until buried and covered, the rate of discharge of the spring-loaded relief valve installed thereon may be reduced to a minimum of 30 percent of the rate of discharge specified in paragraph (b) (10) (ii) of this section. Containers so protected shall not be uncovered after installation until the liquid fuel has been removed therefrom. Containers which may contain liquid fuel before being installed under ground and before being completely covered with earth are to be considered aboveground containers when determining the rate of discharge requirement of the relief valves.

(iv) On underground containers of more than 2,000 gallons water capacity, the discharge from safety relief devices shall be piped vertically and directly upward to a point at least 7 feet above the ground.

Where there is a probability of the manhole or housing becoming flooded, the discharge from regulator vent lines shall be above the highest probable water level. All manholes or housings shall be provided with ventilated louvers or their equivalent, the area of such openings equaling or exceeding the combined discharge areas of the safety relief valves and other vent lines which discharge their content into the manhole housing.

(v) Safety devices for vaporizers shall be provided as follows:

(a) Vaporizers of less than 1 quart total capacity, heated by the ground or the surrounding air, need not be equipped with safety relief valves provided that

adequate tests certified by any of the authorities referred to in paragraph (b) (3) of this section, demonstrate that the assembly is safe without safety relief valves.

(b) No vaporizer shall be equipped with fusible plugs.

(c) In industrial and gas manufacturing plants, safety relief valves on vaporizers within a building shall be piped to a point outside the building and be discharged upward.

(5) *Reinstallation of containers.* Containers may be reinstalled if they do not show any evidence of harmful external corrosion or other damage. Where containers are reinstalled underground, the corrosion resistant coating shall be put in good condition (see subparagraph (7) (vi) of this paragraph). Where containers are reinstalled above ground, the safety devices and gaging devices shall comply with subparagraph (4) of this paragraph and paragraph (b) (19) of this section respectively for aboveground containers.

(6) *Capacity of containers.* A storage container shall not exceed 90,000 gallons water capacity.

(7) *Installation of storage containers.* (i) Containers installed above ground, except as provided in subdivision (vii) of this subparagraph, shall be provided with substantial masonry or noncombustible structural supports on firm masonry foundation.

(ii) Aboveground containers shall be supported as follows:

(a) Horizontal containers shall be mounted on saddles in such a manner as to permit expansion and contraction. Structural metal supports may be employed when they are protected against fire in an approved manner. Suitable means of preventing corrosion shall be provided on that portion of the container in contact with the foundations or saddles.

(b) Containers of 2,000 gallons water capacity or less may be installed with nonfireproofed ferrous metal supports if mounted on concrete pads or footings, and if the distance from the outside bottom of the container shell to the concrete pad, footing, or the ground does not exceed 24 inches.

(iii) Any container may be installed with nonfireproofed ferrous metal supports if mounted on concrete pads or footings, and if the distance from the outside bottom of the container to the ground does not exceed 5 feet, provided the container is in an isolated location.

(iv) Containers may be partially buried providing the following requirements are met:

(a) The portion of the container below the surface and for a vertical distance not less than 3 inches above the surface of the ground is protected to resist corrosion, and the container is protected against settling and corrosion as required for fully buried containers.

(b) Spacing requirements shall be as specified for underground tanks in paragraph (b) (6) (ii) of this section.

(c) Relief valve capacity shall be as required for aboveground containers.

(8) *Manhole.* is located so as not to be subject to vehicular damage, or is adequately protected against such damage.

(e) *Filling densities* shall be as required for above-ground containers.

(v) Containers buried underground shall be placed so that the top of the container is not less than 6 inches below grade. Where an underground container might be subject to abrasive action or physical damage due to vehicular traffic or other causes, then it shall be:

(a) Placed not less than 2 feet below grade, or

(b) Otherwise protected against such physical damage.

It will not be necessary to cover the portion of the container to which manhole and other connections are affixed; however, where necessary, protection shall be provided against vehicular damage. When necessary to prevent floating, containers shall be securely anchored or weighted.

(vi) (a) Containers shall be given a protective coating before being placed under ground. This coating shall be equivalent to hot-dip galvanizing or to two coatings of red lead followed by a heavy coating of coal tar or asphalt. In lowering the container into place, care shall be exercised to prevent damage to the coating. Any damage to the coating shall be repaired before backfilling.

(b) Containers shall be set on a firm foundation (firm earth may be used) and surrounded with earth or sand firmly tamped in place. Backfill should be free of rocks or other abrasive materials.

(vii) Containers with foundations attached (portable or semiportable containers with suitable steel "runners" or "skids" and popularly known in the industry as "skid tanks") shall be designed, installed, and used in accordance with these rules subject to the following provisions:

(a) If they are to be used at a given general location for a temporary period not to exceed 6 months they need not have fire-resisting foundations or saddles but shall have adequate ferrous metal supports.

(b) They shall not be located with the outside bottom of the container shell more than 5 feet above the surface of the ground unless fire-resisting supports are provided.

(c) The bottom of the skids shall not be less than 2 inches or more than 12 inches below the outside bottom of the container shell.

(d) Flanges, nozzles, valves, fittings, and the like, having communication with the interior of the container, shall be protected against physical damage.

(e) When not permanently located on fire-resisting foundations, piping connections shall be sufficiently flexible to minimize the possibility of breakage or leakage of connections if the container settles, moves, or is otherwise displaced.

(f) Skids, or lugs for attachment of skids, shall be secured to the container in accordance with the code or rules under which the container is designed and

built (with a minimum factor of safety of four) to withstand loading in any direction equal to four times the weight of the container and attachments when filled to the maximum permissible loads weight.

(viii) Field welding where necessary, shall be made only on saddle plates or brackets which were applied by the manufacturer of the tank.

(ix) For aboveground containers, secure anchorage or adequate pier height shall be provided against possible container flotation wherever sufficiently high floodwater might occur.

(x) When permanently installed containers are interconnected, provision shall be made to compensate for expansion, contraction, vibration, and settling of containers, and interconnecting piping. Where flexible connections are used, they shall be of an approved type and shall be designed for a bursting pressure of not less than five times the vapor pressure of the product at 100° F. The use of nonmetallic hose is prohibited for permanently interconnecting such containers.

(xi) Container assemblies listed for interchangeable installation above ground or under ground shall conform to the requirements for aboveground installations with respect to safety relief capacity and filling density. For installation above ground all other requirements for aboveground installations shall apply. For installation under ground all other requirements for underground installations shall apply.

(8) *Protection of container accessories.* (i) Valves, regulating, gaging, and other container accessory equipment shall be protected against tampering and physical damage. Such accessories shall also be so protected during the transit of containers intended for installation underground.

(ii) On underground or combination aboveground-underground containers, the service valve handwheel, the terminal for connecting the hose, and the opening through which there can be a flow from safety relief valves shall be at least 4 inches above the container and this opening shall be located in the dome or housing. Underground systems shall be so installed that all the above openings, including the regulator vent, are located above the normal maximum water table.

(iii) All connections to underground containers shall be located within a substantial dome, housing, or manhole and with access thereto protected by a substantial cover.

(9) *Drips for condensed gas.* Where vaporized gas on the low-pressure side of the system may condense to a liquid at normal operating temperatures and pressures, suitable means shall be provided for reevaporation of the condensate.

(10) *Damage from vehicles.* When damage to LP-Gas systems from vehicular traffic is a possibility, precautions against such damage shall be taken.

(11) *Pits and drains.* Every effort should be made to avoid the use of pits,

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not be fitted with automatic flame-out gas detecting device. The device, however, shall be directed into or to the vicinity of power systems used for emergency.

(12) General provisions applicable to use in industrial plants (of 2,000 gal. water capacity and more) and to filling plants. (1) When standard service is provided, it shall be extended to the LP-Gas installation and personnel properly trained.

(2) If loading and unloading are not done during other than daylight hours, adequate lights shall be provided. Illuminate storage containers, control valves, and other equipment.

(3) Suitable roadways or means of access for extinguishing equipment such as wheeled extinguishers or fire department apparatus shall be provided.

(4) To minimize trespassing or tampering, the area which includes container enclosures, pumping equipment, filling and unloading facilities, and cylinder-filling facilities shall be enclosed by at least a 6-foot-high industrial fence unless otherwise adequately protected. There shall be at least two means of emergency access.

(5) Container-charging plants. (1) Container-charging room shall be located not less than:

(a) Ten feet from bulk storage containers.

(b) Twenty-five feet from line of adjoining property which may be built on.

(c) Tank truck filling station outlets located not less than:

(1) Twenty-five feet from line of adjoining property which may be built on.

(2) Ten feet from pumps and compressors if housed in one or more separate buildings.

(3) The pumps or compressors may be located in the container-charging room or building, in a separate building, outside of buildings. When housed in separate building, such building (a) noncombustible weather cover is to be constructed as a building shall be located not less than:

(1) Ten feet from bulk storage tanks.

(2) Twenty-five feet from line of adjoining property which may be built on.

(3) Twenty-five feet from access of road.

(4) When a part of the container-charging building is to be used for a storeroom or where open flames or other sources of ignition exist or are employed, the space to be so occupied shall be separated from container charging room by a partition wall or walls of resistant construction continuous from floor to roof or ceiling. Such separation walls shall be without openings and shall be joined to the floor, other walls, and ceiling or roof in a manner to form a permanent gas-tight joint.

(5) Electrical equipment and installations shall conform with paragraphs (17) and (18) of this section.

(6) Fire protection. (1) Each bulk container shall be provided with at least

one approved portable fire extinguisher having a minimum rating of 1B-10, C.

(2) In industrial installations involving containers of 180,000 gallons aggregate water capacity or more, provision shall be made for an adequate supply of water at the container site for fire protection in the container area, unless other adequate means for fire control are provided. Water hydrants shall be readily accessible and so spaced as to provide water protection for all containers. Sufficient lengths of firehoses shall be provided at each hydrant location on a hose cart, or other means provided to facilitate easy movement of the hose in the container area. It is desirable to equip the outlet of each hose line with a combination fog nozzle. A shaker shall be provided to protect the hose and its conveyor from the weather.

(3) Painting. Aboveground containers shall be kept properly painted.

(4) Lighting. Electrical equipment and installations shall conform to paragraphs (b) (17) and (18) of this section.

(5) Vaporizers for internal combustion engines. The provisions of paragraph (e) (8) of this section shall apply.

(6) Gas regulating and mixing equipment for internal combustion engines. The provisions of paragraph (e) (9) of this section shall apply.

(7) Liquefied petroleum gas as a motor fuel—(1) Application. (1) This paragraph applies to internal combustion engines, fuel containers, and pertinent equipment for the use of liquefied petroleum gases as a motor fuel on easily movable, readily portable units including self-propelled vehicles.

(2) Fuel containers and pertinent equipment for internal combustion engines using liquefied petroleum gas where installation is of the stationary type are covered by paragraph (d) of this section. This paragraph does not apply to containers for transportation of liquefied petroleum gases nor to marine fuel use. All requirements of paragraph (b) of this section apply to this paragraph, unless otherwise noted in paragraph (b) of this section.

(3) General. (1) Fuel may be used from the cargo tank of a truck while in transit, but not from cargo tanks on trailers or semitrailers. The use of fuel from the cargo tanks to operate stationary engines is permitted providing wheels are securely blocked.

(2) Passenger-carrying vehicles shall not be fueled while passengers are on board.

(3) Industrial trucks (including lift trucks) equipped with permanently mounted fuel containers shall be charged outdoors. Charging equipment shall comply with the provisions of paragraph (b) of this section.

(4) LP-Gas fueled industrial trucks shall comply with the Standard for Type Designations, Areas of Use, Maintenance and Operation of Powered Industrial Trucks, NFPA 505-1968.

(5) Engines on vehicles shall be shut down while fueling if the fueling operation involves venting to the atmosphere.

(6) Design, construction and classification of fuel containers. (1) Except as covered in subparagraphs (2) and (3) of this subparagraph, containers shall be in accordance with Table H-32.

(2) Fuel containers for use in industrial trucks (including lift trucks) shall be either DOT containers authorized for LP-Gas service having a minimum service pressure of 240 p.s.i.g. or minimum Container Type 250. Under 1960 and later ASME codes, this means a 312.5-p.s.i.g. design pressure container.

TABLE H-32

Container type	For gases with vapor pressure not in excess of 140 p.s.i.g. (9.3 C.)	Minimum design pressure of container lb. per sq. in. gage	
		1959 and earlier editions of ASME Code (Part U-200)	1960 edition of ASME Code (Part U-200); 1960, 1962, 1964, 1966, 1968, 1970, 1972, 1974, 1976, 1978, 1980, 1982, 1984, 1986, 1988, 1990, 1992, 1994, 1996, 1998, 2000, 2002, 2004, 2006, 2008, 2010, 2012, 2014, 2016, 2018, 2020, 2022, 2024, 2026, 2028, 2030, 2032, 2034, 2036, 2038, 2040, 2042, 2044, 2046, 2048, 2050, 2052, 2054, 2056, 2058, 2060, 2062, 2064, 2066, 2068, 2070, 2072, 2074, 2076, 2078, 2080, 2082, 2084, 2086, 2088, 2090, 2092, 2094, 2096, 2098, 2100, 2102, 2104, 2106, 2108, 2110, 2112, 2114, 2116, 2118, 2120, 2122, 2124, 2126, 2128, 2130, 2132, 2134, 2136, 2138, 2140, 2142, 2144, 2146, 2148, 2150, 2152, 2154, 2156, 2158, 2160, 2162, 2164, 2166, 2168, 2170, 2172, 2174, 2176, 2178, 2180, 2182, 2184, 2186, 2188, 2190, 2192, 2194, 2196, 2198, 2200, 2202, 2204, 2206, 2208, 2210, 2212, 2214, 2216, 2218, 2220, 2222, 2224, 2226, 2228, 2230, 2232, 2234, 2236, 2238, 2240, 2242, 2244, 2246, 2248, 2250, 2252, 2254, 2256, 2258, 2260, 2262, 2264, 2266, 2268, 2270, 2272, 2274, 2276, 2278, 2280, 2282, 2284, 2286, 2288, 2290, 2292, 2294, 2296, 2298, 2300, 2302, 2304, 2306, 2308, 2310, 2312, 2314, 2316, 2318, 2320, 2322, 2324, 2326, 2328, 2330, 2332, 2334, 2336, 2338, 2340, 2342, 2344, 2346, 2348, 2350, 2352, 2354, 2356, 2358, 2360, 2362, 2364, 2366, 2368, 2370, 2372, 2374, 2376, 2378, 2380, 2382, 2384, 2386, 2388, 2390, 2392, 2394, 2396, 2398, 2400, 2402, 2404, 2406, 2408, 2410, 2412, 2414, 2416, 2418, 2420, 2422, 2424, 2426, 2428, 2430, 2432, 2434, 2436, 2438, 2440, 2442, 2444, 2446, 2448, 2450, 2452, 2454, 2456, 2458, 2460, 2462, 2464, 2466, 2468, 2470, 2472, 2474, 2476, 2478, 2480, 2482, 2484, 2486, 2488, 2490, 2492, 2494, 2496, 2498, 2500, 2502, 2504, 2506, 2508, 2510, 2512, 2514, 2516, 2518, 2520, 2522, 2524, 2526, 2528, 2530, 2532, 2534, 2536, 2538, 2540, 2542, 2544, 2546, 2548, 2550, 2552, 2554, 2556, 2558, 2560, 2562, 2564, 2566, 2568, 2570, 2572, 2574, 2576, 2578, 2580, 2582, 2584, 2586, 2588, 2590, 2592, 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2926, 2928, 2930, 2932, 2934, 2936, 2938, 2940, 2942, 2944, 2946, 2948, 2950, 2952, 2954, 2956, 2958, 2960, 2962, 2964, 2966, 2968, 2970, 2972, 2974, 2976, 2978, 2980, 2982, 2984, 2986, 2988, 2990, 2992, 2994, 2996, 2998, 3000, 3002, 3004, 3006, 3008, 3010, 3012, 3014, 3016, 3018, 3020, 3022, 3024, 3026, 3028, 3030, 3032, 3034, 3036, 3038, 3040, 3042, 3044, 3046, 3048, 3050, 3052, 3054, 3056, 3058, 3060, 3062, 3064, 3066, 3068, 3070, 3072, 3074, 3076, 3078, 3080, 3082, 3084, 3086, 3088, 3090, 3092, 3094, 3096, 3098, 3100, 3102, 3104, 3106, 3108, 3110, 3112, 3114, 3116, 3118, 3120, 3122, 3124, 3126, 3128, 3130, 3132, 3134, 3136, 3138, 3140, 3142, 3144, 3146, 3148, 3150, 3152, 3154, 3156, 3158, 3160, 3162, 3164, 3166, 3168, 3170, 3172, 3174, 3176, 3178, 3180, 3182, 3184, 3186, 3188, 3190, 3192, 3194, 3196, 3198, 3200, 3202, 3204, 3206, 3208, 3210, 3212, 3214, 3216, 3218, 3220, 3222, 3224, 3226, 3228, 3230, 3232, 3234, 3236, 3238, 3240, 3242, 3244, 3246, 3248, 3250, 3252, 3254, 3256, 3258, 3260, 3262, 3264, 3266, 3268, 3270, 3272, 3274, 3276, 3278, 3280, 3282, 3284, 3286, 3288, 3290, 3292, 3294, 3296, 3298, 3300, 3302, 3304, 3306, 3308, 3310, 3312, 3314, 3316, 3318, 3320, 3322, 3324, 3326, 3328, 3330, 3332, 3334, 3336, 3338, 3340, 3342, 3344, 3346, 3348, 3350, 3352, 3354, 3356, 3358, 3360, 3362, 3364, 3366, 3368, 3370, 3372, 3374, 3376, 3378, 3380, 3382, 3384, 3386, 3388, 3390, 3392, 3394, 3396, 3398, 3400, 3402, 3404, 3406, 3408, 3410, 3412, 3414, 3416, 3418, 3420, 3422, 3424, 3426, 3428, 3430, 3432, 3434, 3436, 3438, 3440, 3442, 3444, 3446, 3448, 3450, 3452, 3454, 3456, 3458, 3460, 3462, 3464, 3466, 3468, 3470, 3472, 3474, 3476, 3478, 3480, 3482, 3484, 3486, 3488, 3490, 3492, 3494, 3496, 3498, 3500, 3502, 3504, 3506, 3508, 3510, 3512, 3514, 3516, 3518, 3520, 3522, 3524, 3526, 3528, 3530, 3532, 3534, 3536, 3538, 3540, 3542, 3544, 3546, 3548, 3550, 3552, 3554, 3556, 3558, 3560, 3562, 3564, 3566, 3568, 3570, 3572, 3574, 3576, 3578, 3580, 3582, 3584, 3586, 3588, 3590, 3592, 3594, 3596, 3598, 3600, 3602, 3604, 3606, 3608, 3610, 3612, 3614, 3616, 3618, 3620, 3622, 3624, 3626, 3628, 3630, 3632, 3634, 3636, 3638, 3640, 3642, 3644, 3646, 3648, 3650, 3652, 3654, 3656, 3658, 3660, 3662, 3664, 3666, 3668, 3670, 3672, 3674, 3676, 3678, 3680, 3682, 3684, 3686, 3688, 3690, 3692, 3694, 3696, 3698, 3700, 3702, 3704, 3706, 3708, 3710, 3712, 3714, 3716, 3718, 3720, 3722, 3724, 3726, 3728, 3730, 3732, 3734, 3736, 3738, 3740, 3742, 3744, 3746, 3748, 3750, 3752, 3754, 3756, 3758, 3760, 3762, 3764, 3766, 3768, 3770, 3772, 3774, 3776, 3778, 3780, 3782, 3784, 3786, 3788, 3790, 3792, 3794, 3796, 3798, 3800, 3802, 3804, 3806, 3808, 3810, 3812, 3814, 3816, 3818, 3820, 3822, 3824, 3826, 3828, 3830, 3832, 3834, 3836, 3838, 3840, 3842, 3844, 3846, 3848, 3850, 3852, 3854, 3856, 3858, 3860, 3862, 3864, 3866, 3868, 3870, 3872, 3874, 3876, 3878, 3880, 3882, 3884, 3886, 3888, 3890, 3892, 3894, 3896, 3898, 3900, 3902, 3904, 3906, 3908, 3910, 3912, 3914, 3916, 3918, 3920, 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4254, 4256, 4258, 4260, 4262, 4264, 4266, 4268, 4270, 4272, 4274, 4276, 4278, 4280, 4282, 4284, 4286, 4288, 4290, 4292, 4294, 4296, 4298, 4300, 4302, 4304, 4306, 4308, 4310, 4312, 4314, 4316, 4318, 4320, 4322, 4324, 4326, 4328, 4330, 4332, 4334, 4336, 4338, 4340, 4342, 4344, 4346, 4348, 4350, 4352, 4354, 4356, 4358, 4360, 4362, 4364, 4366, 4368, 4370, 4372, 4374, 4376, 4378, 4380, 4382, 4384, 4386, 4388, 4390, 4392, 4394, 4396, 4398, 4400, 4402, 4404, 4406, 4408, 4410, 4412, 4414, 4416, 4418, 4420, 4422, 4424, 4426, 4428, 4430, 4432, 4434, 4436, 4438, 4440, 4442, 4444, 4446, 4448, 4450, 4452, 4454, 4456, 4458, 4460, 4462, 4464, 4466, 4468, 4470, 4472, 4474, 4476, 4478, 4480, 4482, 4484, 4486, 4488, 4490, 4492, 4494, 4496, 4498, 4500, 4502, 4504, 4506, 4508, 4510, 4512, 4514, 4516, 4518, 4520, 4522, 4524, 4526, 4528, 4530, 4532, 4534, 4536, 4538, 4540, 4542, 4544, 4546, 4548, 4550, 4552, 4554, 4556, 4558, 4560, 4562, 4564, 4566, 4568, 4570, 4572, 4574, 4576, 4578, 4580, 4582, 4584, 4586, 4588, 4590, 4592, 4594, 4596, 4598, 4600, 4602, 4604, 4606, 4608, 4610, 4612, 4614, 4616, 4618, 4620, 4622, 4624, 4626, 4628, 4630, 4632, 4634, 4636, 4638, 4640, 4642, 4644, 4646, 4648, 4650, 4652, 4654, 4656, 4658, 4660, 4662, 4664, 4666, 4668, 4670, 4672, 4674, 4676, 4678, 4680, 4682, 4684, 4686, 4688, 4690, 4692, 4694, 4696, 4698, 4700, 4702, 4704, 4706, 4708, 4710, 4712, 4714, 4716, 4718, 4720, 4722, 4724, 4726, 4728, 4730, 4732, 4734, 4736, 4738, 4740, 4742, 4744, 4746, 4748, 4750, 4752, 4754, 4756, 4758, 4760, 4762, 4764, 4766, 4768, 4770, 4772, 4774, 4776, 4778, 4780, 4782, 4784, 4786, 4788, 4790, 4792, 4794, 4796, 4798, 4800, 4802, 4804, 4806, 4808, 4810, 4812, 4814, 4816, 4818, 4820, 4822, 4824, 4826, 4828, 4830, 4832, 4834, 4836, 4838, 4840, 4842, 4844, 4846, 4848, 4850, 4852, 4854, 4856, 4858, 4860, 4862, 4864, 4866, 4868, 4870, 4872, 4874, 4876, 4878, 4880, 4882, 4884, 4886, 4888, 4890, 4892, 4894, 4896, 4898, 4900, 4902, 4904, 4906, 4908, 4910, 4912, 4914, 4916, 4918, 4920, 4922, 4924, 4926, 4928, 4930, 4932, 4934, 4936, 4938, 4940, 4942, 4944, 4946, 4948, 4950, 4952, 4954, 4956, 4958, 4960, 4962, 4964, 4966, 4968, 4970, 4972, 4974, 4976, 4978, 4980, 4982, 4984, 4986, 4988, 4990, 4992, 4994, 4996, 4998, 5000, 5002, 5004, 5006, 5008, 5010, 5012, 5014, 5016, 5018, 5020, 5022, 5024, 5026, 5028, 5030, 5032, 5034, 5036, 5038, 5040, 5042, 5044, 5046, 5048, 5050, 5052, 5054, 5056, 5058, 5060, 5062, 5064, 5066, 5068, 5070, 5072, 5074, 5076, 5078, 5080, 5082, 5084, 5086, 5088, 5090, 5092, 5094, 5096, 5098, 5100, 5102, 5104, 5106, 5108, 5110, 5112, 5114, 5116, 5118, 5120, 5122, 5124, 5126, 5128, 5130, 5132, 5134, 5136, 5138, 5140, 5142, 5144, 5146, 5148, 5150, 5152, 5154, 5156, 5158, 5160, 5162, 5164, 5166, 5168, 5170, 5172, 5174, 5176, 5178, 5180, 5182, 5184, 5186

and constructed to withstand static loading in any direction equal to twice the weight of the tank and attachments when filled with fuel using a safety factor of not less than four based on the ultimate strength of the material to be used. Field welding, when necessary, shall be made only on saddle plates, lugs or brackets, originally attached to the container by the tank manufacturer.

(iv) Fuel containers on buses shall be permanently installed.

(v) Containers from which vapor only is to be withdrawn shall be installed and equipped with suitable connections to minimize the accidental withdrawal of liquid.

(5) *Valves and accessories.* (i) Container valves and accessories shall have a rated working pressure of at least 250 p.s.i.g., and shall be of a type suitable for liquefied petroleum gas service.

(ii) The filling connection shall be fitted with an approved double back-pressure check valve, or a positive shutoff in conjunction with an internal back-pressure check valve. On a removable container the filler valve may be a hand operated shutoff valve with an internal excess flow valve. Main shutoff valves on the container on liquid and vapor must be readily accessible.

(iii) With the exceptions of subdivision (iv) (c) of this subparagraph, filling connections equipped with approved automatic back-pressure check valves, and safety relief valves, all connections to containers having openings for the flow of gas in excess of a No. 54 drill size shall be equipped with approved automatic excess flow valves to prevent discharge of content in case connections are broken.

(iv) *Liquid-level gaging devices:*

(a) Variable liquid-level gages which require the venting of fuel to the atmosphere shall not be used on fuel containers of industrial trucks (including lift trucks).

(b) On portable containers that may be filled in the vertical and/or horizontal position, the fixed liquid-level gage must indicate maximum permitted filling level for both vertical and horizontal filling with the container oriented to place the safety relief valve in communication with the vapor space.

(c) In the case of containers used solely in farm tractor service, and charged at a point at least 50 feet from any important building, the fixed liquid-level gaging device may be so constructed that the outward flow of container content exceeds that passed by a No. 54 drill size opening, but in no case shall the flow exceed that passed by a No. 31 drill-size opening. An excess flow valve is not required. Fittings equipped with such restricted drill size opening and container on which they are used shall be marked to indicate the size of the opening.

(d) All valves and connections on containers shall be adequately protected to prevent damage due to accidental contact with stationary objects or from loose objects thrown up from the road, and all valves shall be safeguarded against damage due to collision, overturning or other

accident. For farm tractors where parts of the vehicle provide such protection to valves and fittings, the foregoing requirements shall be considered fulfilled. However, on removable type containers the protection for the fittings shall be permanently attached to the container.

(e) Exchange of removable fuel containers preferably should be done outdoors but may be done indoors. When removable fuel containers are used, means shall be provided in the fuel system to minimize the escape of fuel when the containers are exchanged. This may be accomplished by either of the following methods:

(1) Using an approved automatic quick-closing coupling (a type closing in both directions when uncoupled) in the fuel line, or

(2) Closing the valve at the fuel container and allowing the engine to run until the fuel in the line is consumed.

(6) *Piping—including pipe, tubing, and fittings.* (i) Pipe from fuel container to first-stage regulator shall be not less than schedule 80 wrought iron or steel (black or galvanized), brass or copper; or seamless copper, brass, or steel tubing. Steel tubing shall have a minimum wall thickness of 0.049 inch. Steel pipe or tubing shall be adequately protected against exterior corrosion. Copper tubing shall be types K or L or equivalent having a minimum wall thickness of 0.032 inch. Approved flexible connections may be used between container and regulator or between regulator and gas-air mixer within the limits of approval. The use of aluminum pipe or tubing is prohibited. In the case of removable containers an approved flexible connection shall be used between the container and the fuel line.

(ii) All piping shall be installed, braced, and supported so as to reduce to a minimum the possibility of vibration strains or wear.

(7) *Safety devices.* (i) Spring-loaded internal type safety relief valves shall be used on all motor fuel containers.

(ii) The discharge outlet from safety relief valves shall be located on the outside of enclosed spaces and as far as practicable from possible sources of ignition, and vented upward within 45 degrees of the vertical in such a manner as to prevent impingement of escaping gas upon containers, or parts of vehicles, or on vehicles in adjacent lines of traffic. A rain cap or other protector shall be used to keep water and dirt from collecting in the valve.

(iii) When a discharge line from the container safety relief valve is used, the line shall be metallic, other than aluminum, and shall be sized, located, and maintained so as not to restrict the required flow of gas from the safety relief valve. Such discharge line shall be able to withstand the pressure resulting from the discharge of vapor when the safety relief valve is in the full open position. When flexibility is necessary, flexible metal hose or tubing shall be used.

(iv) Portable containers equipped for volumetric filling may be filled in either the vertical or horizontal position only

when oriented to place the safety relief valve in communication with the vapor space.

(v) Paragraph (b) (10) (iii) of this section for hydrostatic relief valves shall apply.

(8) *Vaporizers.* (i) Vaporizers and any part thereof and other devices that may be subjected to container pressure shall have a design pressure of at least 250 p.s.i.g.

(ii) Each vaporizer shall have a valve or suitable plug which will permit substantially complete draining of the vaporizer. It shall be located at or near the lowest portion of the section occupied by the water or other heating medium.

(iii) Vaporizers shall be securely fastened so as to minimize the possibility of becoming loosened.

(iv) Each vaporizer shall be permanently marked at a visible point as follows:

(a) With the design pressure of the fuel-containing portion in p.s.i.g.

(b) With the water capacity of the fuel-containing portion of the vaporizer in pounds.

(v) Devices to supply heat directly to a fuel container shall be equipped with an automatic device to cut off the supply of heat before the pressure inside the fuel container reaches 80 percent of the start to discharge pressure setting of the safety relief device on the fuel container.

(vi) Engine exhaust gases may be used as a direct source of heat supply for the vaporization of fuel if the materials of construction of those parts of the vaporizer in contact with exhaust gases are resistant to the corrosive action of exhaust gases and the vaporizer system is designed to prevent excessive pressures.

(vii) Vaporizers shall not be equipped with fusible plugs.

(9) *Gas regulating and mixing equipment.* (i) Approved automatic pressure reducing equipment shall be installed in a secure manner between the fuel supply container and gas-air mixer for the purpose of reducing the pressure of the fuel delivered to the gas-air mixer.

(ii) An approved automatic shutoff valve shall be provided in the fuel system at some point ahead of the inlet of the gas-air mixer, designed to prevent flow of fuel to the mixer when the ignition is off and the engine is not running. In the case of industrial trucks and engines operating in buildings other than those used exclusively to house engines, the automatic shutoff valve shall be designed to operate if the engine should stop. Atmospheric type regulators (zero governors) shall be considered adequate as an automatic shutoff valve only in cases of outdoor operation such as farm tractors, construction equipment, irrigation pump engines, and other outdoor stationary engine installations.

(iii) The source of the air for combustion shall be completely isolated from the passenger compartment, ventilating system, or air-conditioning system.

(10) *Capacity of containers.* No single fuel container used on passenger carry-

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vehicles shall exceed 300 gallons or capacity. No single fuel container other vehicles normally operating on highway shall exceed 300 gallons or capacity except as provided in subparagraph (2) (i) of this paragraph.

(1) *Stationary engines in buildings.* Stationary engines and gas turbines installed in buildings, including portable engines used instead of or to supplement stationary engines, shall comply with the standard for the installation and use of stationary Combustion Engines and Gas turbines, NFPA 37-1970, and the appropriate provisions of paragraphs (b), (c), (d), of this section.

(2) *Portable engines in buildings.* (i) Portable engines may be used in buildings only for emergency use, except as provided by subparagraph (1) of this paragraph.

(ii) Exhaust gases shall be discharged to outside the building or to an area where they will not constitute a hazard.

(3) Provision shall be made to supply sufficient air for combustion and ventilation.

(4) An approved automatic shutoff valve shall be provided in the fuel system of the engine, designed to prevent flow of fuel to the engine when the engine is off or if the engine should

(5) The capacity of LP-Gas containers with such engines shall comply with the applicable occupancy provisions of paragraph (c) (5) of this section.

(6) *Industrial trucks inside buildings.* (i) LP-Gas-fueled industrial trucks permitted to be used in buildings and structures.

(ii) No more than two LP-Gas containers shall be used on an industrial truck for motor fuel purposes.

(iii) LP-Gas-fueled industrial trucks permitted to be used in buildings frequented by the public, when occupied by the public. The total water capacity of containers on each industrial truck shall not exceed 105 pounds (nominal 45 pounds LP-Gas).

(iv) Trucks shall not be left unattended in areas occupied by the public.

(v) Industrial trucks shall not be stored and left unattended in areas of excessive heat or sources of ignition.

(6) *Garaging LP-Gas-fueled vehicles.* LP-Gas-fueled vehicles may be stored or serviced inside garages provided there are no leaks in the fuel system and the fuel tanks are not filled and the maximum filling capacity provided in paragraph (b) (12) (i) of this section.

(7) LP-Gas-fueled vehicles being repaired in garages shall have the container shutoff valve closed except when required for engine operation.

(8) Such vehicles shall not be parked near sources of heat, open flames, or other sources of ignition or near open flames unless such pits are adequately protected.

(9) *Storage of containers awaiting use or resale.*—(1) *Application.* This paragraph shall apply to the storage of portable containers not in excess of 1,000 pounds water capacity, filled or partially filled, at user location but not connected for use, or in storage for resale by dealers or resellers. This paragraph shall not apply to containers stored at charging plants or at plants devoted primarily to the storage and distribution of LP-Gas or other petroleum products.

(2) *General.* (i) Containers in storage shall be located so as to minimize exposure to excessive temperature rise, physical damage, or tampering by unauthorized persons.

(ii) Containers when stored inside shall not be located near exits, stairways, or in areas normally used or intended for the safe exit of people.

(iii) Container valves shall be protected while in storage as follows:

(a) By setting into recess of container to prevent the possibility of their being struck if the container is dropped upon a flat surface, or

(b) By ventilated cap or collar, fastened to container capable of withstanding blow from any direction equivalent to that of a 30-pound weight dropped 4 feet. Construction must be such that a blow will not be transmitted to a valve or other connection.

(iv) The outlet valves of containers in storage shall be closed.

(v) Empty containers which have been in LP-Gas service should preferably be stored in the open. When stored inside, they shall be considered as full containers for the purpose of determining the maximum quantity of LP-Gas permitted by this paragraph.

(3) *Storage within buildings frequented by the public.* (i) DOT specification containers having a maximum individual water capacity of 2½ pounds, used with completely self-contained hand torches and similar applications, are permitted to be stored or displayed in a building frequented by the public. The display of such containers shall be limited to a total of 24 units of each brand and size. The total quantity on display and in storage shall not exceed 200 pounds LP-Gas.

(ii) Storage as provided in subparagraph (3) of this paragraph shall not be permitted within or attached to such a building.

(4) *Storage within buildings not frequented by the public (such as industrial buildings).* (i) The quantity of LP-Gas stored shall not exceed 300 pounds (approximately 2,850 cubic feet in vapor form) except as provided in subparagraph (5) of this paragraph.

(ii) Containers carried as a part of service equipment on highway mobile vehicles are not to be considered in the total storage capacity in subdivision (i) of this subparagraph provided such vehicles are stored in private garages, and are limited to one container per vehicle with an LP-Gas capacity of not more than 100 pounds. All container valves shall be closed.

(5) *Storage within special buildings or rooms.* (i) The quantity of LP-Gas

stored in special buildings or rooms shall not exceed 10,000 pounds.

(ii) The walls, floors, and ceilings of container storage rooms that are within or adjacent to other parts of the building shall be constructed of material having at least a 2-hour fire resistance rating.

(iii) A portion of the exterior walls or roof having an area not less than 10 percent of that of the combined area of the enclosing walls and roof, shall be of single-strength glass or other similar explosion relieving construction.

(iv) Each opening from such storage rooms to other parts of the building shall be protected by a 1½ hour (B) fire door listed by Underwriters Laboratories Inc.

(v) Such rooms shall have no open flames for heating or lighting.

(vi) Such rooms shall be adequately ventilated both top and bottom to the outside only. The openings from such vents shall be at least 5 feet away from any other opening into any building.

(vii) The floors of such rooms shall not be below ground level. Any space below the floor shall be of solid fill or properly ventilated to the open air.

(viii) Such storage rooms shall not be located adjoining the line of property occupied by schools, churches, hospitals, athletic fields or other points of public gathering.

(ix) Fixed electrical equipment shall be installed in accordance with paragraph (b) (18) of this section.

(6) *Storage outside of buildings.* (i) Storage outside of buildings, for containers awaiting use or resale, shall be located in accordance with Table H-33 with respect to the nearest important building or group of buildings; the line of adjoining property which may be built upon; busy thoroughfares; the line of adjoining property occupied by schools, churches, hospitals, athletic fields, or other points of public gathering.

TABLE H-33

Quantity of LP-Gas Stored:	Distance
500 pounds or less.....	0
501 to 2,500 pounds.....	0*
2,501 to 5,000 pounds.....	10 feet
5,001 to 10,000 pounds.....	20 feet
Over 10,000 pounds.....	25 feet

*Container or containers shall be at least 10 feet from any building on adjoining property, any sidewalk, or any of the exposures described in subparagraph (6) (i) (c) or (d) of this paragraph.

(ii) Containers shall be in a suitable enclosure or otherwise protected against tampering.

(7) *Fire protection.* Storage locations other than supply depots separated and located apart from dealer, reseller, or user establishments shall be provided with at least one approved portable fire extinguisher having a minimum rating of 8-B, C.

(g) *LP-Gas system installations on commercial vehicles.*—(1) *Application.* This paragraph applies to LP-Gas-system installations on vehicles (whether self-propelled or of the trailer or semi-trailer type) used for commercial, construction, or public service purposes such

as mobile libraries and clinics; to all exchangeable container systems with container capacities greater than 100 pounds water capacity (approximately 40 pounds LP-Gas capacity) and to systems using containers permanently mounted on vehicles. It does not apply to LP-Gas motor fuel systems covered by paragraph (e) of this section. Paragraph (b) of this section applies to this paragraph unless otherwise noted. When such a vehicle is permanently parked, and LP-Gas is supplied from a system not mounted on and secured to the unit, paragraphs (c) and (d) of this section shall apply.

(2) Construction and marking of containers. Containers shall be constructed in accordance with paragraph (b)(3) of this section, and marked in accordance with the applicable requirements of paragraph (b)(5) of this section, and shall also meet the following:

(i) Containers designed for use as portable cylinders shall be constructed in accordance with DOT specifications, and in accordance with paragraph (b)(3)(iv) of this section; where applicable.

(ii) All other containers whether designed for permanent mounting, or for portable or semiportable use (such as skid tanks), shall be constructed as provided for by paragraphs (b)(3)(i) and (iv) of this section. Mounting, securing, and protection of such containers shall be as in subdivisions (iii) and (iv) of this subparagraph.

(iii) Permanently installed containers shall meet the requirements of subdivision (a) of this subdivision with regard to container valves and accessories, and subdivision (b) of this subdivision as to mounting.

(c) (1) Nonrecessed container fittings and appurtenances shall be protected against damage by either:

(i) Their location.

(ii) A protective housing. The protective housing, if used, shall comply with the requirements under which the tanks are fabricated with respect to design and construction and shall be designed to withstand static loadings in any direction equal to twice the weight of the tank and attachments when filled with the liquid using a safety factor of not less than four, based on the ultimate strength of the material to be used. The housing shall be provided with a weather cover if necessary to insure proper operation of valves and safety devices.

(2) Manually operated shutoff valves, except as covered in paragraph (e)(2)(i) of this section, or self-closing internal valves shall be closed except during transfer operations.

(b) (1) Tank motor vehicles with frames not made integral with the tank, as by welding, shall be provided with turnbuckles or similar positive devices for drawing the tank down tight on the frame. In addition, suitable stops or anchors shall be attached to the frame and/or the tank to prevent relative motion between them due to starting, stopping, and turning. The stops and anchors shall be so installed as to be readily accessible for inspection and maintenance.

(2) Any tank motor vehicle designed and constructed so that the cargo tank constitutes in whole or in part the stress member used in lieu of a frame shall be supported by external cradles subtending at least 120 degrees of the shell circumference. The design calculations shall include beam stress, shear stress, torsion stress, bending moment, and acceleration stress for the cargo tank as a whole using a factor of safety of four, based on the ultimate tensile strength of the material. Maximum concentrated stresses which might be created at pads and cradles due to shear, bending, and torsion shall also be calculated in accordance with Appendix G of the American Society of Mechanical Engineers, Unified Pressure Vessel Code, 1968. Fully loaded vehicles shall be assumed to be operating under highway conditions equal to two "g" loading. The effects of fatigue shall be taken into consideration. Cargo tanks mounted on frames may be supported by longitudinal members attached to pads providing the above-stated factors are taken into account.

(3) Where any tank support is attached to any part of a tank head, the stresses imposed upon the head shall be provided for as required in (2) of this subdivision.

(4) Tank supports, stops, anchors, and bumpers shall not be welded directly to the tank but shall be attached by means of pads of the same material as the tank. The pad thickness shall be not less than one-fourth inch, or the thickness of the shell material if less, and no greater than the shell material. Each pad shall extend at least four times its thickness, in each direction, beyond the weld attaching the support, bumper, stop, or anchor. Each pad shall be preformed to an inside radius no greater than the outside radius of the tank at the place of attachment. Each pad corner shall be rounded to a radius at least one-fourth the width of the pad, and no greater than one-half the width of the pad. Weepholes and tell-tale holes, if used, shall be drilled or punched before the pads are attached to the tank. Each pad shall be attached to the tank by continuous fillet welding using filler material having properties conforming to the recommendations of the maker of the shell and head material.

(iv) Portable or semiportable containers (skid tanks as covered by paragraph (d)(7)(vi) of this section) shall meet the applicable requirements of (a) to (f) of this subdivision inclusive with regard to container valves and accessories and paragraph (e)(4)(iii) of this section as to mounting. Containers designed for permanent installation as part of systems under paragraph (d) of this section shall not be used.

(a) Nonrecessed container fittings and appurtenances shall be protected against damage by either—

(1) Their location.

(2) The vehicle frame or bumper, or

(3) A protective housing. The protective housing, if used, shall comply with the requirements under which the tanks

are fabricated with respect to design and construction and shall be designed to withstand static loadings in any direction equal to twice the weight of the tank and attachments when filled with the liquid using a safety factor of not less than four, based on the ultimate strength of the material to be used. The housing shall be provided with a weather cover if necessary to insure proper operation of valves and safety devices.

(b) Filling connections shall be provided with approved automatic back pressure check valves, excess flow check valves or quick closing internal valves to prevent excessive escape of gas in case the filling connection is broken, except that where the filling and discharge connect on a common opening in the container shell, and that opening is fitted with a quick-closing internal valve as specified in subdivision (c) of this subdivision, the automatic valve shall not be required. In addition every inlet and outlet connection shall be equipped with a manually or automatically operated shutoff valve. Liquid discharge openings, except those for engine fuel lines, on tanks built after September 1, 1968, shall be fitted with a remotely controlled internal shutoff valve. Such valve shall conform to the following requirements:

(1) The seat of the valve shall be inside the tank, or in the opening nozzle or flange, or in a companion flange bolted to the nozzle or flange.

(2) All parts of the valve inside the tank, nozzle, or companion flange shall be made of material not subject to corrosion or other deterioration in the presence of the liquid.

(3) The arrangement of parts shall be such that damage to parts exterior to the tank will not prevent effective seating of the valve.

(4) The valve may be operated normally by mechanical means, by hydraulic means, or by air, or gas pressure.

(5) The valve shall be provided with remote means of automatic closure, both mechanical and thermal, in at least two places for tanks over 3,500 gallons water capacity. These remote control stations shall be located at each end of the tank and diagonally opposite each other. The thermal control mechanism shall have a fusible element with a melting point not over 220° F. or less than 208° F. At least one remote control station shall be provided for tanks of 3,500 gallons water capacity or less, and such actuating means may be mechanical.

(c) All other connections to containers, except those used for gaging devices, thermometer wells, safety relief devices, and plugged openings, shall be provided with suitable automatic excess flow valves, or in lieu thereof may be fitted with quick-closing internal valves.

The control mechanism for the internal valve shall be provided with a secondary control, remote from the fill or discharge connections (for use in the event of accidents or fire during delivery operations), and such control mechanism shall have a fusible element with a melting point not over 220° F. or less than 208° F.

(2) All other systems in accordance with paragraph (d) (3) (ii) through (vii) of this section.

(3) Portable, semiportable and permanently mounted containers shall be mounted and protected as provided under subparagraph (2) (ii) through (iv) of this paragraph.

(4) *Safety-relief devices.* (i) DOT containers shall be provided with safety-relief devices as required by the regulations of DOT.

(ii) ASME containers and API-ASME containers shall be provided with safety-relief devices as required by paragraph (b) (10) of this section.

(iii) (a) A final stage regulator of an LP-Gas system (excluding any appliance regulator) shall be equipped on the low-pressure side with a relief valve which is set to start to discharge within the limits specified in Table H-30.

(b) The relief valve and space above the regulator and relief valve diaphragms shall be vented to the outside air and terminate at a position to minimize the possibility of vapors accumulating at sources of ignition.

(iv) Whenever equipment such as a cargo heater or cooler on commercial vehicles is a type designed to be in operation while in transit, suitable means to stop the flow such as an excess flow valve or other device, shall be installed. This device will be actuated to stop the flow in the event of the break in the fuel supply line. All excess flow valves shall comply with paragraph (b) (7) (iii) of this section.

(5) *System design and line pressure.* Systems may be of either vapor withdrawal or liquid withdrawal type and shall comply with the applicable requirements for the type of usage involved.

(6) *System enclosure and mounting.* (i) Housing or enclosures shall be designed to provide proper ventilation.

(ii) Hoods, domes, or removable portions of cabinets shall be provided with means to keep them firmly in place during transit.

(iii) Provision shall be incorporated in the assembly to hold the containers firmly in position and prevent their movement during transit in accordance with paragraph (e) (4) (iii) of this section.

(iv) Containers shall be mounted on a substantial support or base secured firmly to the vehicle chassis. Neither the container nor its support shall extend below the frame.

(10) *Piping—including pipe, tubing, and fittings.* (i) Regulators shall be connected directly to the container valve outlet or mounted securely by means of a support bracket and connected to the container valve or valves with a listed high pressure flexible connector.

(ii) Provision shall be made between the regulator outlet and the gas service lines by either a flexible connector or a tubing loop to provide for expansion, contraction, jarring, and vibration.

(iii) Pipe, tubing, and fittings shall conform to paragraph (b) (8) of this section except that the use of aluminum alloy piping is prohibited. Steel tubing shall have a minimum wall thickness of 0.049 inch. Steel piping or tubing shall be adequately protected against exterior corrosion.

(iv) Approved gas tubing fittings shall be employed for making tubing connections.

(v) The fuel line shall be firmly fastened in a protected location and where under the vehicle and outside and below any insulation or false bottom, fastenings shall be such as to prevent abrasion or damage to the gasoline due to vibration. Where the fuel line passes through structural members or floors, a rubber grommet or equivalent shall be installed to prevent chafing.

(vi) The fuel line shall be installed to enter the vehicle through the floor directly beneath or adjacent to the appliance which it serves. When a branch line is required the tee connection shall be in the main fuel line and located under the floor and outside the vehicle.

(vii) All parts of the system assembly shall be so designed and secured as to preclude such parts working loose during transit.

(11) *Appliances.* (i) LP-Gas appliances shall be approved for use on commercial vehicles.

(ii) In the case of vehicles not intended for human occupancy and where the gas-fired heating appliance is used to protect the cargo, such heater may be of the unvented type but provision shall be made to dispose of the products of combustion to the outside.

(iii) In the case of vehicles intended for human occupancy, all gas-fired heating appliances, including water heaters, shall be designed or installed to provide for complete separation of the combustion system from the atmosphere of the living space. Such appliances shall be installed with the combustion air inlet assembly furnished as a component of the appliance and, also, with either—

(a) The flue gas outlet assembly furnished as a component of the appliance, or

(b) A listed roof jack if the appliance is listed for such use.

The combustion air inlet assembly, flue gas outlet assembly, and roof jack shall extend to the outside atmosphere.

(iv) Provision shall be made to insure an adequate supply of outside air for combustion.

(v) All gas-fired heating appliances and water heaters shall be equipped with an approved automatic device designed to shut off the flow of gas to the main burner and to the pilot in the event the pilot flame is extinguished.

(vi) Gas-fired appliances installed in the cargo space shall be located so they are readily accessible.

(vii) Appliances shall be constructed or protected to reduce to a minimum possible damage or impaired operation resulting from cargo shifting or handling.

(1) DOT containers shall be provided with safety-relief devices as required by the regulations of DOT.

(2) ASME containers and API-ASME containers shall be provided with safety-relief devices as required by paragraph (b) (10) of this section.

(3) A final stage regulator of an LP-Gas system (excluding any appliance regulator) shall be equipped on the low-pressure side with a relief valve which is set to start to discharge within the limits specified in Table H-30.

(4) The relief valve and space above the regulator and relief valve diaphragms shall be vented to the outside air and terminate at a position to minimize the possibility of vapors accumulating at sources of ignition.

(5) Whenever equipment such as a cargo heater or cooler on commercial vehicles is a type designed to be in operation while in transit, suitable means to stop the flow such as an excess flow valve or other device, shall be installed. This device will be actuated to stop the flow in the event of the break in the fuel supply line. All excess flow valves shall comply with paragraph (b) (7) (iii) of this section.

(6) *System design and line pressure.* Systems may be of either vapor withdrawal or liquid withdrawal type and shall comply with the applicable requirements for the type of usage involved.

(7) *System enclosure and mounting.* (i) Housing or enclosures shall be designed to provide proper ventilation.

(ii) Hoods, domes, or removable portions of cabinets shall be provided with means to keep them firmly in place during transit.

(iii) Provision shall be incorporated in the assembly to hold the containers firmly in position and prevent their movement during transit in accordance with paragraph (e) (4) (iii) of this section.

(iv) Containers shall be mounted on a substantial support or base secured firmly to the vehicle chassis. Neither the container nor its support shall extend below the frame.

(10) *Piping—including pipe, tubing, and fittings.* (i) Regulators shall be connected directly to the container valve outlet or mounted securely by means of a support bracket and connected to the container valve or valves with a listed high pressure flexible connector.

(ii) Provision shall be made between the regulator outlet and the gas service lines by either a flexible connector or a tubing loop to provide for expansion, contraction, jarring, and vibration.

(iii) Pipe, tubing, and fittings shall conform to paragraph (b) (8) of this section except that the use of aluminum alloy piping is prohibited. Steel tubing shall have a minimum wall thickness of 0.049 inch. Steel piping or tubing shall be adequately protected against exterior corrosion.

(iv) Approved gas tubing fittings shall be employed for making tubing connections.

(v) The fuel line shall be firmly fastened in a protected location and where under the vehicle and outside and below any insulation or false bottom, fastenings shall be such as to prevent abrasion or damage to the gasoline due to vibration. Where the fuel line passes through structural members or floors, a rubber grommet or equivalent shall be installed to prevent chafing.

(vi) The fuel line shall be installed to enter the vehicle through the floor directly beneath or adjacent to the appliance which it serves. When a branch line is required the tee connection shall be in the main fuel line and located under the floor and outside the vehicle.

(vii) All parts of the system assembly shall be so designed and secured as to preclude such parts working loose during transit.

(11) *Appliances.* (i) LP-Gas appliances shall be approved for use on commercial vehicles.

(ii) In the case of vehicles not intended for human occupancy and where the gas-fired heating appliance is used to protect the cargo, such heater may be of the unvented type but provision shall be made to dispose of the products of combustion to the outside.

(iii) In the case of vehicles intended for human occupancy, all gas-fired heating appliances, including water heaters, shall be designed or installed to provide for complete separation of the combustion system from the atmosphere of the living space. Such appliances shall be installed with the combustion air inlet assembly furnished as a component of the appliance and, also, with either—

(a) The flue gas outlet assembly furnished as a component of the appliance, or

(b) A listed roof jack if the appliance is listed for such use.

The combustion air inlet assembly, flue gas outlet assembly, and roof jack shall extend to the outside atmosphere.

(iv) Provision shall be made to insure an adequate supply of outside air for combustion.

(v) All gas-fired heating appliances and water heaters shall be equipped with an approved automatic device designed to shut off the flow of gas to the main burner and to the pilot in the event the pilot flame is extinguished.

(vi) Gas-fired appliances installed in the cargo space shall be located so they are readily accessible.

(vii) Appliances shall be constructed or protected to reduce to a minimum possible damage or impaired operation resulting from cargo shifting or handling.

TABLE II-30

¹ Container type may be increased by increments of 25. The minimum design pressure of containers shall be 100 percent of the container type designation when constructed under 1908 or earlier editions of the ASME Code (Par. U-41 and U-49). The minimum design pressure of containers shall be 150 percent of the container type designation when constructed under (1) the 1950 ASME Code (Paragraphs U-20 and U-41), (2) 1950, 1955, 1960, 1965, 1970, 1976, and 1982 editions of the ASME Code, and (3) all editions of the API-ASME Code.

(2) An internal excess flow valve.

provided with a suitable pressure gage.

(5) **Capacity of liquid containers.** Individual liquid storage containers shall not exceed 30,000 gallons water capacity.

Installation of storage containers. All LP-Gas storage containers used exclusively in service station operations shall comply with the following table which specifies minimum distances to a building, groups of buildings, and adjoining property lines which may be built upon.

Water capacity per container (gallons)	Minimum distance	
	Above ground and underground (feet)	Between aboveground containers (feet)
Up to 1,000.....	25	5
Over 1,000.....	30	5

Note: The above distances may be reduced to not less than 10 feet for service station buildings of other than wood frame construction.

(b) Readily ignitable material including weeds and long dry grass, shall be removed within 10 feet of containers.

(c) The minimum separation between LP-Gas containers and flammable liquid tanks shall be 20 feet and the minimum separation between a container and the centerline of the dike shall be 10 feet.

(d) LP-Gas containers located near flammable liquid containers shall be protected against the flow or accumulation of flammable liquids by dikes, diversion curbs, or grading.

(e) LP-Gas containers shall not be located within diked areas for flammable liquid containers.

(f) Field welding is permitted only on saddle plates or brackets which were applied by the container manufacturer.

(g) When permanently installed containers are interconnected, provision shall be made to compensate for expansion, contraction, vibration, and settling of containers and interconnecting piping. Where flexible connections are used, they shall be of an approved type and shall be designed for a bursting pressure of not less than five times the vapor pressure of the product at 100° F. The use of nonmetallic hose is prohibited for interconnecting such containers.

(h) Where high water table or flood conditions may be encountered protection against container flotation shall be provided.

(i) Aboveground containers shall be installed in accordance with this subdivision.

(a) Containers may be installed horizontally or vertically.

(b) Containers shall be protected by crash rails or guards to prevent physical damage unless they are so protected by virtue of their location. Vehicles shall not be serviced within 10 feet of containers.

(c) Container foundations shall be of substantial masonry or other noncombustible material. Containers shall be mounted on saddles which shall permit expansion and contraction, and shall provide against the excessive concentration of stresses. Corrosion protection shall be provided for tank-mounting areas. Structural metal container supports shall be protected against fire. This protection is not required on prefabricated storage and pump assemblies.

mounted on a common base, with containers bottom not more than 24 inches above ground and whose water capacity is 2,000 gallons or less if the piping connected to the storage and pump assembly is sufficiently flexible to minimize the possibility of breakage or leakage in the event of failure of the container supports.

(iii) Underground containers shall be installed in accordance with this subdivision.

(d) Containers shall be given a protective coating before being placed under ground. This coating shall be equivalent to hot-dip galvanizing or to two coatings of red lead followed by a heavy coating of coal tar or asphalt. In lowering the container into place, care shall be exercised to minimize abrasion or other damage to the coating. Damage to the coating shall be repaired before backfilling.

(b) Containers shall be set on a firm foundation (firm earth may be used) and surrounded with earth or sand firmly tamped in place. Backfill should be free of rocks or other abrasive materials.

(c) A minimum of 2 feet of earth cover shall be provided. Where ground conditions make compliance with this requirement impractical, equivalent protection against physical damage shall be provided. The portion of the container to which manhole and other connections are attached need not be covered. If the location is subjected to vehicular traffic, containers shall be protected by a concrete slab or other cover adequate to prevent the weight of a loaded vehicle imposing concentrated direct loads on the container shell.

(7) **Protection of container fittings.** Valves, regulators, gages, and other container fittings shall be protected against tampering and physical damage.

(8) **Transport truck unloading point.** (i) During unloading, the transport truck shall not be parked on public thoroughfares and shall be at least 5 feet from storage containers, and shall be positioned so that shutoff valves are readily accessible.

(ii) The filling pipe inlet terminal shall not be located within a building nor within 10 feet of any building or driveway. It shall be protected against physical damage.

(9) **Piping, valves, and fittings.** (i) Piping may be underground, above ground, or a combination of both. It shall be well supported and protected against physical damage and corrosion.

(ii) Piping laid beneath driveways shall be installed to prevent physical damage by vehicles.

(iii) Piping shall be wrought iron or steel (black or galvanized), brass or copper pipe; or seamless copper, brass, or steel tubing and shall be suitable for a minimum pressure of 250 p.s.i.g. Pipe joints may be screwed, flanged, brazed, or welded. The use of aluminum alloy piping or tubing is prohibited.

(iv) All shutoff valves (liquid or gas) shall be suitable for liquefied petroleum

gas service and designed for not less than the maximum pressure to which they may be subjected. Valves which may be subjected to container pressure shall have a rated working pressure of at least 266 p.s.i.g.

(v) All materials used for valve seats, packing, gaskets, diaphragms, etc., shall be resistant to the action of LP-Gas.

(vi) Fittings shall be steel, malleable iron, or brass having a minimum working pressure of 250 p.s.i.g. Cast iron pipe fittings, such as elbows, tees, and unions shall not be used.

(vii) All piping shall be tested after assembly and proved free from leaks at not less than normal operating pressures.

(viii) Provision shall be made for expansion, contraction, jarring, and vibration, and for settling. This may be accomplished by flexible connections.

(10) **Pumps and accessories.** All pumps and accessory equipment shall be suitable for LP-Gas service, and designed for not less than the maximum pressure to which they may be subjected. Accessories shall have a minimum rated working pressure of 266 p.s.i.g. Positive displacement pumps shall be equipped with suitable pressure actuated bypass valves permitting flow from pump discharge to storage container or pump suction.

(11) **Dispensing devices.** (i) Meters, vapor separators, valves, and fittings in the dispenser shall be suitable for LP-Gas service and shall be designed for a minimum working pressure of 250 p.s.i.g.

(ii) Provisions shall be made for venting LP-Gas contained in a dispensing device to a safe location.

(iii) Pumps used to transfer LP-Gas shall be equipped to allow control of the flow and to prevent leakage or accidental discharge. Means shall be provided outside the dispensing device to readily shut off the power in the event of fire or accident.

(iv) A manual shutoff valve and an excess flow check valve shall be installed downstream of the pump and ahead of the dispenser inlet.

(v) Dispensing hose shall be resistant to the action of LP-Gas in the liquid phase and designed for a minimum bursting pressure of 1,250 p.s.i.g.

(b) An excess flow check valve or automatic shutoff valve shall be installed at the terminus of the liquid line at the point of attachment of the dispensing hose.

(v) (a) LP-Gas dispensing devices shall be located not less than 10 feet from aboveground storage containers greater than 2,000 gallons water capacity. The dispensing devices shall not be less than 20 feet from any building (not including canopies), basement, cellar, pit, or line of adjoining property which may be built upon and not less than 10 feet from sidewalks, streets, or thoroughfares. No drains or blowoff lines shall be directed into or in proximity to the sewer systems used for other purposes.

(b) LP-Gas dispensing devices shall be installed on a concrete foundation or as part of a complete storage and dispensing assembly mounted on a common base.

shall be constructed, protected from weather, and shall be located as follows:

(v) The dispensing device shall not be located in a building except that they may be located under a weather shelter or canopy provided this area is not enclosed on more than two sides. If the enclosing sides are adjacent to each other, the area shall be properly ventilated.

(vi) The dispensing of LP-Gas into the fuel container of a vehicle shall be performed by a competent attendant who shall remain at the LP-Gas dispenser during the entire transfer operation.

(12) **Additional rules.** There shall be no smoking on the driveway of service stations in the dispensing area or transport truck unloading areas. Conspicuous signs prohibiting smoking shall be posted within sight of the customer being served. Letters on such signs shall be not less than 4 inches high. The motors of all vehicles being fueled shall be shut off during the fueling operations.

(13) **Electrical.** Electrical equipment and installations shall conform to paragraphs (b) (17) and (18) of this section.

(14) **Fire protection.** Each service station shall be provided with at least one approved portable fire extinguisher having at least an A-B, C, rating.

§ 1910.111 Storage and handling of anhydrous ammonia.

(a) **General.**—(1) **Scope.** (i) This standard is intended to apply to the design, construction, location, installation, and operation of anhydrous ammonia systems including refrigerated ammonia storage systems.

(ii) This standard does not apply to: (a) Ammonia manufacturing plants. (b) Refrigeration plants where ammonia is used solely as a refrigerant.

(2) **Definitions.** As used in this section: (i) **"Appurtenances"**—All devices such as pumps, safety relief devices, liquid-level gaging devices, valves, and pressure gauges.

(ii) **"Cylinder"**—A container of 1,000 pounds of water capacity or less constructed in accordance with Department of Transportation specifications.

(iii) **"Code"**—The Boiler and Pressure Vessel Code, Section VIII, Unfired Pressure Vessels of the American Society of Mechanical Engineers (ASME)—1963.

(iv) **"Container"**—Includes all vessels, tanks, cylinders, or spheres used for transportation, storage, or application of anhydrous ammonia.

(v) **"DOT"**—U.S. Department of Transportation.

(vi) **"Design pressure"** is identical to the term "Maximum Allowable Working Pressure" used in the Code.

(vii) **"Farm vehicle"** (Implement of husbandry)—A vehicle for use on a farm on which is mounted a container of not over 1,200 gallons water capacity.

(viii) **"Filling density"**—the percent ratio of the weight of the gas in a container to the weight of water at 60° F. that the container will hold.

(ix) **"Gas"**—Anhydrous ammonia in either the gaseous or liquefied state.

(x) **"Liquefied gas"**—Anhydrous ammonia in the liquid state.

(xi) **"Capacity"**—Total volume of the container in standard U.S. gallons.

(xii) **"DOT specifications"**—Regulations of the Department of Transportation published in 49 CFR Chapter I.

(xiii) **"DOT regulations"**—See § 1910.911(a) (1) (xii).

(xiv) **"DOT requirements"**—See § 1910.911(a) (1) (xii).

(b) **Basic rules.** This paragraph applies to all paragraphs of this section unless otherwise noted.

(1) **Approval of equipment and systems.** The appurtenances of each system shall be listed by at least one of the following nationally recognized testing laboratories: Underwriters Laboratories, Inc.; Factory Mutual Engineering Corp.

(2) **Requirements for construction, original test and requalification of non-refrigerated containers.** (i) Containers used with systems covered in paragraphs (c), (f), (g), and (h) of this section shall be constructed and tested in accordance with the Code except that construction under Table UW12 at a basic joint efficiency of under 90 percent is not authorized.

(ii) Containers built according to the Code do not have to comply with Paragraphs UG125 to UG128 inclusive, and Paragraphs UG132 and UG133 of the Code.

(iii) Containers exceeding 36 inches in diameter or 250 gallons water capacity shall be constructed to comply with one or more of the following:

(a) Containers shall be stress relieved after fabrication in accordance with the Code, or

(b) Cold-formed heads, when used, shall be stress relieved, or

(c) Hot-formed heads shall be used.

(iv) Welding to the shell, head, or any other part of the container subject to internal pressure shall be done in compliance with the Code. Other welding is permitted only on saddle plates, lugs, or brackets attached to the container by the container manufacturer.

(v) Containers used with systems covered in paragraph (e) of this section shall be constructed and tested in accordance with the DOT specifications.

(vi) The provisions of subdivision (i) of this subparagraph shall not be construed as prohibiting the continued use or reinstallation of containers constructed and maintained in accordance with the 1949, 1950, 1952, 1956, 1959, and 1962 editions of the Code or any revisions thereof in effect at the time of fabrication.

(3) **Marking nonrefrigerated containers.** (i) System nameplates, when required, shall be permanently attached to the system so as to be readily accessible for inspection and shall include markings as prescribed in subdivision (ii) of this subparagraph.

(ii) Each container or system covered in paragraphs (c), (f), (g), and (h) of this section shall be marked as specified in the following:

(c) **With a marking**—The marking shall be placed with the name of the system which the container is used for.

Under ground: Container and system nameplate.

Above ground: Container.

(d) **With a notation whether the system is designed for underground or aboveground installation or both.**

(e) **With the name and address of the supplier of the system or the trade name of the system and with the date of fabrication.**

Under ground and above ground: System nameplate.

(f) **With the water capacity of the container in pounds at 60° F. or gallons, U.S. Standard.**

Under ground: Container and system nameplate.

Above ground: Container.

(g) **With the design pressure in pounds per square inch.**

Under ground: Container and system nameplate.

Above ground: Container.

(h) **With the wall thickness of the shell and heads.**

Under ground: Container and system nameplate.

Above ground: Container.

(i) **With marking indicating the maximum level to which the container may be filled with liquid anhydrous ammonia at temperatures between 30° F. and 130° F. except on containers provided with fixed level indicators, such as fixed length dip tubes, or containers that are filled with weight. Markings shall be in increments of not more than 20° F.**

Above ground and under ground: System nameplate or on liquid-level gaging device.

(j) **With the total outside surface area of the container in square feet.**

Under ground: System nameplate.

Above ground: No requirement.

(k) **Marking specified on the container shall be on the container itself or on a nameplate permanently attached to it.**

(4) **Marking refrigerated containers.** Each refrigerated container shall be marked with nameplate on the outer covering in an accessible place as specified in the following:

(i) With the notation, "Anhydrous Ammonia."

(ii) With the name and address of the builder and the date of fabrication.

(iii) With the water capacity of the container in gallons, U.S. Standard.

(iv) With the design pressure.

(v) With the minimum temperature in degrees Fahrenheit for which the container was designed.

(vi) The maximum allowable water level to which the container may be filled for test purposes.

(vii) With the density of the product in pounds per cubic foot for which the container was designed.

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shall be the maximum level to which the container may be filled with anhydrous ammonia.

(b) Location of containers. The location shall be given in the physical effects of ammonia as well as to adjacent fire hazards in selecting the location for a storage container. Containers shall be located outside of buildings in buildings or sections thereof especially provided for this purpose.

(ii) Permanent storage containers shall be located at least 50 feet from a well or other source of potable water supply, unless the container is a part of a water-treatment installation.

(iii) Permanent storage containers shall be located outside densely populated areas.

(iv) Container locations shall comply with table H-35:

TABLE H-35

Nominal capacity of container (gallons)	Minimum distances (feet) from container to:		
	Line of adjoining property which may be built upon	Place of public assembly	Institutional occupancy
or 500 to 1,000	25	150	250
or 1,000 to 10,000	50	300	500
or 10,000 to 50,000	50	450	750
or 50,000 to 100,000	50	600	1,000

(v) Storage areas shall be kept free readily ignitable materials such as straw, weeds, and long dry grass.

(6) Container appurtenances. (i) All appurtenances shall be designed for not less than the maximum working pressure that portion of the system on which they are installed. All appurtenances shall be fabricated from materials proved suitable for anhydrous ammonia service.

(ii) All connections to containers except safety relief devices, gaging devices, those fitted with No. 54 drill-size orifice shall have shutoff valves located as close to the container as practicable.

(iii) Excess flow valves where required these standards shall close automatically at the rated flows of vapor or liquid specified by the manufacturer. The connections and line including valves and fittings being protected by an excess flow valve shall have a greater capacity than the rated flow of the excess flow valve that the valve will close in case of failure of the line or fittings.

(iv) Liquid-level gaging devices that require bleeding of the product to the atmosphere and which are so constructed that outward flow will not exceed that used by a No. 54 drill-size opening need be equipped with excess flow valves.

(v) Openings from the container or through fittings attached directly on the container to which pressure gage connections are made need not be equipped with excess flow valves if such openings are not larger than No. 54 drill size.

(vi) Excess flow and back pressure check valves where required by the standards in this section shall be located in-

side of the container or at a point outside as close as practicable to where the line enters the container. In the latter case installation shall be made in such manner that any undue strain beyond the excess flow or back pressure check valve will not cause breakage between the container and the valve.

(vii) Excess flow valves shall be designed with a bypass, not to exceed a No. 60 drill-size opening to allow equalization of pressures.

(viii) All excess flow valves shall be plainly and permanently marked with the name or trademark of the manufacturer, the catalog number, and the rated capacity.

(7) Piping, tubing, and fittings. (i) All piping, tubing, and fittings shall be made of material suitable for anhydrous ammonia service.

(ii) All piping, tubing, and fittings shall be designed for a pressure not less than the maximum pressure to which they may be subjected in service.

(iii) All refrigerated piping shall conform to the Refrigeration Piping Code, American National Standards Institute, B31.5-1966 with addenda B31.1a-1968 as it applies to ammonia.

(iv) Piping used on non-refrigerated systems shall be at least American Society for Testing and Materials (ASTM) A-53-69 Grade B Electric Resistance Welded and Electric Flash Welded Pipe or equal. Such pipe shall be at least schedule 40 when joints are welded, or welded and flanged. Such pipe shall be at least schedule 80 when joints are threaded. Threaded connections shall not be back-welded. Brass, copper, or galvanized steel pipe shall not be used.

(v) Tubing made of brass, copper, or other material subject to attack by ammonia shall not be used.

(vi) Cast iron fittings shall not be used but this shall not prohibit the use of fittings made specifically for ammonia service of malleable, nodular, or high strength gray iron meeting American Society for Testing and Materials (ASTM) A47-68, ASTM 396-68, or ASTM A126-66 Class B or C.

(vii) Joint compounds shall be resistant to ammonia.

(8) Hose specifications. (i) Hose used in ammonia service shall conform to the Joint Agricultural Ammonia Institute-Rubber Manufacturers Association Specifications for Anhydrous Ammonia Hose.

(ii) Hose subject to container pressure shall be designed for a minimum working pressure of 350 p.s.i.g. and a minimum burst pressure of 1,750 p.s.i.g. Hose assemblies, when made up, shall be capable of withstanding a test pressure of 500 p.s.i.g.

(iii) Hose and hose connections located on the low-pressure side of flow control or pressure-reducing valves shall be designed for a bursting pressure of not less than five times the pressure setting of the safety relief devices protecting that portion of the system but not less than 125 p.s.i.g. All connections shall be so designed and constructed that there will be no leakage when connected.

(iv) Where hose is to be used for transferring liquid from one container to another, "wet" hose is recommended. Such hose shall be equipped with approved shutoff valves at the discharge end. Provisions shall be made to prevent excessive pressure in the hose.

(v) On all hose one-half inch outside diameter and larger, used for the transfer of anhydrous ammonia liquid or vapor, there shall be etched, cast, or impressed at 8-foot intervals the following information:

"Anhydrous Ammonia" xxx p.s.i.g. (maximum working pressure), manufacturer's name or trademark, year of manufacture.

In lieu of this requirement the same information may be contained on a nameplate permanently attached to the hose.

TABLE H-36

Minimum required rate of discharge in cubic feet per minute of air at 150 percent of the maximum permitted start to discharge pressure for safety relief valves.

Surface area (sq. ft.)	Flow rate CFM
25	250
30	310
35	360
40	405
45	450
50	501
55	547
60	591
65	635
70	678
75	720
80	762
85	804
90	845
95	885
100	925
105	965
110	1,010
115	1,050
120	1,090
125	1,130
130	1,180
135	1,230
140	1,280
145	1,310
150	1,350
155	1,390
160	1,430
165	1,460
170	1,500
175	1,550
180	1,570
185	1,600
190	1,640
195	1,670
200	1,710
210	1,780
220	1,850
230	1,920
240	1,980
250	2,050
260	2,120
270	2,180
280	2,250
290	2,320
300	2,380
310	2,450
320	2,510
330	2,570
340	2,640
350	2,700
360	2,760
370	2,820
380	2,890
390	2,960

Surf area sq. ft.	CFM at 60° F.
400	2,111
450	2,355
500	2,599
550	2,843
600	3,087
650	3,331
700	3,575
750	3,819
800	4,063
850	4,307
900	4,551
950	4,795
1,000	5,039
1,050	5,283
1,100	5,527
1,150	5,771
1,200	6,015
1,250	6,259
1,300	6,503
1,350	6,747
1,400	6,991
1,450	7,235
1,500	7,479
1,550	7,723
1,600	7,967
1,650	8,211
1,700	8,455
1,750	8,699
1,800	8,943
1,850	9,187
1,900	9,431
1,950	9,675
2,000	9,919
2,050	10,163
2,100	10,407
2,150	10,651
2,200	10,895
2,250	11,139
2,300	11,383
2,350	11,627
2,400	11,871
2,450	12,115
2,500	12,359

"Surface Area = total outside surface area of container in square feet. When the surface area is not stamped on the nameplate or when the marking is not legible the area can be calculated by using one of the following formulas:

(1) Cylindrical container with hemispherical heads:
Area = overall length in feet times outside diameter in feet times 3.1416.

(2) Cylindrical container with other than hemispherical heads:
Area = (overall length in feet plus 0.3 outside diameter in feet) times outside diameter in feet times 3.1416.

(3) Spherical container:
Area = outside diameter in feet squared times 3.1416."

"Flow Rate—CFM Air = cubic feet per minute of air required at standard conditions, 60° F. and atmospheric pressure (14.7 p.s.i.a.)."

"The rate of discharge may be interpolated for intermediate values of surface area. For containers with total outside surface area greater than 2,500 square feet, the required flow rate can be calculated using the formula: Flow Rate CFM Air = 22.11 A^{0.66}, where A = outside surface area of the container in square feet."

(9) **Safety relief devices.** (i) Every container used in systems covered by paragraphs (c), (f), (g), and (h) of this section shall be provided with one or more safety relief valves of the spring-loaded or equivalent type. The discharge from safety-relief valves shall be vented away from the container upward and unobstructed to the atmosphere. All relief-valve discharge openings shall

be so located that the discharge will not create a hazard to personnel or property. The discharge shall be made in such a manner that the discharge will not interfere with the provisions of these regulations.

(ii) Containers safety-relief valves shall be set to start to discharge as follows with reference to the design pressure of the container:

Container	Minimum (percent)	Maximum (percent)
ASME U-1, U-2	125	135
ASME U-2A, U-2B	95	105
ASME U-2C, 2D, 2E, or 2F	95	105
API-650	95	105
U.S. Coast Guard	95	105

As required by DOT Regulations.

(iii) Safety relief devices used in systems covered by paragraphs (c), (f), (g), and (h) of this section shall be constructed to discharge at not less than the rates required in subdivision (i) of this subparagraph before the pressure is in excess of 125 percent (not including the 10 percent tolerance referred to in subdivision (ii) of this subparagraph) of the maximum permitted start-to-discharge pressure setting of the device.

(iv) Safety-relief valves shall be so arranged that the possibility of tampering will be minimized. If the pressure setting adjustment is external, the relief valves shall be provided with means for sealing the adjustment.

(v) Shutoff valves shall not be installed between the safety-relief valves and the container; except, that a shutoff valve may be used where the arrangement of this valve is such as always to afford full required capacity flow through the relief valves.

(vi) Safety-relief valves shall direct communication with the vapor space of the container.

(vii) Each container safety-relief valve used with systems covered by paragraphs (c), (f), (g), and (h) of this section shall be plainly and permanently marked with the symbol "NH₃" or "AA"; with the pressure in pounds-per-square-inch gage at which the valve is set to start-to-discharge; with the actual rate of discharge of the valve at its full open position in cubic feet per minute of air at 60° F. and atmospheric pressure; and with the manufacturer's name and catalog number. Example: "NH₃, 250-4050 Air" indicates that the valve is suitable for use on an anhydrous ammonia container, is set to start-to-discharge at a pressure of 250 p.s.i.g., and that its rate of discharge at full open position (subdivisions (ii) and (iii) of this subparagraph) is 4,050 cubic feet per minute of air.

(viii) The flow capacity of the relief valve shall not be restricted by any connection to it on either the upstream or downstream side.

(ix) A hydrostatic relief valve shall be installed between each pair of valves in the liquid ammonia piping or hose where liquid may be trapped so as to relieve into the atmosphere at a safe location.

Each container shall have at least two safety-relief valves, one of which shall be suitable for emergency action.

(10) All stationary storage installations shall have at least two suitable safety-relief valves in readily accessible locations. Full face masks with ammonia canisters as approved by the Bureau of Mines, U.S. Department of the Interior (see 30 CFR Part 11), are suitable for emergency action for most leaks, particularly those that occur outdoors. For protection in concentrated ammonia atmospheres self-contained breathing air apparatus is required.

(11) Stationary storage installations shall have an easily accessible shower or a 50-gallon drum of water.

(iv) Each vehicle transporting ammonia in bulk except farm applicator vehicles shall carry a container of at least 5 gallons of water and shall be equipped with a full face mask.

(11) **Charging of containers.** (i) The filling densities for containers that are not refrigerated shall not exceed the following:

Type of container	Percent by volume	Percent by weight
Aboveground—Uninsulated	85	85
Aboveground—Insulated	85	85
Belowground—Uninsulated	85	85
DOT—In accord with DOT regulations	85	85

(ii) Aboveground uninsulated containers may be charged 87.5 percent by volume provided the temperature of the anhydrous ammonia being charged is determined to be not lower than 30° F. or provided the charging of the container is stopped at the first indication of frost or ice formation on its outside surface and is not resumed until such frost or ice has disappeared.

(iii) Any container, including DOT cargo and portable tanks, shipped under DOT jurisdiction shall be filled according to DOT regulations.

(iv) Refer to paragraph (d) of this section for filling densities of refrigerated storage containers.

(12) **Transfer of liquids.** (i) Anhydrous ammonia shall always be at a temperature suitable for the material of construction and the design of the receiving container.

(ii) The employer shall require the continuous presence of an attendant in the vicinity of the operation during such time as ammonia is being transferred.

(iii) Containers shall be charged or used only upon authorization of the owner.

(iv) Containers shall be gaged and charged only in the open atmosphere or in buildings or areas thereof provided for that purpose.

(v) Pumps used for transferring ammonia shall be those manufactured for that purpose.

(a) Pumps shall be designed for at least 250 p.s.i.g. working pressure.

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(c) Positive displacement pumps shall be installed off the discharge port of the differential relief valve discharging into the suction port of the pump through a line of sufficient size to carry the full capacity of the pump at that valve setting, which setting and installation shall be according to the pump manufacturer's recommendations.

(c) On the discharge side of the pump, before the relief valve line, there shall be installed a pressure gage graduated from 0 to 400 p.s.i.

(d) Plant piping shall contain shutoff valves located as close as practical to pump connections.

(vi) Compressors used for transferring refrigerating ammonia shall be recommended for ammonia service by the manufacturer.

(e) Compressors shall be designed for at least 250 p.s.i.g. working pressure.

(b) Plant piping shall contain shutoff valves located as close as practical to compressor connections.

(c) A relief valve large enough to discharge the full capacity of the compressor shall be connected to the discharge before any shutoff valve.

(d) Compressors shall have pressure gauges at suction and discharge graduated to at least one and one-half times the maximum pressure that can be developed.

(e) Adequate means, such as drainable liquid trap, shall be provided on the compressor suction to minimize the entry of liquid into the compressor.

(f) Where necessary to prevent contamination, an oil separator shall be provided on the discharge side of the compressor.

(vii) Loading and unloading systems shall be protected by suitable devices to prevent emptying of the storage container or the container being loaded or unloaded in the event of severance of the hose. Backflow check valves or properly sized excess flow valves shall be installed here necessary to provide such protection. In the event that such valves are of practical, remotely operated shutoff valves may be installed.

(13) Tank car unloading points and operations. (i) Provisions for unloading tank cars shall conform to the applicable recommendations contained in the OT regulations.

(ii) The employer shall insure that unloading operations are performed by suitable persons properly instructed and given the authority to monitor careful compliance with all applicable procedures.

(iii) Caution signs shall be so placed on the track or car as to give necessary warning to persons approaching the car from open end or ends of siding and shall be left up until after the car is loaded and disconnected from discharge connections. Signs shall be of metal or other suitable material, at least 15 inches in size and bear the words "STOP—Tank Car Connected" or "STOP—Men at Work" the word, "STOP," being in letters at least 4 inches high and the other words in letters at least 2 inches high. The letters shall be white on a blue background.

(iv) The track of a tank car siding shall be substantially level.

(v) Brakes shall be set and wheels blocked on all cars being unloaded.

(14) Liquid-level gaging device. (i) Each container except those filled by weight shall be equipped with an approved liquid-level gaging device. A thermometer well shall be provided in all containers not utilizing a fixed liquid-level gaging device.

(ii) All gaging devices shall be arranged so that the maximum liquid level to which the container is filled is readily determined.

(iii) Gaging devices that require bleeding of the product to the atmosphere such as the rotary tube, fixed tube, and slip tube devices shall be designed so that the maximum opening of the bleed valve is not larger than No. 54 drill size unless provided with an excess flow valve. (This requirement does not apply to farm vehicles used for the application of ammonia as covered in paragraph (h) of this section.)

(iv) Gaging devices shall have a design pressure equal to or greater than the design pressure of the container on which they are installed.

(v) Fixed tube liquid-level gages shall be designed and installed to indicate that level at which the container is filled to 85 percent of its water capacity in gallons.

(vi) Gage glasses of the columnar type shall be restricted to stationary storage installations. They shall be equipped with shutoff valves having metallic handwheels, with excess-flow valves, and with extra heavy glass adequately protected with a metal housing applied by the gage manufacturer. They shall be shielded against the direct rays of the sun.

(15) Painting of containers. Above-ground uninsulated containers should have a reflective surface maintained in good condition.

(16) Electrical equipment and wiring.

(i) Electrical equipment and wiring for use in ammonia installations shall be general purpose or weather resistant as appropriate.

(ii) Electrical systems shall be installed and maintained in accordance with Subpart S of this part.

(c) Systems utilizing stationary, non-refrigerated storage containers. This paragraph applies to stationary, non-refrigerated storage installations utilizing containers other than those covered in paragraph (e) of this section. Paragraph (b) of this section applies to this paragraph unless otherwise noted.

(1) Design pressure and construction of containers. The minimum design pressure for nonrefrigerated containers shall be 250 p.s.i.g.

(2) Container valves and accessories, filling and discharge connections. (i) Each filling connection shall be provided with combination back-pressure check valve and excess-flow valve; one double or two single back-pressure check valves; or a positive shutoff valve in conjunction with either an internal back-pressure check valve or an internal excess flow valve.

(ii) All liquid and vapor connections to containers except filling pipes, safety relief connections, and liquid-level gaging and pressure gage connections provided with orifices not larger than No. 54 drill size as required in paragraphs (b) (6) (iv) and (v) of this section shall be equipped with excess-flow valves.

(iii) Each storage container shall be provided with a pressure gage graduated from 0 to 400 p.s.i. Gages shall be designated for use in ammonia service.

(iv) All containers shall be equipped with vapor return valves.

(3) Safety-relief devices. (i) Every container shall be provided with one or more safety-relief valves of the spring-loaded or equivalent type in accordance with paragraph (b) (9) of this section.

(ii) The rate of discharge of spring-loaded safety relief valves installed on underground containers may be reduced to a minimum of 30 percent of the rate of discharge specified in Table H-36. Containers so protected shall not be uncovered after installation until the liquid ammonia has been removed. Containers which may contain liquid ammonia before being installed underground and before being completely covered with earth are to be considered aboveground containers when determining the rate of discharge requirements of the safety-relief valves.

(iii) On underground installations where there is a probability of the manhole or housing becoming flooded, the discharge from vent lines shall be located above the high water level. All manholes or housings shall be provided with ventilated louvers or their equivalent, the area of such openings equalling or exceeding combined discharge areas of safety-relief valves and vent lines which discharge their content into the manhole housing.

(iv) Vent pipes, when used, shall not be restricted or of smaller diameter than the relief-valve outlet connection.

(v) If desired, vent pipes from two or more safety-relief devices located on the same unit, or similar lines from two or more different units may be run into a common discharge header, provided the capacity of such header is at least equal to the sum of the capacities of the individual discharge lines.

(4) Reinstallation of containers. (i) Containers once installed under ground shall not later be reinstalled above ground or under ground, unless they successfully withstand hydrostatic pressure retests at the pressure specified for the original hydrostatic test as required by the code under which constructed and show no evidence of serious corrosion.

(ii) Where containers are reinstalled under ground, the corrosion-resistant coating shall be put in good condition; see subparagraph (5) (iv) of this paragraph. Where containers are reinstalled above ground, safety devices or gaging devices shall comply with paragraph (b) (9) of this section and this subparagraph respectively for aboveground containers.

(5) *Installation of storage containers.*
(i) Containers installed above ground, except as provided in subdivision (v) of this subparagraph shall be provided with substantial concrete or masonry supports or structural steel supports on firm concrete or masonry foundations. All foundations shall extend below the frost line.

(ii) Horizontal aboveground containers shall be so mounted on foundations as to permit expansion and contraction. Every container shall be supported to prevent the concentration of excessive loads on the supporting portion of the shell. That portion of the container in contact with foundations or saddles shall be protected against corrosion.

(iii) Containers installed under ground shall be so placed that the top of the container is below the frost line and in no case less than 2 feet below the surface of the ground. Should ground conditions make compliance with these requirements impracticable, installation shall be made otherwise to prevent physical damage. It will not be necessary to cover the portion of the container to which manhole and other connections are affixed. When necessary to prevent floating, containers shall be securely anchored or weighted.

(iv) Underground containers shall be set on a firm foundation (firm earth may be used) and surrounded with earth or sand well tamped in place. The container, prior to being placed under ground, shall be given a corrosion resisting protective coating. The container thus coated shall be so lowered into place as to prevent abrasion or other damage to the coating.

(v) Containers with foundations attached (portable or semiportable tank containers with suitable steel "runners" or "skids" and commonly known in the industry as "skid tanks") shall be designed and constructed in accordance with subparagraph (i) of this paragraph.

(vi) Secure anchorage or adequate pier height shall be provided against container flotation wherever sufficiently high flood water might occur.

(vii) The distance between underground containers of over 2,000 gallons capacity shall be at least 5 feet.

(8) *Protection of appurtenances.*

(i) Valves, regulating, gaging, and other appurtenances shall be protected against tampering and physical damage. Such appurtenances shall also be protected during transit of containers.

(ii) All connections to underground containers shall be located within a dome, housing, or manhole and with access thereto by means of a substantial cover.

(7) *Damage from vehicles.* Precaution shall be taken against damage to ammonia systems from vehicles.

(d) *Refrigerated storage systems.* This paragraph applies to systems utilizing containers with the storage of anhydrous ammonia under refrigerated conditions. All applicable rules of paragraph (b) of this section apply to this paragraph unless otherwise noted.

(7) *Design of containers.*

(i) The design temperature shall be the minimum temperature to which the container will be refrigerated.

(ii) Containers with a design pressure exceeding 15 p.s.i.g. shall be constructed in accordance with paragraph (b) (2) of this section, and the materials shall be selected from those listed in API Standard 630, Recommended Rules for Design and Construction of Large, Welded, Low-Pressure Storage Tanks, Fourth Edition, 1970, Tables 2.02, R2.2, R2.2(A), R2.2.1, or R2.3.

(iii) Containers with a design pressure of 15 p.s.i.g. and less shall be constructed in accordance with the applicable requirements of API Standard 630 including its Appendix R.

(iv) When austenitic steels or nonferrous materials are used, the Code shall be used as a guide in the selection of materials for use at the design temperature.

(v) The filling density for refrigerated storage containers shall be such that the container will not be liquid full at a liquid temperature corresponding to the vapor pressure at the start-to-discharge pressure setting of the safety-relief valve.

(2) *Installation of refrigerated storage containers.* (i) Containers shall be supported on suitable noncombustible foundations designed to accommodate the type of container being used.

(ii) Adequate protection against flotation or other water damage shall be provided wherever high flood water might occur.

(iii) Containers for product storage at less than 32° F. shall be supported in such a way, or heat shall be supplied, to prevent the effects of freezing and consequent frost heaving.

(3) *Shutoff valves.* When operating conditions make it advisable, a check valve shall be installed on the fill connection and a remotely operated shutoff valve on other connections located below the maximum liquid level.

(4) *Safety relief devices.* (i) Safety relief valves shall be set to start-to-discharge at a pressure not in excess of the design pressure of the container and shall have a total relieving capacity sufficient to prevent a maximum pressure in the container of more than 120 percent of the design pressure. Relief valves for refrigerated storage containers shall be self-contained spring-loaded, weight-loaded, or self-contained pilot-operated type.

(ii) The total relieving capacity shall be the larger of:

(a) Possible refrigeration system upset such as (1) cooling water failure, (2) power failure, (3) instrument air or instrument failure, (4) mechanical failure of any equipment, (5) excessive pumping rates.

(b) Fire exposure determined in accordance with Compressed Gas Association (CGA) 8-1, Part 3, Safety Relief Device Standards for Compressed Gas Storage Containers, 1959, except that "A" shall be the total exposed surface area in square feet up to 25 feet above grade or to the equator of the storage con-

tainer if 25 is a sphere, whichever is greater. If the relieving capacity required for fire exposure is greater than that required by (a) of this subdivision, the additional capacity may be provided by weak roof to shell seams in containers operating at essentially atmospheric pressure and having an inherently weak roof-to-shell seam. The weak roof-to-shell seam is not to be considered as providing any of the capacity required in (a) of this subdivision.

(iii) If vent lines are installed to conduct the vapors from the relief valve, the back pressure under full relieving conditions shall not exceed 50 percent of the start-to-discharge pressure for pressure balanced valves or 10 percent of the start-to-discharge pressure for conventional valves. The vent lines shall be installed to prevent accumulation of liquid in the lines.

(iv) The valve or valve installation shall provide weather protection.

(v) Atmospheric storage shall be provided with vacuum breakers. Ammonia gas, nitrogen, methane, or other inert gases can be used to provide a pad.

(6) *Protection of container appurtenances.* Appurtenances shall be protected against tampering and physical damage.

(8) *Reinstallation of refrigerated storage containers.* Containers of such size as to require field fabrication shall, when moved and reinstalled, be reconstructed and reinspected in complete accordance with the requirements under which they were constructed. The containers shall be subjected to a pressure retest and if re-rating is necessary, re-rating shall be in accordance with applicable requirements.

(7) *Damage from vehicles.* Precaution shall be taken against damage from vehicles.

(8) *Refrigeration load and equipment.*

(i) The total refrigeration load shall be computed as the sum of the following:

(a) Load imposed by heat flow into the container caused by the temperature differential between design ambient temperature and storage temperature.

(b) Load imposed by heat flow into the container caused by maximum sun radiation.

(c) Maximum load imposed by filling the container with ammonia warmer than the design storage temperature.

(ii) More than one storage container may be handled by the same refrigeration system.

(9) *Compressors.*

(i) A minimum of two compressors shall be provided either of which shall be of sufficient size to handle the loads listed in subparagraphs (8) (i) (a) and (b) of this paragraph. Where more than two compressors are provided minimum standby equipment equal to the largest normally operating equipment shall be installed. Filling compressors may be used as standby equipment for holding compressors.

(ii) Compressors shall be sized to operate with a suction pressure at least 10 percent below the minimum setting of

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the safety valve(s) on the storage container and shall withstand a setting pressure at least equal to 130 percent of the design pressure of the container.

(10) Compressor drives.

(i) Each compressor shall have its individual driving unit.

(ii) An emergency source of power of sufficient capacity to handle the loads listed in subparagraphs (8) (i) (s) and (b) of this paragraph shall be provided unless facilities are available to safely dispose of vented vapors while the refrigeration system is not operating.

(11) Automatic control equipment.

(i) The refrigeration system shall be arranged with suitable controls to govern the compressor operation in accordance with the load as evidenced by the pressure in the container(s).

(ii) An emergency alarm system shall be installed to function in the event the pressure in the container(s) rises to the maximum allowable operating pressure.

(iii) An emergency alarm and shutoff shall be located in the condenser system to respond to excess discharge pressure caused by failure of the cooling medium.

(iv) All automatic controls shall be installed in a manner to preclude operation of alternate compressors unless the controls will function with the alternate compressors.

(12) Separators for compressors.

(i) An entrainment separator of suitable size and design pressure shall be installed in the compressor suction line of lubricated compression. The separator shall be equipped with a drain and gaging device.

(ii) An oil separator of suitable size shall be installed in the compressor discharge line. It shall be designed for at least 250 p.s.i.g. and shall be equipped with a gaging device and drain valve.

(13) *Condensers.* The condenser system may be cooled by air or water or both. The condenser shall be designed for at least 250 p.s.i.g. Provision shall be made for purging noncondensibles either manually or automatically.

(14) *Receiver and liquid drain.* A receiver shall be provided with a liquid-level control to discharge the liquid ammonia to storage. The receiver shall be designed for at least 250 p.s.i.g. and be equipped with the necessary connections safety valves, and gaging device.

(15) *Insulation.* Refrigerated containers and pipelines which are insulated shall be covered with a material of suitable quality and thickness for the temperatures encountered. Insulation shall be suitably supported and protected against the weather. Weatherproofing shall be of a type which will not support flame propagation.

(e) *Systems utilizing portable DOT containers.* (1) *Conformance.* Cylinders shall comply with DOT specifications and shall be maintained, filled, packaged, marked, labeled, and shipped to comply with 49 CFR Chapter I and Marking Portable Compressed Gas Containers to Identify the Material Contained, ANSI Z48.1-1954 (R1970).

(2) *Storage.* Cylinders shall be stored in an area free from ignitable debris and

in such manner as to prevent external corrosion. Storage may be indoors or outdoors.

(5) *Heat protection.* Cylinders filled in accordance with DOT regulations will become liquid full at 145° F. Cylinders shall be protected from heat sources such as radiant flame and steam pipes. Heat shall not be applied directly to cylinders to raise the pressure.

(4) *Protection.* Cylinders shall be stored in such manner as to protect them from moving vehicles or external damage.

(5) *Valve cap.* Any cylinder which is designed to have a valve protection cap shall have the cap securely in place when the cylinder is not in service.

(f) *Tank motor vehicles for the transportation of ammonia.* (1) This paragraph applies to containers and pertinent equipment mounted on tank motor vehicles including semitrailers and full trailers used for the transportation of ammonia. This paragraph does not apply to farm vehicles. For requirements covering farm vehicles, refer to paragraphs (g) and (h) of this section.

Paragraph (b) of this section applies to this paragraph unless otherwise noted. Containers and pertinent equipment for tank motor vehicles for the transportation of anhydrous ammonia, in addition to complying with the requirements of this section, shall also comply with the requirements of DOT.

(2) *Design pressure and construction of containers.* (i) The minimum design pressure for containers shall be that specified in the regulations of the DOT.

(ii) The shell or head thickness of any container shall not be less than three-sixteenth inch.

(iii) All container openings, except safety relief valves, liquid-level gaging devices, and pressure gages, shall be labeled to designate whether they communicate with liquid or vapor space.

(3) *Container appurtenances.* (i) All appurtenances shall be protected against physical damage.

(ii) All connections to containers, except filling connections, safety relief devices, and liquid-level and pressure gage connections, shall be provided with suitable automatic excess flow valves, or in lieu thereof, may be fitted with quick-closing internal valves, which shall remain closed except during delivery operations. The control mechanism for such valves may be provided with a secondary control remote from the delivery connections and such control mechanism shall be provided with a fusible section (melting point 208° F. to 220° F.) which will permit the internal valve to close automatically in case of fire.

(iii) Filling connections shall be provided with automatic back-pressure check valves, excess-flow valves, or quick-closing internal valves, to prevent back-flow in case the filling connection is broken. Where the filling and discharge connect to a common opening in the container shell and that opening is fitted with a quick-closing internal valve as specified in subdivision (ii) of this sub-

paragraph, the automatic valve shall not be required.

(iv) All containers shall be equipped for spray loading (filling in the vapor space) with an approved vapor return valve of adequate capacity.

(4) *Piping and fittings.* (i) All piping, tubing, and fittings shall be securely mounted and protected against damage. Means shall be provided to protect hoses while the vehicle is in motion.

(ii) Fittings shall comply with paragraph (b) (6) of this section. Pipe shall be schedule 80.

(5) *Safety relief devices.* (i) The discharge from safety relief valves shall be vented away from the container upward and unobstructed to the open air in such a manner as to prevent any impingement of escaping gas upon the container; loose-fitting rain caps shall be used. Size of discharge lines from safety valves shall not be smaller than the nominal size of the safety-relief valve outlet connection. Suitable provision shall be made for draining condensate which may accumulate in the discharge pipe.

(ii) Any portion of liquid ammonia piping which at any time may be closed at both ends shall be provided with a hydrostatic relief valve.

(6) *Transfer of liquid.* (i) The content of tank motor vehicle containers shall be determined by weight, by a suitable liquid-level gaging device, or other approved methods. If the content of a container is to be determined by liquid-level measurement, the container shall have a thermometer well so that the internal liquid temperature can be easily determined. This volume when converted to weight shall not exceed the filling density specified by the DOT.

(ii) Any pump, except a constant speed centrifugal pump, shall be equipped with a suitable pressure actuated bypass valve permitting flow from discharge to suction when the discharge pressure rises above the predetermined point. Pump discharge shall also be equipped with a spring-loaded safety relief valve set at a pressure not more than 135 percent of the setting of the bypass valve or more than 400 p.s.i.g., whichever is larger.

(iii) Compressors shall be equipped with manually operated shutoff valves on both suction and discharge connections. Pressure gages of bourdon-tube type shall be installed on the suction and discharge of the compressor before the shutoff valves. The compressor shall not be operated if either pressure gage is removed or is inoperative. A spring-loaded, safety-relief valve capable of discharging to atmosphere the full flow of gas from the compressor at a pressure not exceeding 300 p.s.i.g. shall be connected between the compressor discharge and the discharge shutoff valve.

(iv) Valve functions shall be clearly and legibly identified by metal tags or nameplates permanently affixed to each valve.

(7) *Full trailers and semitrailers.* (i) All full trailers shall be firmly and securely attached to the vehicle drawing

them by means of suitable drawbar or the replacement by a safety chain (or other device) or safety cables.

(II) Every full trailer or semitrailer shall have a reliable system of brakes, and adequate provision shall be made to operate the brakes from the driver's seat.

(III) Every full trailer shall be equipped with self-energizing brakes.

(IV) Full trailers shall be so designed that the towed vehicle will follow substantially in the path of the towing vehicle and will not whip or swerve dangerously from side to side.

(V) Where a fifth wheel is employed, it shall be ruggedly designed, securely fastened to both units, and equipped with a positive locking mechanism which will prevent separation of the two units except by manual release.

(8) *Protection against collision.* Each tank motor vehicle shall be provided with properly attached bumpers or chassis extension arranged to protect the tank, piping, valves, and fittings from physical damage in case of collision.

(9) *Chock blocks.* At least two chock blocks shall be provided. These blocks shall be placed to prevent rolling of the vehicle whenever it is parked during loading and unloading operations.

(10) *Portable tank containers (skid tanks).* Where portable tank containers are used for farm storage they shall comply with paragraph (c)(1) of this section. When portable tank containers are used in lieu of cargo tanks and are permanently mounted on tank motor vehicles for the transportation of ammonia, they shall comply with the requirements of this paragraph.

(g) *Systems mounted on farm vehicles other than for the application of ammonia—(1) Application.* This paragraph applies to containers of 1,200 gallons capacity or less and pertinent equipment mounted on farm vehicles (implements of husbandry) and used other than for the application of ammonia to the soil. Paragraph (b) of this section applies to this paragraph unless otherwise noted.

(2) *Design pressure and classification of containers.* (i) The minimum design pressure for containers shall be 250 p.s.i.g.

(ii) The shell or head thickness of any container shall be not less than three-sixteenths of an inch.

(3) *Mounting containers.* (i) A suitable "stop" or "stops" shall be mounted on the vehicle or on the container in such a way that the container shall not be dislodged from its mounting due to the vehicle coming to a sudden stop. Back slippage shall also be prevented by proper methods.

(ii) A suitable "hold down" device shall be provided which will anchor the container to the vehicle at one or more places on each side of the container.

(iii) When containers are mounted on four-wheel trailers, care shall be taken to insure that the weight is distributed evenly over both axles.

(iv) When the cradle and the tank are not welded together suitable material shall be used between them to eliminate metal-to-metal friction.

for permanent attachment. (d) All valves should be tested with a fixed dipole in which the valve is closed.

(II) All tanks shall have a capacity exceeding 250 gallons shall be equipped with a pressure gage having a dial graduated from 0-400 p.s.i.

(iii) The filling connection shall be fitted with combination back-pressure check valve and excess-flow valve; one double or two single back-pressure check valves; or a positive shutoff valve in conjunction with either an internal back-pressure check valve or an internal excess flow valve.

(iv) All containers with a capacity exceeding 250 gallons shall be equipped for spray loading or with an approved vapor return valve.

(v) All vapor and liquid connections except safety-relief valves and those specifically exempted by paragraph (b)(7)(v) of this section shall be equipped with approved excess-flow valves or may be fitted with quick-closing internal valves which, except during operating periods, shall remain closed.

(vi) Fittings shall be adequately protected from damage by a metal box or cylinder with open top securely fastened to the container or by rigid guards, well braced, welded to the container on both sides of the fittings or by a metal dome. If a metal dome is used, the relief valve shall be properly vented through the dome.

(vii) If a liquid withdrawal line is installed in the bottom of a container, the connections thereto, including hose, shall not be lower than the lowest horizontal edge of the vehicle axle.

(viii) Provision shall be made to secure both ends of the hose while in transit.

(5) *Marking the container.* There shall appear on each side and on the rear end of the container in letters at least 4 inches high, the words, "Caution—Ammonia" or the container shall be marked in accordance with DOT regulations.

(6) *Farm vehicles.*

(i) Farm vehicles shall conform with State regulations.

(ii) All trailers shall be securely attached to the vehicle drawing them by means of drawbars supplemented by suitable safety chains.

(iii) A trailer shall be constructed so that it will follow substantially in the path of the towing vehicle and will not whip or swerve dangerously from side to side.

(iii) All vehicles shall carry a can containing 5 gallons or more of water.

(h) *Systems mounted on farm vehicles for the application of ammonia.* (i) This paragraph applies to systems utilizing containers of 250 gallons capacity or less which are mounted on farm vehicles (implement of husbandry) and used for the application of ammonia to the soil. Paragraph (b) of this section applies to this paragraph unless otherwise noted. Where larger containers are used, they shall comply with paragraph (g) of this section.

(2) *Design pressure and classification of containers.* (i) The minimum design

pressure for containers shall be 250 p.s.i.g.

(ii) The shell or head thickness of any container shall not be less than three-sixteenths inch.

(3) *Mounting of containers.* All containers and flow-control devices shall be securely mounted.

(4) *Container valves and accessories.* (i) Each container shall have a fixed liquid-level gage.

(ii) The filling connection shall be fitted with a combination back-pressure check valve and an excess-flow valve; one double or two single back-pressure check valves; or a positive shutoff valve in conjunction with an internal back-pressure check valve or an internal excess-flow valve.

(iii) The applicator tank may be filled by venting to open air provided the bleeder valve orifice does not exceed seven-sixteenths inch in diameter.

(iv) Regulation equipment may be connected directly to the tank coupling or flange, in which case a flexible connection shall be used between such regulating equipment and the remainder of the liquid withdrawal system. Regulating equipment not so installed shall be flexibly connected to the container shutoff valve.

(v) No excess flow valve is required in the liquid withdrawal line provided the controlling orifice between the contents of the container and the outlet of the shutoff valve does not exceed seven-sixteenths inch in diameter.

§ 1910.112 [Reserved]

§ 1910.113 [Reserved]

§ 1910.114 Additional delay in effective date.

The requirements of this Subpart H shall be effective on February 15, 1973, unless before that date any employment or place of employment becomes subject to any safety or health standard which is published in 41 CFR Part 50-304 by virtue of the application of the Walsh-Healey Public Contracts Act (41 U.S.C. 35-45) and which is incorporated in this subpart. In which event, the standard shall be effective under this subpart upon the commencement of the Walsh-Healey requirement.

§ 1910.115 Sources of standards.

Sec.	Source
1910.101.....	41 CFR 50-204.67, 70, and 71.
1910.102.....	41 CFR 50-204.66.
1910.103.....	NFPA No. 50B-1968, Standard for Liquid Hydrogen Systems at Consumer Sites.
1910.104.....	NFPA No. 50C-1968, Standard for the Installation of Bulk Oxygen Systems at Consumer Sites.
1910.105.....	NFPA No. 30-1969, Flammable and Combustible Liquids Code.
1910.107.....	NFPA No. 33-1969, Standard for Spray Finishing using Flammable and Combustible Materials.

§ 1924.116 Standards organizations.
 National Fire Protection Association (NFPA),
 66 Montgomery Street, Boston, MA 02110.
 National Fire Protection Association, 700 K Street
 NW, Washington, DC 20005.
 Compressed Gas Association, Inc., 500 Fifth
 Avenue, New York, NY 10006.
 American Society of Mechanical Engineers
 Inc., United Engineering Center, 345 East
 47th Street, New York, NY 10017.
 American Petroleum Institute, 1801 K Street
 NW, Washington, DC 20006.
 National Board of Boiler and Pressure Vessel
 Inspectors, 1155 North High Street,
 Columbus, OH 43201.
 American National Standards Institute, 1430
 Broadway, New York, NY 10018.
 American Society for Testing and Materials
 (ASTM), 1916 Race Street Philadelphia,
 PA 19103.
 Underwriters Laboratories, Inc. (UL), 307
 East Ohio Street, Chicago, IL 60611.

§ 1910.132 General requirements.

(a) *Application.* Protective equipment, including personal protective equipment for eyes, face, head, and extremities, protective clothing, respiratory devices, and protective shields and barriers, shall be provided, used, and maintained in a sanitary and reliable condition wherever it is necessary by reason of hazards of processes or environment, chemical hazards, radiological hazards, or mechanical irritants encountered in a manner capable of causing injury or impairment in the function of any part of the body through absorption, inhalation or physical contact.

(b) **Employee-owned equipment.** Where employees provide their own protective equipment, the employer shall be responsible to assure its adequacy, including proper maintenance, and sanitation of such equipment.

(c) *Design.* All personal protective equipment shall be of safe design and construction of the work to be performed.

§ 1910.133 Eye and face protection.

(a) *General.* (1) Protective eye and face equipment shall be required where there is a reasonable probability of injury that can be prevented by such equipment. In such cases, employers shall make conveniently available a type of protector suitable for the work to be performed, and employees shall use such

...to the extent that external
...the possibility of ... where in-
...of flying objects, glass break, injurious
...radiation, or a combination of these haz-
...ards.

(30) Protestors shall meet the following minimum requirements:

(1) They shall provide adequate protection against the particular hazards for which they are designed.

(H) They shall be reasonably comfortable when worn under the designated conditions.

(M1) They shall fit snugly and shall not unduly interfere with the movements of the wearer.

(iv) They shall be durable.

(v) They shall be capable of being disinfected.

- (vi) They shall be easily cleanable.
- (vii) Protectors should be kept clean and in good repair.

(3) Persons whose vision requires the use of corrective lenses in spectacles, and who are required by this standard to wear eye protection, shall wear goggles or spectacles of one of the following types:

(1) Spectacles whose protective lenses provide optical correction.

(ii) Goggles that can be worn over corrective spectacles without disturbing the adjustment of the spectacles.

(iii) Goggles that incorporate corrective lenses mounted behind the protective lenses.

(4) Every protector shall be distinctly marked to facilitate identification only of the manufacturer.

(5) When limitations or precautions are indicated by the manufacturer, they shall be transmitted to the user and care taken to see that such limitations and precautions are strictly observed.

(6) Design, construction, testing, and use of devices for eye and face protection shall be in accordance with American National Standard for Occupational and Educational Eye and Face Protection, Z87. 1-1968.

§ 1910.134 Respiratory protection.

(a) *Permissible practice.* (1) In the control of those occupational diseases caused by breathing air contaminated with harmful dusts, fogs, fumes, mists, gases, smokes, sprays, or vapors, the primary objective shall be to prevent atmospheric contamination. This shall be accomplished as far as feasible by accepted engineering control measures (for example, enclosure or confinement of the operation, general and local ventilation, and substitution of less toxic materials). When effective engineering controls are not feasible, or while they are being instituted, appropriate respirators shall be used pursuant to the following requirements.

(2) Respirators shall be provided by the employer when such equipment is necessary to protect the health of the employee. The employer shall provide the respirators which are applicable and suitable for the purpose intended. The employer shall be responsible for the

any protective program which shall include the requirements stated in paragraph (b) of this section.

(5) The employee shall use the provided respiratory protection in accordance with instructions and training received.

(b) **Requirements for a minimal acceptable program.** (1) Written standard operating procedures governing the selection and use of respirators shall be established.

(2) Respirators shall be selected on the basis of hazards to which the worker is exposed.

(3) The user shall be instructed and trained in the proper use of respirators and their limitations.

(4) Where practicable, the respirators should be assigned to individual workers for their exclusive use.

(5) Respirators shall be regularly cleaned and disinfected. Those issued for the exclusive use of one worker should be

cleaned after each day's use, or more often if necessary. Those used by more than one worker shall be thoroughly

(6) Respirators shall be stored in a convenient, clean, and sanitary location.

(7) Respirators used routinely shall be inspected during cleaning. Worn or deteriorated parts shall be replaced. Respirators for emergency use such as self-contained devices shall be thoroughly inspected at least once a month and after each use.

(8) Appropriate surveillance of work area conditions and degree of employee exposure or stress shall be maintained.

(9) There shall be regular inspection and evaluation to determine the continued effectiveness of the program.

(10) Persons should not be assigned to tasks requiring use of respirators unless it has been determined that they are physically able to perform the work and use the equipment. The local physician shall determine what health and physical conditions are pertinent. The respirator user's medical status should be reviewed periodically (for instance, annually).

(11) Approved or accepted respirators shall be used when they are available. The respirator furnished shall provide adequate respiratory protection against the particular hazard for which it is designed in accordance with standards established by competent authorities. The U.S. Department of Interior, Bureau of Mines, and the U.S. Department of Agriculture are recognized as such authorities. Although respirators listed by the U.S. Department of Agriculture continue to be acceptable for protection against specified pesticides, the U.S. Department of the Interior, Bureau of Mines, is the agency now responsible for testing and approving pesticide respirators.

(c) **Selection of respirators.** Proper selection of respirators shall be made according to the guidance of American National Standard Practices for Respiratory Protection Z89.2-1966.

(d) *Air quality.* (1) Compressed air, compressed oxygen, liquid air, and liquid oxygen used for respiration shall be of

Barry T. Jimmy H. G. Corbett
John H. B. Harbert C. R.

2 BLDG + mixer

- ✓ 1 Strapping Boxes. Wires on floor - Housekeeping
- ✓ 2 Noise Level - State control - NO SAFETY
- ✓ 3 SAFETY EQUIP.?
- ✓ 3 Mag Feed Hopper - CORNER with point sticking out + falling over. need repairs
- ✓ 4 Hanging Dust collector Pipes. TAPE Holding it.
- X 5 Doorway EXIT. blocked must be clear
- X 6 Electric Panel Board Blocked. Too many boxes made? Railing by panel boards?

43 Bldg 7 covers on top of TANKS ON.
gents + covers

- X 8 Fire EXT. Empty - to be checked
- X 9 Lift TRUCK oil on mixer. Nothing to dry oil
- X 10 Two ways narrow in plant area which are needed for lift Trucks.
- X 11 Potholes
- 12 complete safety shoe? (Also covers)

JAN 4th next meeting
Next wk Safety Equip.
safety shoes + Hats

...pure. Oxygen shall meet the requirements of the United States Pharmacopoeia for medical or breathing oxygen. Breathing air shall meet at least the requirements of the gas purity Grade 2 breathing air as specified in Compressed Gas Association Commodity Specification G-7.1-1966. Compressed oxygen shall not be used in supplied-air respirators or in open circuit self-contained breathing apparatus that have previously used compressed air. Oxygen must never be used with air line respirators.

(3) Breathing air may be supplied to respirators from cylinders or air compressors.

(i) Cylinders shall be tested and maintained in as prescribed in the Shipping Container Specification Regulations of the Department of Transportation (49 CFR Part 178).

(ii) The compressor for supplying air shall be equipped with necessary safety and standby devices. A breathing air-type compressor shall be used. Compressors shall be constructed and situated so as to avoid entry of contaminated air into the system and suitable in-line air purifying sorbent beds and filters installed to further assure breathing air quality. A receiver of sufficient capacity to enable the respirator wearer to escape from a contaminated atmosphere in event of compressor failure, and alarms to indicate compressor failure and overheating shall be installed in the system. If an oil-lubricated compressor is used, it shall have a high-temperature or carbon monoxide alarm, or both. If only a high-temperature alarm is used, the air from the compressor shall be frequently tested for carbon monoxide to insure that it meets the specifications in subparagraph (1) of this paragraph.

(3) Air line couplings shall be incompatible with outlets for other gas systems to prevent inadvertent servicing of air line respirators with nonrespirable gases or oxygen.

(4) Breathing gas containers shall be marked in accordance with American National Standard Method of Marking Portable Compressed Gas Containers to Identify the Material Contained, Z48.1-1954; Federal Specification BB-A-1034a, June 21, 1966, Air, Compressed for Breathing Purposes; or Interim Federal Specification GG-B-00675b, April 27, 1965, Breathing Apparatus, Self-Contained.

(e) Use of respirators. (1) Standard procedures shall be developed for respirator use. These should include all information and guidance necessary for their proper selection, use, and care. Possible emergency and routine uses of respirators should be anticipated and planned for.

(2) The correct respirator shall be specified for each job. The respirator type is usually specified in the work procedures by a qualified individual supervising the respiratory protective program. The individual issuing them shall be adequately instructed to insure that the correct respirator is issued. Each respira-

tor should be checked for proper fit and function before use. The date of inspection should be recorded.

(2) Written procedures shall be prepared covering safe use of respirators in dangerous atmospheres that might be encountered in normal operations or in emergencies. Personnel shall be familiar with these procedures and the available respirators.

(i) In areas where the wearer, with failure of the respirator, could be overcome by a toxic or oxygen-deficient atmosphere, at least one additional man shall be present. Communications (visual, voice, or signal line) shall be maintained between both or all individuals present. Planning shall be such that one individual will be unaffected by any likely incident and have the proper rescue equipment to be able to assist the other(s) in case of emergency.

(ii) When self-contained breathing apparatus or hose masks with blowers are used in atmospheres immediately dangerous to life or health, standby men must be present with suitable rescue equipment.

(iii) Persons using air line respirators in atmospheres immediately hazardous to life or health shall be equipped with safety harnesses and safety lines for lifting or removing persons from hazardous atmospheres or other and equivalent provisions for the rescue of persons from hazardous atmospheres shall be used. A standby man or men with suitable self-contained breathing apparatus shall be at the nearest fresh air base for emergency rescue.

(4) Respiratory protection is no better than the respirator in use, even though it is worn conscientiously. Frequent random inspections shall be conducted by a qualified individual to assure that respirators are properly selected, used, cleaned, and maintained.

(5) For safe use of any respirator, it is essential that the user be properly instructed in its selection, use, and maintenance. Both supervisors and workers shall be so instructed by competent persons. Training shall provide the men an opportunity to handle the respirator, have it fitted properly, test its face-piece-to-face seal, wear it in normal air for a long familiarity period, and, finally, to wear it in a test atmosphere.

(i) Every respirator wearer shall receive fitting instructions including demonstrations and practice in how the respirator should be worn, how to adjust it, and how to determine if it fits properly. Respirators shall not be worn when conditions prevent a good face seal. Such conditions may be a growth of beard, sideburns, a skull cap that projects under the facepiece, or temple pieces on glasses. Also, the absence of one or both dentures can seriously affect the fit of a facepiece. The worker's diligence in observing these factors shall be evaluated by periodic check. To assure proper protection, the facepiece fit shall be checked by the

...the date of inspection should be recorded.

(i) For individuals wearing respirators in a serious situation, a program shall be established if the person wearing glasses extend through the top of the full facepiece. As a safety measure, glasses with safety lenses or without temple bars may be taped to the wearer's head. Wearing of contact lenses in contaminated atmospheres with a respirator shall not be allowed. Systems have been developed for mounting corrective lenses inside full facepieces. When a workman must wear corrective lenses as part of the facepiece, the facepiece and lenses shall be fitted to qualified individuals to provide good vision, comfort, and a gas-tight seal.

(ii) If corrective spectacles or goggles are required, they shall be fitted so as not to affect the fit of the facepiece. Proper selection of equipment will minimize or avoid this problem.

(f) Maintenance and care of respirators. (1) A program for maintenance and care of respirators shall be developed to the type of plant, working conditions, and hazards involved, and shall include the following basic services:

- (i) Inspection for defects, including a leak check).
- (ii) Cleaning and disinfecting.
- (iii) Repair, and
- (iv) Storage

Equipment shall be properly maintained to retain its original effectiveness.

(2) (i) All respirators shall be inspected routinely before and after each use. A respirator that is not routinely used but is kept ready for emergency use shall be inspected after each use and at least monthly to assure that it is in satisfactory working condition.

(ii) Self-contained breathing apparatus shall be inspected monthly. Air and oxygen cylinders shall be fully charged according to the manufacturer's instructions. It shall be determined that the regulator and warning devices function properly.

(iii) Respirator inspection shall include a check of the tightness of connections and the condition of the facepiece, headbands, valves, connecting tube, and canisters. Rubber or elastomer parts shall be inspected for pliability and signs of deterioration. Stretching and manipulating rubber or elastomer parts with a massaging action will keep them pliable and flexible and prevent them from taking a set during storage.

(iv) A record shall be kept of inspection dates and findings for respirators maintained for emergency use.

(3) Routinely used respirators shall be collected, cleaned, and disinfected as frequently as necessary to insure that proper protection is provided for the wearer. Each worker should be briefed on the cleaning procedure and be assured that he will always receive a clean and disinfected respirator. Such assurances

(4) After inspection, cleaning, and necessary repair, respirators shall be altered to protect against dust, sun, heat, extreme cold, excessive moisture, or damaging chemicals. Respirators placed at stations and work areas for emergency use should be readily accessible at all times and should be stored in compartments built for the purpose. The compartments should be clearly marked. Routinely used respirators, such as dust respirators, may be placed in plastic bags. Respirators should not be stored in such places as lockers or tool boxes unless they are in carrying cases or cartons.

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(ii) Respirators should be packed or stored so that the facepiece and exhalation valve will rest in a normal position and function will not be impaired by the elastomer setting in an abnormal position.

(iii) Instructions for proper storage of emergency respirators, such as gas masks and self-contained breathing apparatus, are found in "use and care" instructions usually mounted inside the carrying case lid.

(g) Identification of gas mask canisters. (1) The primary means of identifying a gas mask canister shall be by means of properly worded labels. The secondary means of identifying a gas mask canister shall be by a color code.

(2) All who issue or use gas masks falling within the scope of this section shall see that all gas mask canisters purchased or used by them are properly labeled and colored in accordance with these requirements before they are placed in service and that the labels and colors are properly maintained at all times thereafter until the canisters have completely served their purpose.

(3) On each canister shall appear in bold letters the following:

(1) —
Canister for
(Name for atmospheric contaminant)
or
Type N Gas Mask Canister
(ii) In addition, essentially the following wording shall appear beneath the appropriate phrase on the canister label: "For respiratory protection in atmospheres containing not more than percent by volume of"
(Name of atmospheric contaminant)

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Canister for
(Name for atmospheric contaminant)
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Type N Gas Mask Canister
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(Name of atmospheric contaminant)

TABLE 1-1

Atmospheric contaminants to be protected against	Colors assigned*
Acid gases.....	White.
Hydrocyanic acid gas.....	White with 1/4-inch green stripe completely around the canister near the bottom.
Chlorine gas.....	White with 1/4-inch yellow stripe completely around the canister near the bottom.
Organic vapors.....	Black.
Ammonia gas.....	Green.
Acid gases and ammonia gas.....	Green with 1/4-inch white stripe completely around the canister near the bottom.
Carbon monoxide.....	Blue.
Acid gases and organic vapors.....	Yellow.
Hydrocyanic acid gas and chloroform vapor.....	Yellow with 1/4-inch blue stripe completely around the canister near the bottom.
Acid gases, organic vapors, and ammonia gases.....	Brown.
Radioactive materials, excepting tritium and noble gases.....	Purple (Magenta).
Particulates (dusts, fumes, mists, fogs, or smokes) in combination with any of the above gases or vapors.....	Canister color for contaminant, as designated above, with 1/4-inch gray stripe completely around the canister near the top.
All of the above atmospheric contaminants.....	Red with 1/4-inch gray stripe completely around the canister near the top.

*Gray shall not be assigned as the main color for a canister designed to remove acids or vapors.

Note: Orange shall be used as a complete body, or stripe color to represent gases not included in this table. The user will need to refer to the canister label to determine the degree of protection the canister will afford.

§ 1910.135 Occupational head protection.

Helmets for the protection of heads of occupational workers from impact and penetration from falling and flying objects and from limited electric shock and burn shall meet the requirements and specifications established in American National Standard Safety Requirements for Industrial Head Protection, Z89.1-1969.

§ 1910.136 Occupational foot protection.

Safety-toe footwear for employees shall meet the requirements and specifications in American National Standard for Men's Safety-Toe Footwear, Z41.1-1967.

§ 1910.137 Electrical protective devices.

Rubber protective equipment for electrical workers shall conform to the requirements established in the American National Standards Institute Standards as specified in the following list:

Item	Standard
Rubber insulating gloves.....	JG.5-1967.
Rubber matting for use around electric apparatus.....	JG.7-1965 (R1965).
Rubber insulating blankets.....	JG.4-1970.
Rubber insulating hoods.....	JG.3-1966 (R1965).
Rubber insulating line hoes.....	JG.1-1960 (R1965).
Rubber insulating sleeves.....	JG.2-1962.

§ 1910.138 Additional delay in effective date.

The requirements of this Subpart I shall be effective on February 15, 1972, unless before that date any employment or place of employment becomes subject to any safety or health standard which is published in 41 CFR Part 50-204 by virtue of the application of the Walsh-Healey Public Contracts Act (41 U.S.C. 35-45) and which is incorporated in this subpart. In which event, the standard shall be effective under this subpart

following: bromotrifluoromethane, carbon dioxide, dry chemical, and multi-purpose dry chemical.

Notes: Carbon dioxide extinguishers equipped with metal horns are not considered safe for use on fires in energized electrical equipment and, therefore, are not classified for use on Class C hazards.

(v) Extinguishers and extinguishing agents for the protection of Class D hazards shall be of types approved for use on the specific combustible-metal hazard.

(c) **Distribution of portable fire extinguishers.** (1) **General.** (i) The number of fire extinguishers needed to protect a property shall be determined as prescribed herein, considering the area and arrangement of the building or occupancy, the severity of the hazard, the anticipated classes of fires, and the distances to be traveled to reach extinguishers.

(ii) Fire extinguishers shall be provided for the protection of both the building structure, if combustible and the occupancy hazards contained therein.

(iii) Required building protection shall be provided by fire extinguishers suitable for Class A fires.

(iv) Occupancy hazard protection shall be provided by fire extinguishers suitable for such Class A, B, C, or D fire potentials as may be present.

(v) Extinguishers provided for building protection may be considered also for the protection of occupancies having a Class A fire potential.

(vi) Combustible buildings having an occupancy hazard subject to Class B, and/or Class C fires, shall have a standard complement of Class A fire extinguishers as required by Table L-1 for building protection, plus additional Class B and/or Class C extinguishers. Where fire extinguishers have more than one letter classification (such as 2-A:20-B:C), they may be considered to satisfy the requirements of each letter class.

(vii) Rooms or areas shall be graded generally as light hazard, ordinary hazard, or extra hazard. Limited areas of greater or lesser hazard shall be protected as required.

(2) **Fire extinguisher size and placement for Class A hazards.** (i) Minimal sizes of fire extinguishers for the listed grades of hazard shall be provided on the basis of Table L-1. Extinguishers shall be located so that the maximum travel distances shall not exceed those specified in Table L-1.

TABLE L-1

Basic minimum extinguisher rating for area specified	Maximum travel distance to extinguisher (feet)	Areas to be protected per extinguisher		
		Light hazard occupancy (square feet)	Ordinary hazard occupancy (square feet)	Extra hazard occupancy (square feet)
1A.....	75	3,000	3,000	Note 1
2A.....	75	6,000	3,000	Note 1
3A.....	75	9,000	4,500	3,000
4A.....	75	11,250	5,625	3,000
5A.....	75	11,250	5,625	4,500

Notes: 1: Not permitted except as specified in subdivision (ii) of this subparagraph.

(ii) The protection requirements specified in Table L-1 may be fulfilled by several extinguishers of lower ratings for ordinary or extra-hazard occupancies.

(iii) Where the floor area of a building is less than that specified in Table L-1, at least one extinguisher of the minimum size recommended shall be provided.

(iv) The protection requirements may be fulfilled with extinguishers of higher rating provided the travel distance to such larger extinguishers shall not exceed 75 feet.

(3) **Fire extinguisher size and placement for Class B fires other than for fires in flammable liquids of appreciable depth.**

(i) Minimal sizes of fire extinguishers for the listed grades of hazard shall be provided on the basis of Table L-2. Extinguishers shall be located so that the maximum travel distances shall not exceed those specified in Table L-2.

TABLE L-2

Type of hazard	Basic minimum extinguisher rating	Maximum travel distance to extinguisher (feet)
Light.....	4B	30
Ordinary.....	8B	30
Extra.....	11B	30

(ii) Two or more extinguishers of lower ratings, except for foam extinguishers, shall not be used to fulfill the protection requirements of Table L-2. Up to three foam extinguishers may be used to fulfill these requirements.

(iii) The protection requirements may be fulfilled with extinguishers of higher ratings provided the travel distance to such larger extinguishers shall not exceed 50 feet.

(4) **Fire extinguisher size and placement for Class B fires in flammable liquids of appreciable depth.** (i) For flammable liquid hazards of appreciable depth (Class B), such as in dip or quench tanks, Class B fire extinguishers shall be provided on the basis of one numerical unit of Class B extinguishing potential per square foot of flammable liquid surface of the largest tank hazard within the area.

Notes: Appreciable depth is defined as a depth of a liquid greater than one-quarter inch.

(ii) Two or more extinguishers of lower ratings except for foam extinguishers, shall not be used in lieu of the extinguisher required for the largest tank. Up to three foam extinguishers may be used to fulfill these requirements.

(iii) Scattered or widely separated hazards shall be individually protected if the specified travel distances in subparagraph (3) (i) of this paragraph are exceeded. Likewise, extinguishers in the proximity of a hazard shall be carefully located so as to be accessible in the presence of a fire without undue danger to the operator.

(5) **Fire extinguisher size and placement for Class C hazards.** (i) Extinguishers with Class C ratings shall be required where energized electrical equipment may be encountered which would

require a nonconducting extinguishing media. This will include the entire directly involving or surrounding electrical equipment. Since the fire hazard is a Class A or Class B hazard the extinguishers are sized and located on the basis of the anticipated Class A or B hazard.

(d) **Inspection, maintenance, and hydrostatic tests.** (1) **General.** (i) The owner or occupant of a property in which extinguishers are located shall be responsible for such inspection, maintenance, and testing.

(ii) For details of conducting needed inspections, proper maintenance operations, and required tests, see NFPA No. 10A-1970, Maintenance and Use of Portable Fire Extinguishers.

(2) **Inspection.** (i) Extinguishers shall be inspected monthly, or at more frequent intervals when circumstances require, to insure they are in their designated places, to insure they have not been actuated or tampered with, and to detect any obvious physical damage, corrosion, or other impairments.

(ii) Any extinguishers showing defects shall be given a complete maintenance check.

(3) **Maintenance.** (i) At regular intervals, not more than 1 year apart, or when specifically indicated by an inspection, extinguishers shall be thoroughly examined and/or recharged or repaired to insure operability and safety, or replaced as needed.

(ii) Extinguishers removed from the premises to be recharged shall be replaced by spare extinguishers during the period they are gone.

(iii) Pails or drums of powder-extinguishing agents for scoop or shovel application to metal fires shall be kept full at all times.

(iv) Each extinguisher shall have a durable tag securely attached to show the maintenance or recharge date and the initials or signature of the person who performs this service.

(4) **Hydrostatic tests.** (i) If, at any time, an extinguisher shows evidence of corrosion or mechanical injury, it shall be subjected to a hydrostatic pressure test, or replaced.

(ii) For evaluating the condition of extinguisher cylinders made to Department of Transportation specifications (cf. 49 CFR Chapter I), see the Standard for Visual Inspection of Compressed Gas Cylinders (CGA C-6), published by the Compressed Gas Association, 500 Fifth Avenue, New York, NY 10036.

(iii) At intervals not exceeding those specified in Table L-3 and subdivisions (iv) through (vi) of this subparagraph, extinguishers shall be hydrostatically tested. The first hydrostatic test may be conducted between the fifth and sixth years for those with a designated test interval of 5 years.

TABLE L-3
HYDROSTATIC TEST INTERVAL
FOR EXTINGUISHERS

Extinguisher type:	Test interval, year
Soda-acid	5
Cartridge-operated water and/or anti-freeze	5
Storage-pressure water and/or anti-freeze	5
Wetting agent	5
Foam	5
Loaded stream	5
Dry chemical extinguishers with stainless steel shells, aluminum shells, or soldered-brass shells	5
Carbon dioxide extinguishers	5
Dry chemical extinguishers with brass-brass shells, or mild-steel shell	12
Bromotrifluoromethane	12
Dry powder extinguishers for metal fires	12

NOTE: Cylinders under jurisdiction of the U.S. Department of Transportation (formerly Interstate Commerce Commission) may require hydrostatic testing at more frequent periods.

(iv) Nitrogen cylinders (or other cylinders used for inert-gas storage), such as found on wheeled extinguishers, shall be tested at a 5-year interval.

(v) On those extinguishers which are equipped with a shutoff nozzle at the outlet end of the hose, a hydrostatic test shall be performed on the hose with its couplings (but without the discharge nozzle) at the test interval specified for the unit on which the hose is installed.

(vi) The test pressure for dry chemical and dry powder hose assemblies requiring a hydrostatic test shall be at a test pressure of 300 pounds per square inch for a 1-minute period. Carbon dioxide hose assemblies requiring a hydrostatic test shall be at test pressure of 1,250 p.s.i. for a 1-minute period.

(vii) Hydrostatic tests are not required on fire pails, pump-type water and/or antifreeze extinguishers, and factory-sealed disposable (nonrefillable) containers. If such an extinguisher or water pail shows evidence of corrosion or mechanical injury, it may be unsafe or unsuitable for further use and shall be replaced with a new unit.

(viii) The hydrostatic test date shall be recorded on a record tag of metal or equally durable material, or a suitable metallized decal which shall be affixed (by a heatless process) to the shell of an extinguisher which favorably passes the hydrostatic test. The record tag shall contain the following information: Date of test, test pressure, and name or initials of person or agency making the test.

(ix) For extinguishers subjected to an original factory test pressure of 350 p.s.i. or greater, the test pressure shall be 75 percent of the factory test pressure (as noted on the extinguisher nameplate), but in no case less than 300 p.s.i., see Table L-4. For extinguishers subjected to an original factory test pressure of less than 350 p.s.i., the test pressure shall be 75 percent of the factory test pressure; see Table L-4. Pressure shall be applied

at a rate of rise to reach the test pressure in approximately 1 minute, and the pressure shall be held for 1 minute, after which it shall be released.

TABLE L-4

HYDROSTATIC TEST PRESSURE REQUIREMENTS—NON-ICC SHELLS, SHELLS NOT SPECIFIED IN U.S. DEPARTMENT OF TRANSPORTATION REGULATIONS, (FORMERLY INTERSTATE COMMERCE COMMISSION)

Extinguisher type	Original factory test pressure	Required hydrostatic test pressure
All dry chemical and dry powder	400 p.s.i. or greater	75% of factory test pressure
	350-399 p.s.i.	300 p.s.i.
	below 350 p.s.i.	75% of factory test pressure
Foam—500 p.s.i. factory test	500	375
Foam—300 p.s.i. factory test	300	225
Soda-acid—500 p.s.i. factory test	500	375
Soda-acid—350 p.s.i. factory test	350	300
Stored-pressure or cartridge-operated water-type (including antifreeze and loaded-stream)	400 p.s.i. or greater	75% of factory test pressure
	350-399 p.s.i.	300 p.s.i.
	below 350 p.s.i.	75% of factory test pressure

(x) Carbon dioxide extinguishers, nitrogen cylinders, and other cylinders or cartridges used for the storage of inert, compressed gases shall be hydrostatically tested in accordance with the requirements of the U.S. Department of Transportation (formerly Interstate Commerce Commission); see 49 CFR Parts 171-190.

(xi) Extinguisher shells, cartridges, or cylinders which show leakage or permanent distortion in excess of specified limits, or which rupture, shall be removed from service.

§ 1910.158 Standpipe and hose systems.

(a) General requirements.—(1) Application. Where standpipe and hose systems are provided they shall meet the design requirements of the National Fire Protection Association's Standard for the Installation of Standpipe and Hose Systems NFPA 14-1970 and the requirements of this section.

(2) Closets and cabinets. Closets and cabinets used to contain fire hose shall be of sufficient size to permit the installation of the necessary equipment at hose stations, and so designed as not to interfere with the prompt handling of the hose and equipment at time of fire. They shall be used for fire equipment only.

(3) Protection of standpipes. Standpipes shall be so located that they are protected against mechanical and fire damage.

(b) Hose outlets.—(1) Location of hose. (i) Hose outlets shall be within easy reach of a person standing on the floor and in no case shall be over 6 feet from the floor. Hose stations shall be located conspicuously within the immediate area and where not likely to be obstructed. Hose may be located at one side of the standpipe and supplied by short lateral connections to the standpipe where necessary to avoid obstructions.

(ii) For Class III service, the outlets for large hose shall be located in a stairway enclosure, and for small hose the outlets shall be located in the corridor

or space adjacent to the stairway enclosure.

(2) Hose connections. (i) Standpipes for Class I service shall be provided with 2½-inch hose connections on each floor.

(ii) Standpipes for Class II service shall be provided with 1½-inch hose connections on each floor.

(iii) Standpipes for Class III service shall be provided with both a 2½-inch and 1½-inch hose connection on each floor. The hose connections may be through one 2½-inch hose valve and an easily removable 2½-inch by 1½-inch adapter.

(3) Hose. Each hose outlet provided for the use of building occupants (Class II and III services) shall be equipped with not more than 75 feet and preferably not more than 50 feet of approved small fire hose attached and ready for use.

(4) Hose racks. Each station provided with small hose shall be equipped with an approved rack securely fastened in position.

(5) Hose valves. (i) An approved hose valve shall be provided at each outlet for attachment of hose.

(ii) Where the static pressure at any standpipe outlet for small hose exceeds 100 pounds per square inch, an approved device shall be installed at the outlet to reduce the pressure so that the nozzle pressure will be approximately 80 pounds per square inch.

NOTE: Pressure reducers are not required on standpipe outlets for 2½-inch hose because it is assumed 2½-inch hose will be attached only when the persons likely to use it are trained in handling large streams.

(iii) National (American) Standard Fire Hose Coupling Screw Threads shall be used whenever they will fit existing equipment; see Standard for Screw Threads Gaskets for Fire Hose Couplings, NFPA No. 194-1968.

(6) Nozzles. Nozzles shall be of an approved type. Size of nozzles for small hose shall be not larger than one-half inch.

(7) Dry standpipe identification. Each hose connection on dry standpipes shall be provided with a conspicuous, durable, and permanently legible sign reading "Dry Standpipe for Fire Department Use Only."

(c) Water supplies.—(1) Minimum supply for Class I service. (i) The minimum supply for Class I service shall be sufficient to provide 500 gallons per minute for a period of at least thirty (30) minutes.

(ii) Where more than one standpipe is required, the minimum supply shall be 500 gallons per minute for the first standpipe and 250 gallons per minute for each additional standpipe, the total supply not to exceed 2,500 gallons a minute, for a period of at least thirty (30) minutes.

(iii) The supply shall be sufficient to maintain a residual pressure of 65 pounds per square inch at the topmost outlet of each standpipe (including the roof outlet) with 500 gallons per minute flowing.

(2) Minimum supply for Class II service. The minimum supply for Class II service shall be sufficient to provide 100

gallons per minute for a period of at least thirty (30) minutes. The supply shall be sufficient to maintain a residual pressure of 80 pounds per square inch at the top-most outlet of each standpipe (including the roof outlet) with 100 gallons per minute flowing.

(3) *Minimum supply for Class III service.* The minimum supply for Class III service shall be the same as for Class I service.

(4) *Fire department connections.* (i) One or more fire department connections shall be provided for each Class I or Class III standpipe system.

(ii) In high-rise buildings having two or more zones, a fire department connection shall be provided for each zone.

(iii) Fire department connections shall be properly supported.

(iv) There shall be no shutoff valve in the fire department connection.

(v) An approved straightway check valve shall be installed in each fire department connection, located as near as practicable to the point where it joins the system.

(vi) The pipe between the check valve and the outside hose coupling shall be equipped with an approved automatic drip, arranged to discharge to a proper place.

(vii) Hose connections shall be approved type and shall be equipped with standard caps, properly secured and arranged for easy removal by fire departments.

(viii) Hose coupling threads shall conform to those used by the local fire department. (American) National Standard Fire-Hose Coupling Screw Threads shall be used whenever they will fit the local fire department hose threads; see standard for Screw Threads and Gaskets for Fire Hose Couplings, NFPA No. 194-1968.

(ix) Hose connections should be on the street side of buildings and shall be located and arranged so that hose lines can be readily and conveniently attached to the inlets without interference from any nearby objects including buildings, fences, posts, or other fire department connections.

(x) Hose connections shall be designated by a sign having raised letters at least one inch in size cast on a plate or fitting, reading "Standpipe."

(xi) If hose connection does not serve all of the building an appropriate and durable sign shall be attached indicating the portions of the building served.

(d) *Tests and maintenance.* (1) *Tests.* All new systems including yard piping shall be tested hydrostatically at not less than 200 pounds per square inch pressure for 2 hours, or at 50 pounds per square inch in excess of the normal pressure when the normal pressure is in excess of 150 pounds per square inch.

(2) *Periodic inspection.* (i) The tanks shall be kept properly filled, and where pressure tanks are employed, a pressure of at least 75 pounds per square inch shall be maintained at all times.

Note: For further details, see Standard for Water Tanks for Private Fire Protection, NFPA No. 22-1970.

(ii) The valves in the main connection to the automatic sources of water supply shall be open at all times. The hose valves should be frequently examined to see that they are tight.

Note: For further details, see Care of Fire Hose, NFPA No. 194-1968.

FIXED FIRE SUPPRESSION EQUIPMENT

§ 1910.159 Automatic sprinkler systems.

(a) *General requirements.* (1) *Design.* When automatic sprinkler systems are provided they shall meet design requirements of the National Fire Protection Association's Standard for the Installation of Sprinkler Systems NFPA No. 13-1969 and the requirements of this section.

(2) *Water supply.* Every automatic sprinkler system shall have at least one automatic water supply of adequate pressure, capacity and reliability.

(3) *Fire department connection.* A connection through which a fire department can pump water into the sprinkler system makes a desirable auxiliary supply. For this purpose, one or more fire department connections shall be provided in all cases.

(b) *Fire department connections.* (1) *Size.* Pipe size shall not be less than 4 inches for fire engine connections and not less than 6 inches for fireboat connections, except that 3-inch pipe may be used to connect a single hose connection to a 3-inch or smaller riser.

(2) *Valves.* (i) An approved straightaway check valve shall be installed in each fire department connection, located as near as practicable to the point where it joins the system.

(ii) There shall be no shutoff valve in the fire department connection.

(3) *Support.* Fire department connections shall be properly supported.

(4) *Hose connections.* (i) Hose connections shall be of approved type.

(ii) Hose coupling threads shall conform to those used by the local fire department. (American) Standard Fire Hose Coupling Screw Threads shall be used whenever they will fit the local fire department hose.

(iii) Hose connections shall be equipped with caps, properly secured and arranged for easy removal by fire departments.

(iv) Hose connections shall be located and arranged so that hose lines can be readily and conveniently attached to the inlets without interference from any nearby objects including buildings, fences, posts, or other fire department connections.

(v) Hose connections shall be designated by a sign having raised letters at least 1 inch in size cast on plate or fitting reading for service designated: Vis—"AUTO-SPKR." or "OPEN SPKR."

(c) *Sprinkler alarms.* (1) *General.* (i) Waterflow alarms shall be provided on all sprinkler installations.

(ii) An alarm unit shall include an approved mechanical alarm, horn, or siren, or an approved weatherproof electric gong, bell, horn, or siren on the outside of the building or approved electric gongs, bells, horns, or sirens inside

the building, or a combination of such devices.

(iii) All alarm apparatus shall be so located and installed that all parts are readily accessible for inspection, removal, and repair, and shall be substantially supported. Outdoor mechanical or electrically operated bells shall be of weatherproof and guarded type. On each alarm check valve used under conditions of variable water pressure, a retarding device shall be installed. Suitable valves shall be provided in the connections to retarding chambers, to permit repair or removal without shutting off sprinklers; these valves shall be so arranged that they may be locked or sealed in the open position.

(2) *Waterflow detecting devices.* (i) The alarm apparatus for a wet-pipe system shall consist of an approved alarm check valve or other approved water flow detecting alarm device with the necessary attachments required to give an alarm.

(ii) The alarm apparatus for a dry-pipe system shall consist of approved alarm attachments to the dry-pipe valve. When a dry-pipe valve is located on the system side of an alarm valve, the actuating device of the alarms for the dry-pipe valve may be connected to the alarms on the wet-pipe system.

(iii) The alarm apparatus for preaction and deluge systems shall consist of approved electric alarm attachments, actuated by a thermostatic system independently of flow of water in the system.

(3) *Drains.* Drains from alarm devices shall be so arranged that there will be no danger of freezing, and so that there will be no overflowing at the alarm apparatus, at domestic connections or elsewhere with the sprinkler drains wide open and under pressure.

(d) *Maintenance of sprinkler system.* A sprinkler system installed under this Standard must be properly maintained for efficient service. The owner is responsible for the condition of his sprinkler system and must use due diligence in keeping the system in good operating condition.

(e) *Sprinkler head clearance.* (1) *Type I storage.* Clearance of at least 36 inches shall be maintained between sprinkler deflectors and top of storage to reduce the possibility of obstruction to the distribution of water.

(2) *Type II storage.* Clearance of at least 18 inches shall be maintained between sprinkler deflectors and top of storage to reduce the possibility of obstruction to the distribution of water.

(3) *Type III storage.* In sprinklered buildings, at least 18 inches clearance between sprinkler deflectors and top of storage shall be maintained.

§ 1910.160 Fixed dry, chemical extinguishing systems.

(a) *General requirements.* (1) *Design.* When dry chemical extinguishing systems are provided they shall meet the design requirements of the National Fire Protection Association's "Standard for Dry Chemical Extinguishing Systems" NFPA No. 17-1969 and the requirements of this section.

RULES AND REGULATIONS

(c) **Design requirements.** Where there is a possibility that personnel may be exposed to a dry chemical discharge, suitable extinguishers shall be provided to assure prompt evacuation of such location, and also to provide means for prompt escape of any trapped personnel.

(d) **Alarms and indicators.**—(1) **General.** Alarms and/or indicators are used to indicate the operation of the system, aimed at personnel, or failure of any specified device or equipment. The device may be audible or visual. The type, number, and location of the devices shall be such that their purpose is satisfactorily accomplished. The extent and type of alarm and/or indicator equipment shall be approved.

(2) **Operation alarm.** (i) An alarm or indicator shall be provided to show that the system has operated, that personnel response may be needed, and that the system should be charged.

(ii) Alarms indicating failure of super-pressurized devices or equipment shall give prompt and positive indication of any failure and shall be distinctive from alarms indicating operation or hazardous conditions.

(c) **Inspection and maintenance.**—(1) **Inspection and tests.** (i) At least annually, all dry chemical systems including alarms, shutdowns, and other associated equipment shall be thoroughly inspected and checked for proper operation by a competent inspector.

(ii) The purpose of the inspection and testing prescribed by paragraph (c) of this section shall be not only to insure that the system is in full operating condition but also to indicate the probable continuance of that condition until the next inspection. Attention at this inspection shall be given to any extension of the hazard protected by the system.

(iii) The inspector's report, with recommendations, if any, shall be filed with the owner or with whomsoever is designated by the owner.

(iv) Between the regular service contract inspection or tests, the system shall be inspected visually or otherwise by competent personnel, following an approved schedule.

(v) At least semiannually, all expellant gas containers shall be checked by pressure or weight against the required minimums.

(vi) At least semiannually, all stored pressure dry chemical containers shall be checked by pressure and weight against the required minimums.

(vii) Except for stored pressure systems, at least annually the dry chemical in the system storage container shall be sampled from the top center and also near the wall to determine the existence of lumps harder than will be friable when dropped from a height of 4 inches.

(2) **Maintenance.** (i) These fixed dry chemical systems shall be maintained in full operating condition at all times. Use, impairment, and restoration of this protection shall be reported promptly to the owner.

(ii) Any troubles or impairments shall be corrected at once by competent personnel.

§ 1910.161 Carbon dioxide extinguishing systems.

(a) **General requirements.**—(1) **Design.** When carbon dioxide extinguishing systems are provided they shall meet the design requirements of the National Fire Protection Association's "Standard on Carbon Dioxide Extinguishing Systems" NFPA No. 12-1968 and the requirements of this section.

(2) **Safety requirements.** In any use of carbon dioxide where there is a possibility that employees may be trapped in, or enter into atmospheres made hazardous by a carbon dioxide discharge, suitable safeguards shall be provided to insure prompt evacuation of and to prevent entry into such atmospheres and also to provide means for prompt rescue of any trapped personnel. Such safety items as personnel training, warning signs, discharge alarms, pre-discharge alarms, and breathing apparatus shall be considered.

(b) **Inspection and maintenance.**—(1) **Inspection and tests.** (i) At least annually, all carbon dioxide systems shall be thoroughly inspected and tested for proper operation by a competent engineer or inspector.

(ii) The goal of this inspection and testing shall be not only to insure that the system is in full operating condition but shall indicate the probable continuance of that condition until the next inspection.

(iii) Suitable discharge tests shall be made when any inspection indicates their advisability.

(iv) Between the regular service contract inspection or tests, the system shall be inspected visually or otherwise by competent personnel, following a schedule.

(v) At least semiannually, all high pressure cylinders shall be weighed. If, at any time, a container shows a loss in net content of more than 10 percent, it shall be refilled or replaced.

(vi) If, at any time, a container shows a loss of more than 10 percent, it shall be refilled, unless the minimum gas requirements are still provided.

(2) **Maintenance.** (i) These carbon dioxide systems shall be maintained in full operating condition at all times.

(ii) Any troubles or impairments shall be corrected at once by competent personnel.

§ 1910.163 Other special fixed extinguishing systems. [Reserved]

OTHER FIRE PROTECTION SYSTEMS

§ 1910.165 Local fire alarm signaling systems.

(a) **General requirements.** Where local fire alarm signaling systems are provided they shall meet the design requirements of the National Fire Protection Association's "Standard for the Installation, Maintenance, and Use of Local Protective Signaling Systems for Watchman, Fire Alarm and Supervisory Service." NFPA No. 72A-1967 and the requirements of this section.

(b) **Fire alarm boxes.**—(1) **General.** Manual fire alarm boxes shall be approved for the particular application and

shall be used only for the intended signaling system. Capabilities and vulnerability against tampering shall be acceptable.

(2) **Mounting.** Each box shall be securely mounted.

(3) **Distribution.** Manual fire alarm boxes shall be distributed throughout the protected area so that they are unobstructed, readily accessible, and located in the normal path of exit from the area. Additional boxes shall be provided on each floor to obtain a maximum horizontal travel distance of 200 feet to the nearest box.

(c) **Maintenance.** All systems shall be under the supervision of qualified persons. These persons shall cause tests and inspections to be made at prescribed intervals and shall have general charge of all alterations and additions to the systems under their supervision.

§ 1910.164 Fire brigades. [Reserved]

§ 1910.166 Additional duty in effective date.

The requirements of this Subpart L shall be effective on February 27, 1973, unless before that date any employment or place of employment becomes subject to any safety or health standard which is published in 41 CFR Part 50-304 by virtue of the application of the Walsh-Healey Public Contracts Act (41 U.S.C. 35-48) and which is incorporated in this subpart. In which event, the standard shall be effective under this subpart upon the commencement of the Walsh-Healey requirement.

§ 1910.166a Sources of standards.

Section	Source
1910.156(a) -	
(b) -	NFPA No. 10-1970, Standard for the Installation of Portable Fire Extinguishers.
1910.156(i) -	
(j) -	NFPA No. 12-1968, Standard for the Installation of Sprinkler Systems.
1910.156(k) -	
(o) -	NFPA No. 14-1970, Standard for the Installation of Standpipe and Hose Systems.
1910.156(p) -	
(s) -	NFPA No. 221-1970, Standard for Indoor General Storage.
1910.157 -	NFPA No. 18-1970, Standard for the Installation of Portable Fire Extinguishers.
1910.158 -	NFPA No. 14-1970, Standard for the Installation of Standpipe and Hose Systems.
1910.159(a) -	
(d) -	NFPA No. 22-1968, Standard for the Installation of Sprinkler Systems.
1910.159(e) -	NFPA No. 221-1970, Standard for Indoor General Storage.
1910.160 -	NFPA No. 17-1968, Standard for Dry Chemical Extinguishing Systems.
1910.161 -	NFPA No. 12-1968, Standard on Carbon Dioxide Extinguishing Systems.

§ 1910.155 Standards organizations.
Compressed Gas Association, Inc., 506 Fifth
Avenue, New York, NY 10004.
National Fire Protection Association, 60
Barrington Street, Boston, MA 02110.
American National Standards Institute, 1430
Broadway, New York, NY.

**Support M—Compressed Gas and
Compressed Air Equipment**
§ 1910.166 Inspection of compressed
gas cylinders.

(a) **Definitions.** As used in this section:

(1) **High- and low-pressure cylinders:** High-pressure cylinders means those cylinders with a marked service pressure of 900 p.s.i. or greater; low-pressure cylinders are those with a marked service pressure less than 900 p.s.i.

(2) **Minimum allowable wall thickness:** The minimum allowable wall thickness means the minimum wall thickness required by the specification under which the cylinder was manufactured.

(3) **Dents:** Dents (in cylinders) means deformations caused by the cylinder coming in contact with a blunt object in such a way that the thickness of metal is not materially impaired.

(4) **Cuts, gouges, or digs:** Cuts, gouges, or digs (in cylinders) means deformations caused by contact with a sharp object in such a way as to cut into or upset the metal of the cylinder, decreasing the wall thickness at that point.

(5) **Corrosion or pitting:** Means corrosion or pitting in cylinders involving the loss of wall thickness by corrosive media. There are several kinds of pitting or corrosion to be considered.

(6) **Isolated pitting:** Means isolated pits of small cross-section which do not effectively weaken the cylinder wall but are indicative of possible complete penetration and leakage. Since the pitting is isolated the original wall is essentially intact.

(7) **Line corrosion:** Means pits which are not isolated but are connected or nearly connected to others in a narrow band or line. This condition is more serious than isolated pitting. Line corrosion frequently occurs in the area of intersection of the footing and bottom of a cylinder. This is sometimes referred to as "crevice corrosion."

(8) **General corrosion:** Means corrosion which covers considerable surface areas of the cylinder. It reduces the structural strength. It is often difficult to measure or estimate the depth of general corrosion because direct comparison with the original wall cannot always be made. General corrosion is often accompanied by pitting.

(9) **"DOT"** means the U.S. Department of Transportation.

(b) **General requirements—(1) Application.** (i) Each employer shall determine that compressed gas cylinders

under his control are in a safe condition to the extent that this can be determined by visual and other inspection required by this subparagraph.

(ii) The requirements contained in this section are not intended to apply to cylinders manufactured under specification DOT (ICC)-3HT (49 CFR Ch. 1). Separate requirements covering service life and standards for visual inspection of these cylinders are contained in Compressed Gas Association Pamphlet C-8, "Standard for Requalification of ICC-3HT Cylinders."

(2) **Quality of inspection.** Experience in the inspection of cylinders is an important factor in determining the acceptability of a given cylinder for continued service. Users lacking this experience and having doubtful cylinders should return them to a manufacturer of the same type of cylinders for reinspection.

(c) **Inspection of low-pressure cylinders exempt from the hydrostatic test including acetylene cylinders—(1) Application.** This section covers cylinders of the type that are exempt from the hydrostatic retest requirements of the DOT by virtue of their exclusive use in certain noncorrosive gas service. They are not subject to internal corrosion and do not require internal shell inspection.

(2) **Preparation for inspection.** Rust, scale, baked paint, etc., shall be removed from the exterior surface so that the surface can be adequately observed. Facilities shall be provided for inverting the cylinder to facilitate inspection of the bottom. This is important because experience has shown this area to be the most susceptible to corrosion.

(3) **Exterior inspection.** Cylinders shall be checked as outlined below for corrosion, general distortion, or any other defect that might indicate a weakness which would render it unfit for service.

(i) To fix corrosion limits for all types, designs, and sizes of cylinders, and include them in this section is not practicable. Cylinders shall meet the requirements of this subdivision. Failure to meet any of the requirements of this subdivision is of itself cause for rejection of a cylinder.

(a) A cylinder shall be rejected when the tare weight is less than 95 percent of the original tare weight marked on the cylinder. When determining tare weight, be sure that the cylinder is empty.

(b) A cylinder shall be rejected when the remaining wall in an area having isolated pitting only is less than one-third of the minimum allowable wall thickness as determined under subdivision (ii), (iii), or (iv) of this subparagraph.

(c) A cylinder shall be rejected when line corrosion on the cylinder is 3 inches in length or over and the remaining wall is less than three-fourths of the minimum allowable wall thickness or when line corrosion is less than 3 inches in length and the remaining wall thickness is less than one-half the minimum allowable wall thickness as determined under subdivision (ii), (iii), or (iv) of this subparagraph.

(d) **Corrosion.** When the wall thickness at the time of manufacture is not known, and the actual wall thickness cannot be measured, a cylinder shall be rejected when the inspection reveals that the deepest pit in a general corrosion area exceeds three sixty-fourths inch. This is arrived at by considering that in no case shall the pitting exceed one-half the minimum allowable wall thickness which is 0.064 inch. When a pit measures 0.043 inch (approximately three sixty-fourths inch) in a corrosion area, general corrosion will already have removed 0.021 inch of the original wall and the total pit depth as compared to the initial wall will be 0.064 inch.

(iv) When the original wall thickness at manufacture is known, or the actual wall thickness is measured, this thickness less one and one-half times the maximum measured pit depth shall be 0.064 inch or greater. If it is less, the cylinder shall be rejected.

(v) Dents are of concern where the metal deformation is sharp and confined, or where they are near a weld. Where metal deformation is not sharp, dents of larger magnitude can be tolerated.

(vi) Where denting occurs so that any part of the deformation includes a weld, the maximum allowable dent depth shall be one-fourth inch.

(vii) When denting occurs so that no part of the deformation includes a weld, the cylinder shall be rejected if the depth of the dent is greater than one-tenth of the mean diameter of the dent.

(viii) Cuts, gouges, or digs reduce the wall thickness of the cylinder and in addition are considered to be stress raisers. Depth limits are set in this subparagraph; however, cylinders shall be rejected at one-half of the limit set whenever the length of the defect is 3 inches or more.

(a) When the original wall thickness at manufacture is not known, and the

TABLE M-1

Cylinder size O.D. x length (inches)	DOT Specification marking	Nominal water capacity (pounds)	Minimum allowable wall thickness (inches)
14 1/2 x 48	4BA300	250	0.120
14 1/2 x 60	4BA300	325	0.120
14 1/2 x 72	4BA300	400	0.120
14 1/2 x 84	4BA300	475	0.120
14 1/2 x 96	4BA300	550	0.120
14 1/2 x 108	4BA300	625	0.120

Without longitudinal seams

When the original wall thickness is known, or the actual wall thickness is measured, a cylinder shall be rejected if the original wall thickness minus the depth of the defect is less than one-half of the minimum allowable wall thickness as determined under subsection (E), (F), or (G) of this paragraph.

(ix) Leaks can originate from a number of sources, such as defects in a welded or brazed seam, defects at the threaded opening, or from sharp dents, dips, gouges, or pits.

(x) To check for leaks, the cylinder shall be charged and carefully examined. All seams and pressure openings shall be coated with a soap or other suitable solution to detect the escape of gas. Any leakage is cause for rejection.

(b) Safety relief devices as defined in § 191.167(c)(1) shall be tested for leaks before a charged cylinder is shipped from the cylinder filling plant.

(x) After fire damage, cylinders shall be carefully inspected for evidence of exposure to fire.

(a) Common evidences of exposure to fire are:

- (1) Charring or burning of the paint or other protective coat.
- (2) Burning or sintering of the metal.
- (3) Distortion of the cylinder.
- (4) Melted out fuse plugs.
- (5) Burning or melting of valve.

(b) The evaluation of fire damage by DOT Regulations state that, "A cylinder which has been subjected to the action of fire must not again be placed in service until it has been properly reconditioned", in accordance with 49 CFR 173.34(f). The general intent of this requirement is to remove from service cylinders which have been subject to the action of fire which has changed the metallurgical structure or the strength properties of the steel, or in the case of acetylene cylinders caused breakdown of porous filler. This is normally determined by visual examination as covered above with particular emphasis to the condition of the protective coating. If the protective coating has been burnt off or if the cylinder body is burnt, warped, or distorted, it is assumed that the cylinder has been overheated and 49 CFR 173.34(f) shall be complied with. If, however, the protective coating is only dirtied from smoke or other debris, and is found by examination to be intact underneath, the cylinder shall not be considered affected with the scope of this requirement.

(xi) Cylinders are manufactured with a reasonably symmetrical shape. Cylinders which have definite visible bulges shall be removed from service and evaluated. Cylinders shall be rejected when a variation of 1 percent or more is found in the measured circumferences or in peripheral distances measured from the

where shown by the manufacturer for cylinders under DOT Specifications.

(c) Cylinders must be examined for serious cracks, indentations. Most cracks are normally detected by testing the neck during charging operations with a soap solution.

(xii) Cylinders need threads shall be examined whenever the valve is removed from the cylinder. Cylinders shall be rejected if the required number of effective threads are materially reduced, or if a gas tight seal cannot be obtained by reasonable valving methods. Gaps shall be used to measure the number of effective threads.

(xiii) If the valve is noticeably tilted the cylinder shall be rejected.

(xiv) The seating and handling of cylinders may become so distorted through service abuse that they no longer perform their functions:

(a) To cause the cylinder to remain stable and upright.

(b) To protect the valve. Rings shall be examined for distortion; for looseness, and for failure of welds. Appearances may often warrant rejection of the cylinder.

(d) Low-pressure cylinders subject to hydrostatic testing.—(1) Application.

Cylinders covered in this section are low-pressure cylinders other than those covered in paragraph (c) of this section. They differ essentially from such cylinders in that they require a periodic hydrostatic test which includes an internal and external examination. Defect limits for the external examination are prescribed in paragraph (c) of this section, with exceptions for aluminum cylinders shown in subparagraph (4) of this paragraph.

(2) Preparation for inspection. Flammable gas cylinders shall be purged before being examined with a light. Lamps used for flammable gas cylinder inspection shall be explosion proof.

(3) Internal inspection. Cylinders shall be inspected internally at least every time the cylinder is periodically retested. The examination shall be made with a light of sufficient intensity to clearly illuminate the interior walls.

(4) External inspection of aluminum cylinders. The inspection requirements of paragraph (c) of this section shall be met except as follows:

(i) Aluminum cylinders shall be rejected when impairment to the surface (corrosion or mechanical defect) exceeds a depth where the remaining wall is less than three-fourths of the minimum allowable wall thickness required by the specification under which the cylinder was manufactured.

(ii) Aluminum cylinders subjected to the action of fire shall be removed from service.

(e) High-pressure cylinders.—(1) Application. High-pressure cylinders are those with a marked service pressure of 900 p.s.i. or higher. They are seamless; no welding is permitted. The great bulk of such cylinders are of the 3A or 3AA types under DOT Specifications (49 CFR Ch. 17).

(2) Preparation for inspection. Cylinders shall be prepared for inspection so that the inside and outside surfaces and all openings can be observed. This shall include removal of seals and coating paint from the exterior and the thorough removal of internal scale. Cylinders with interior coating shall be examined for defects in the coating. If the coating is defective, it shall be removed.

(ii) A good inspection light of sufficient intensity to clearly illuminate the interior wall is mandatory for internal inspection. Flammable gas cylinders shall be purged before being examined with a light. Lamps for flammable gas cylinder inspection shall be explosion proof.

(3) Exterior inspection. (i) To fix corrosion limits for all types, designs, and sizes of cylinders, and include them in this section, is not practicable. Considerable judgment is required in evaluating cylinders fit for service. Experience is a major factor, aside from strength considerations for high pressure cylinders.

(ii) When the original wall thickness of the cylinder is not known, and the actual wall thickness cannot be measured, the cylinder is rejected if corrosion exceeds one thirty-second inch in depth. This is arrived at by subtracting from the minimum allowable wall at manufacture (0.221 inch), the limiting wall in service (0.184 inch), to give the maximum allowable corrosion limit of 0.036 inch, say one thirty-second inch.

(iii) When the wall thickness is known, or the actual wall thickness is measured, the difference between this known wall and the limiting value establishes the maximum corrosion figure. The normal hot forged cylinder of this size will have a measured wall of about 0.240 inch. Comparison of this with the limiting wall thickness shows that defects up to about one-sixteenth inch are allowable provided, of course, that the actual wall is measured or is known.

(iv) Cylinders with general corrosion are evaluated by subjecting them to a hydrostatic test. Thus, a cylinder with an elastic expansion of 227 cc. or greater shall be rejected. If areas of pronounced pitting are included within the general corrosion, the depth of such pitting should also be measured (with the high spots of the actual surface as a reference plane) and the criteria established in the first example apply. Thus, the maximum corrosion limit would be one thirty-second inch when the wall was not known.

(v) Any defect of appreciable depth having a sharp bottom is a stress raiser and even though a cylinder may be acceptable from a stress standpoint, it is common practice to remove such defects after any such repair operation, verification of the cylinder strength and structure shall be made by a hydrostatic test or other suitable means.

(vi) Dents can be tolerated when the cylinder wall is not deformed excessively or abruptly. Generally speaking, dent are accepted up to a depth of about one sixteenth inch when the major diameter

of the test is equal to or greater than 20 times the diameter of the hammer dent than this gas cylinder is rejected and shall require repair or replacement. On small diameter cylinders these general rules may have to be adjusted. Considerations of appearance play a major factor in the evaluation of dents.

(vii) Cylinders with one or more dents shall be removed from service. Defects of this nature may be recognized by one of the following conditions:

(a) Removal of metal by scoring or cratering.

(b) A scuffing or burning of the base metal.

(c) A hardened heat affected zone. A simple method for verifying the presence of small area burns is to file the suspected area. The hardened zone will resist filing as compared to the softer base metal.

(viii) Cylinders are normally produced with a symmetrical shape. Cylinders with distinct visual bulges shall be removed from service until the nature of the defect is determined. Some cylinders may have small discontinuities related to the manufacturing process—mushroomed bottoms, offset shoulders, etc. These usually can be identified and are not normally cause for concern.

(ix) Cylinders shall be carefully inspected for evidences of exposure to fire, see paragraph (c) (3) (x) of this section.

(x) Cylinder necks shall be examined for serious cracks, folds, and flaws. See paragraphs (c) (3) (xi) and (xiii) of this section.

(i) Internal inspection. (1) Cylinders shall be inspected internally at least every time the cylinder is periodically retested. This examination shall be made with a light of sufficient intensity to clearly illuminate the interior walls.

(2) A hammer test consists of tapping a cylinder a light blow with a suitably sized hammer. A cylinder, emptied of liquid content, with a clean internal surface, standing free, will have a clear ring. Cylinders with internal corrosion will give a duller ring dependent upon the amount of corrosion and accumulation of foreign material. Such cylinders shall be investigated. The hammer test is very sensitive and is an easy, quick, and convenient test that can be made without removing the valve before each charging. It is an invaluable indicator of internal corrosion.

§ 1910.167 Safety relief devices for compressed gas cylinders.

(a) Definitions. As used in this section:

(1) **Safety relief device.** A "safety relief device" is a device intended to prevent rupture of a cylinder under certain conditions of exposure. (The term as used herein shall include the approach channel, the operating parts, and the discharge channel.)

(2) **Approach channel.** An "approach channel" is the passage or passages through which gas must pass from the cylinder to reach the operating parts of the safety relief device.

(3) **Discharge channel.** A "discharge channel" is the passage or passages be-

hind the operating parts through which gas must pass to reach the atmosphere exclusive of the piping attached to the outlet of the device.

(4) **Safety relief device channel.** A "safety relief device channel" is the channel through which gas released by operation of the device must pass from the cylinder to the atmosphere exclusive of any piping attached to the inlet or outlet of the device.

(5) **Operating part.** The "operating part" of a safety relief device is the part of a safety relief device that normally closes the safety discharge channel but when moved from this position as a result of the action of heat or pressure, or a combination of the two, permits escape of gas from the cylinder.

(6) **Frangible disc.** A "frangible disc" is an operating part in the form of a disc, usually of metal and which is so held as to close the safety relief device channel under normal conditions. The disc is intended to burst at a predetermined pressure to permit the escape of gas.

(7) **Pressure opening.** A "pressure opening" is the orifice against which the frangible disc functions.

(8) **Rated bursting pressure.** A "rated bursting pressure" of a frangible disc is the maximum pressure for which the disc is designed to burst when in contact with the pressure opening for which it was designed when tested.

(9) **Fusible plug.** A "fusible plug" is an operating part in the form of a plug of suitable low melting material, usually a metal alloy, which closes the safety relief device channel under normal conditions and is intended to yield or melt at a predetermined temperature to permit the escape of gas.

(10) **Yield temperature.** The "yield temperature" of a fusible plug is the temperature at which the fusible metal or alloy will yield when tested.

(11) **Reinforced fusible plug.** A "reinforced fusible plug" is a fusible plug consisting of a core of suitable material having a comparatively high yield temperature surrounded by a low-melting point fusible metal of the required yield temperature.

(12) **Combination frangible disc-fusible plug.** A "combination frangible disc-fusible plug" is a frangible disc in combination with a low melting point fusible metal, intended to prevent its bursting at its predetermined bursting pressure unless the temperature also is high enough to cause yielding or melting of the fusible metal.

(13) **Safety relief valve.** A "safety relief valve" is a safety relief device containing an operating part that is held normally in a position closing the safety relief device channel by spring force and is intended to open and to close at predetermined pressures.

(14) **Combination safety relief valve and fusible plug.** A "combination safety relief valve and fusible plug" is a safety relief device utilizing a safety relief valve in combination with a fusible plug. This combination device may be an integral unit or separate units and is intended to

open and to close at predetermined pressures or to open at a predetermined temperature.

(15) **Set pressure.** The "set pressure" of a safety relief valve is the pressure marked on the valve and at which it is set to start to discharge.

(16) **Start-to-discharge pressure.** The "start-to-discharge pressure" of a safety relief valve is the pressure at which the first bubble appears through a water coat of not over 4 inches on the outlet of the safety relief valve.

(17) **Flow capacity.** The "flow capacity" of a safety relief device is the capacity in cubic feet per minute of free air discharged at the required flow rating pressure.

(18) **Flow rating pressure.** The "flow rating pressure" is the pressure at which a safety relief device is rated for capacity.

(19) **Nonliquefied compressed gas.** A "nonliquefied compressed gas" is a gas, other than a gas in solution which under the charging pressure, is entirely gaseous at a temperature of 70° F.

(20) **Liquefied compressed gas.** A "liquefied compressed gas" is a gas, under the charging pressure, is partially liquid at a temperature of 70° F. A flammable-compressed gas which is normally nonliquefied at 70° F. but which is partially liquid under the charging pressure and temperature, shall follow the requirements for liquefied compressed gases.

(21) **Compressed gas in solution.** A "compressed gas in solution" (Acetylene) is a nonliquefied gas which is dissolved in a solvent.

(22) **Pressurized liquid compressed gas.** A "pressurized liquid compressed gas" is a compressed gas other than a compressed gas in solution, which cannot be liquefied at a temperature of 70° F., and which is maintained in the liquid state at a pressure not less than 40 p.s.i.a. by maintaining the gas at a temperature less than 70° F.

(23) **Test pressure of the cylinder.** The "test pressure of the cylinder" is the minimum pressure at which a cylinder must be tested as prescribed in DOT specifications for compressed gas cylinders 41 CFR Ch. I.

(24) **Free air or free gas.** "Free air" or "free gas" is air or gas measured at a pressure of 14.7 pounds per square inch absolute and a temperature of 60° F.

(25) **DOT regulations.** As used in this section "DOT regulations" refers to the U.S. Department of Transportation Regulations for Transportation of Explosives and Other Dangerous Articles by Land and Water in Rail Freight, Express and Baggage Services and by Motor Vehicle (Highway) and Water, including Specifications for Shipping Containers, Code of Federal Regulations, Title 49, Parts 171 to 178.

(b) **General requirements.**—(1) Application. Compressed gas cylinder, portable tanks, and cargo tanks shall have pressure relief devices installed and maintained in accordance with Compressed Gas Association Pamphlets 8-1.1-1963 and 1965 addenda and 8-1.2-1963.

relief devices, as covered by this section, shall be designed as follows:

(i) Type CG-1: Frangible disc. A frangible disc shall be a disc of metal or other material, which, when subjected to a pressure not over 157° F. (165° F. min.).

(ii) Type CG-2: Fusible plug or reinforced fusible plug utilizing a fusible alloy with yield temperature not over 157° F., nor less than 187° F. (212° F. min.).

(iii) Type CG-3: Fusible plug or reinforced fusible plug utilizing a fusible alloy with yield temperature not over 157° F., nor less than 208° F. (212° F. min.).

(iv) Type CG-4: Combination frangible disc-fusible plug, utilizing a fusible alloy with yield temperature not over 157° F., nor less than 187° F. (212° F. min.).

(v) Type CG-5: Combination frangible disc-fusible plug, utilizing a fusible alloy with yield temperature not over 157° F., nor less than 208° F. (212° F. min.).

(vi) Type CG-6: Safety relief valve.

(vii) Type CG-7: Combination safety relief valve and fusible plug.

3) Specifications and tests. All safety relief devices covered by this section shall be designed, constructed, marked, and tested in accordance with the specifications of the "Compressed Gas Association Safety Relief Device Standards Part 1—Cylinders for Compressed Gases: 81.1-1963."

4) Specific requirements for safety relief devices. (i) Compressed gas cylinders, which under the Regulations of the Department of Transportation must be equipped with safety relief devices, shall be considered acceptable when equipped with devices of proper construction, location, and discharge capacity under the conditions prescribed in Part 1 of the Compressed Gas Association Standard 8-1.1-1963.

(ii) Only replacement parts or assemblies provided by the manufacturer shall be used unless the advisability of interchange is proved by adequate tests.

(iii) When a frangible disc is used on a compressed gas cylinder, the rated bursting pressure of the disc shall not exceed the minimum required test pressure of the cylinder with which the device is used, except for DOT-3E cylinders (49 CFR Ch. I) the rated bursting pressure of the device shall not exceed 30 pounds per square inch gage (p.s.i.).

(iv) When a safety relief valve is used on a compressed gas cylinder, the flow pressure shall not exceed the minimum required test pressure of the cylinder on which the safety relief valve is installed and the reseating pressure shall not be less than the pressure in a fully charged cylinder at 130° F.

(v) When fittings and piping are used either the upstream or downstream of both of a safety relief device or of the passages shall be so designed that the flow capacity of the safety relief device will not be reduced below the capacity required for the container on which the safety relief device assembly is installed, nor to the extent that the rating of the device could be im-

paired. Fittings, piping, and mounting attachments shall be designed to withstand normal handling and the pressures developed when the device or device functions.

(vi) No shutoff valve shall be installed between the safety relief device and the cylinder.

(5) Maintenance requirements for safety relief devices. (i) As a precaution to keep cylinder safety relief devices in reliable operating condition, care shall be taken in the handling or storing of compressed gas cylinders to avoid damage. Care shall also be exercised to avoid plugging by paint or other dirt accumulation of safety relief device channels or other parts which could interfere with the functioning of the device. Only qualified personnel shall be allowed to service safety relief devices.

(ii) Each time a compressed gas cylinder is received at a point for refilling, all safety relief devices shall be examined externally for corrosion, damage, plugging of external safety relief device channels, and mechanical defects such as leakage or extrusion of fusible metal. If there is any doubt regarding the suitability of the safety relief device for service the cylinder shall not be filled until it is equipped with a suitable device.

§ 1910.168 Safety relief devices for cargo and portable tanks storing compressed gases.

(a) Definitions applicable to this section—(1) Cargo tank. A "cargo tank" means any container designed to be permanently attached to any motor vehicle or other highway vehicle and in which is to be transported any compressed gas. The term "cargo tank" shall not be construed to include any tank used solely for the purpose of supplying fuel for the propulsion of the vehicle or containers fabricated under specifications for cylinders.

(2) Portable tank. A "portable tank" means any container designed primarily to be temporarily attached to a motor vehicle, other vehicle, railroad car other than tank car, or marine vessel, and equipped with skids, mountings, or accessories to facilitate handling of the container by mechanical means, in which is to be transported any compressed gas. The term "portable tank" shall not be construed to include any cargo tank, any tank car tank, or any tank of the DOT-106A and DOT-110A-W type.

(3) Safety relief device. A "safety relief device" means a device intended to prevent rupture of a container under certain conditions of exposure.

(4) Safety relief valve. A "safety relief valve" means a safety relief device containing an operating part that is held normally in a position closing the safety relief device channel by spring force and is intended to open and to close at predetermined pressures.

(5) Set pressure. The "set pressure" of a safety relief valve is the pressure marked on the valve and at which the valve is set to start-to-discharge.

(6) Start-to-discharge pressure. The "start-to-discharge pressure" of a safety relief valve is the pressure at which the first bubble appears through a water seal of not over 4 inches on the outlet of the valve.

Note: When the nature of the service requires the use of a metal-to-metal seat safety relief valve, with or without secondary sealing means, the start-to-discharge pressure may be considered the pressure at which an audible discharge occurs.

(7) Resealing pressure. The "resealing pressure" of a safety relief valve is the pressure at which leakage ceases through a water seal of not over 4 inches on the outlet of the valve.

(8) Flow capacity. The "flow capacity" of a safety relief device is the capacity in cubic feet per minute of free air discharged at the required flow rating pressure.

(9) Flow rating pressure. The "flow rating pressure" means the pressure at which a safety relief device is rated for capacity.

(10) Free air or free gas. "Free air" or "free gas" means air or gas measured at a pressure of 14.7 pounds per square inch absolute and a temperature of 60° F.

(11) Frangible disc. A "frangible disc" means a safety relief device in the form of a disc, usually of metal, which is so held as to close the safety relief device channel under normal conditions. The disc is intended to burst at a predetermined pressure to permit the escape of gas.

(12) Fusible plug. A "fusible plug" means a safety relief device in the form of a plug of suitable low-melting material, usually a metal alloy, which closes the safety relief device channel under normal conditions and is intended to yield or melt at a predetermined temperature to permit the escape of gas.

(13) DOT design pressure. The "DOT design pressure" is identical to the term "maximum allowable working pressure" as used in the "Code" and is the maximum gage pressure at the top of the tank in its operating position. To determine the minimum permissible thickness of physical characteristics of the different parts of the vessel, the static head of the lading shall be added to the DOT design pressure to determine the thickness of any specific part of the vessel. If vacuum insulation is used, the liquid container shall be designed for a pressure of 15 p.s.i. more than DOT design pressure, plus static head of the lading.

Exception: For containers constructed in accordance with paragraph U-68 or U-69 of section VIII of the ASME Boiler and Pressure Vessel Code, 1949 Edition, the maximum allowable working pressure for the purpose of these standards is considered to be 125 percent of the design pressure as provided in 49 CFR 173.315 of DOT Regulations.

(14) Code. "Code" is defined as paragraph U-68, U-69, U-200 or U-201 of section VIII of the Boiler and Pressure Vessel Code of the American Society of Mechanical Engineers, 1949 Edition; or section VIII of the Boiler and Pressure Vessel Code of the American Society of Mechanical Engineers, 1950, 1952, 1956.

(v) Any portion of liquid piping or hose which at any time may be closed at each end must be provided with a safety relief device to prevent excessive pressure.

(xiii) Safety relief devices shall be arranged to discharge unobstructed to the open air in such a manner as to prevent any impingement of escaping gas upon the container. Safety relief devices shall be arranged to discharge upward except this is not required for carbon dioxide, nitrous oxide and pressurized liquid argon, nitrogen and oxygen.

(b) *Installation and equipment requirements*—(1) *Installation.* Air receivers shall be so installed that drains, handholes, and manholes there are easily accessible. Air receivers shall be supported with sufficient clearance to permit a complete external inspection and to avoid corrosion of external surfaces. Under no circumstances shall an air receiver be buried underground.

shall be an accessible place. The receiver shall be located as close to the equipment or apparatus as is possible in order to keep the liquid level low.

(3) *Drainage and vent.* A drain pipe and valve shall be installed at the lowest point of every air receiver to provide for the removal of accumulated oil and water. Adequate automatic traps may be installed in addition to drain valves. The drain valve on the air receiver shall be opened and the receiver completely drained frequently and at such intervals as to prevent the accumulation of excessive amounts of liquid in the receiver.

(3) *Gages and valves.* (i) Every air receiver shall be equipped with an indicating pressure gage (so located as to be readily visible) and with one or more spring-loaded safety valves. The total relieving capacity of such safety valves shall be such as to prevent pressure in the receiver from exceeding the maximum allowable working pressure of the receiver by more than 10 percent.

(ii) No valve of any type shall be placed between the air receiver and its safety valve or valves.

(iii) Safety appliances, such as safety valves, indicating devices and controlling devices, shall be constructed, located, and installed so that they cannot be readily rendered inoperative by any means, including the elements.

(iv) All safety valves shall be tested frequently and at regular intervals to determine whether they are in good operating condition.

§ 1910.170 Sources of standards.

Sec.	Source
1910.166.....	41 CFR 50-204.85 referencing CGA C-6-1968, Standards for Visual Inspection of Compressed Gas Cylinders.
1910.167.....	41 CFR 50-204.71 and CGA Pamphlets S-1.1-1963 and 1968 addenda and S-1.2-1963 and 1965 addenda and S-1.2-1963, Safety Relief Device Standards.
1910.169.....	ANSI B-19, 1938 Safety Code for Compressed Air Machinery.

§ 1910.171 Standards organizations.

Specific standards of the following organizations have been referenced in this part. Copies of the referenced materials may be obtained from the issuing organizations.

Compressed Gas Association, Inc., 500 Fifth Avenue, New York, NY 10086.
 American Society of Mechanical Engineers, Inc., United Engineering Center, 345 East 47th Street, New York, NY 10017.
 National Fire Protection Association, 60 Battery March Street, Boston, MA 02110.
 American National Standards Institute, 1430 Broadway, New York, NY 10018.

Support N—Materials Handling and Storage

§ 1910.176 Handling materials—general.

(a) *Use of mechanical equipment.* Where mechanical handling equipment

is used, sufficient safe clearance shall be afforded for aisles, at least one clear through doorway and with one turn or passage must be made. Aisle and passageways shall be kept clear and tagged repair, with no obstruction across or in aisles that could create a hazard. Permanent aisles and passageways shall be appropriately marked.

(b) *Secure storage.* Storage of material shall not create a hazard. Bags, containers, bundles, etc., stored in tiers shall be stacked, blocked, interlocked and limited in height so that they are stable and secure against sliding or collapse.

(c) *Housekeeping.* Storage areas shall be kept free from accumulation of materials that constitute hazards from tripping, fire, explosion, or pest harborage. Vegetation control will be exercised when necessary.

(d) *Drainage.* Proper drainage shall be provided.

(e) *Clearance limits.* Clearance signs to warn of clearance limits shall be provided.

(f) *Rolling railroad cars.* Derrail and/or bumper blocks shall be provided on spur railroad tracks where a rolling car could contact other cars being worked, enter a building, work or traffic area.

(g) *Guarding.* Covers and/or guardrails shall be provided to protect personnel from the hazards of open pits, tanks, vats, ditches, etc.

§ 1910.177 Indoor general storage.

(a) *Definitions applicable to this section.* (1) "Available height for storage" means the maximum height at which commodities can be stored above the floor and still maintain adequate clearance from structural members and the required clearance below sprinklers.

(2) "Ordinary combustibles" designates commodities packaging or storage aids which have heats of combustion (British thermal units per pound) similar to wood, cloth, or paper and which produce fires that may normally be extinguished by the quenching and cooling effect of water. This type of fire is defined as a Class A fire in the Standard for the Installation of Portable Fire Extinguishers, NFPA No. 10-1970.

(3) "Exposure" means the exterior presence of combustibles which, if ignited, could cause damage to the storage building or its contents.

(4) A "firewall" is a wall designed to prevent the spread of fire, having a fire resistance rating of not less than 4 hours and having sufficient structural stability under fire conditions to allow collapse of construction on either side without collapse of wall.

(5) "Horizontal channel" means any uninterrupted space in excess of 5 feet in length between horizontal layers of stored commodities. Such channels may be formed by pallets, shelving, racks, or other storage arrangements.

(6) "Noncombustible" designates commodities, packaging, or storage aids which will not ignite, burn or liberate flammable gases when heated to a temperature of 1,380° Fahrenheit for 5 minutes.

(7) "Packaging" designates materials, master wrapping, containers, etc., together.

(8) "Storage aids" means accessories, storage devices such as shelves, racks, dunnage, decks, platforms, trays, bins, separators, and skids.

(9) A "warehouse" is any building or area within a building used principally for the storage of commodities.

(10) "Type I storage" is that in which combustible commodities or noncombustible commodities involving combustible packaging or storage aids are stored over 15 feet but not more than 21 feet high in solid piles or over 12 feet but not more than 21 feet high in piles that contain horizontal channels. Minor quantities of commodities of hazard greater than ordinary combustibles may be included without affecting this general classification.

(11) "Type II storage" is that in which combustible commodities or noncombustible commodities involving combustible packaging or storage aids are stored not over 15 feet high in solid piles or not over 12 feet high in piles that contain horizontal channels. Minor quantities of commodities of hazard greater than ordinary combustibles may be included without affecting this general classification.

(12) "Type III storage" is that in which the stored commodities, packaging and storage aids are noncombustible or contain only a small concentration of combustibles which are incapable of producing a fire that would cause appreciable damage to the commodities stored or to noncombustible wall, floor or roof construction. Ordinary combustible commodities in completely sealed noncombustible containers may qualify in this classification. General commodity storage that is subject to frequent changing and storage of combustible packaging and storage aids is excluded from this category.

(13) "Approved" means listed or approved by at least one of the following nationally recognized testing laboratories: Underwriters Laboratories, Inc.; Factory Mutual Engineering Corp.

(b) *General requirements.* (1) *Application.* This standard applies to storage, 21 feet or less in height, of commodities which with their packaging and storage aids would classify as ordinary combustibles. This standard also applies to storage of commodities which with their packaging and storage aids would classify as noncombustibles regardless of storage height. This standard does not cover unpackaged bulk storage such as grain, coal, or similar commodities. The provisions contained in this standard apply to new buildings. Certain specific commodities introduce hazards different from those contemplated by this standard. Examples are rubber tires, roll paper, and wax-coated cartons.

(2) *Exemptions.* (i) Ordinary combustibles piled higher than 21 feet introduce serious fire protection problems which are not within the scope of this standard.

(ii) The provisions of this standard do not apply to Refrigerated Warehouses.

(13) **Portable fire extinguishers.** Portable fire extinguishers shall be provided at convenient unobstructed accessible locations. In locations where small fires are provided, portable fire extinguishers for Class A fires may be omitted.

(4) **Alarm service.** Storage facilities shall be provided with alarm service. (It may be in the form of central station supervision of automatic fire detection or sprinkler waterflow alarms or watchman making recorded rounds during unattended periods.)

(c) **Piling procedures and precautions.** (1) All commodities shall be stored, handled and piled with due regard to their fire characteristics.

(2) Significant quantities of commodities with fire hazards greater than ordinary combustible commodities as contemplated by this standard, shall be separated from the main bulk of storage by firewalls.

(3) Any commodities which may be hazardous in combination with each other shall be stored so that they cannot come in contact with each other.

(4) Safe floor loads shall not be exceeded.

(d) **Fire protection requirements—**
(1) **Sprinkler systems.** All warehouses having combustible roof or floor construction and all warehouses containing Type I or Type II storage shall be protected with a system of automatic sprinklers designed and installed in accordance with the Standard for the Installation of Sprinkler Systems, NFPA No. 13-1969.

(2) **Hose system water supply.** (i) Water supplies for hose streams shall be provided to supplement that required for automatic sprinklers.

(ii) Where private underground supply mains are necessary, they shall be installed in accordance with Standard for Outside Protection, NFPA No. 24-1970.

(3) **Hose systems.** (i) Small hose (1½ inch) where required by this standard shall be installed in accordance with Standard for the Installation of Sprinkler Systems, NFPA No. 13-1969 and Standard for the Installation of Standpipes and Hose Systems, NFPA No. 14-1970.

(ii) In Type I and Type II storage, sufficient small hose (1½ inch) shall be provided so that one hose stream can reach any portion of the storage area. In buildings three stories or less high, small hose (1½ inch) may be supplied from the sprinkler system in accordance with limitations outlined in Standard for the Installation of Sprinkler Systems, NFPA No. 13-1969.

(iii) Standpipe and hose systems conforming to the requirements of Standard for the Installation of Standpipes and Hose Systems, NFPA No. 14-1970, shall be provided for buildings over three stories in height or having a floor level 75 feet or more above grade. Standpipes shall be fully equipped for fire department operations including fire department connections.

(iv) **Ladder.** Every building and related equipment shall be provided with the proper fire department will provide such equipment promptly.

(e) **Mechanical handling equipment.** (1) **Power-operated industrial trucks.** shall be of type designated in Standard for the Use, Maintenance and Operation of Powered Industrial Trucks, NFPA No. 505-1969, Part A, in accordance with the hazards of the location in which they are used.

(2) **Maintenance and operation of electric, liquid, and gaseous fueled industrial trucks** shall be in accordance with Standard for the Use, Maintenance and Operation of Powered Industrial Trucks, NFPA No. 505-1969, Parts B and C.

(f) **Building service equipment.** (1) **Heating, lighting, and service equipment** shall be of approved types, installed, maintained and operated in accordance with good practice.

(2) **Steam lines and other heating equipment and machinery** shall be installed or protected so that the stored commodities cannot come in contact with the heating elements.

(3) **Electrical equipment** shall be installed in accordance with the provisions of the National Electrical Code, NFPA No. 70-1968.

(4) **Refrigeration systems,** if used, shall conform to the recommendations of Safety Code for Mechanical Refrigeration, American Society of Heating, Refrigeration and Air Conditioning Engineers, Inc. (ASHRAE) 15-63, ANSI B9.1-1964.

(5) **Stored commodities** shall not be located under liquid fuel heating equipment.

(g) **Smoking.** Smoking shall be strictly prohibited, except in locations prominently designated as smoking areas, and "No Smoking" signs shall be posted in prohibited areas.

1910.178 Powered industrial trucks.

(a) **General requirements.** (1) The requirements of this section apply to fire protection for fork trucks, tractors, platform lift trucks, motorized hand trucks and other specialized industrial trucks powered by electric motors or internal combustion engines. These fire protection requirements do not apply to compressed air or nonflammable compressed gas-operated industrial trucks, nor to farm vehicles, nor automotive vehicles for highway use.

(2) All new powered industrial trucks acquired after the effective date of this subpart shall meet the design specifications established in the "American National Standard for Powered Industrial Trucks, Part II, ANSI B56.1-1969", except for vehicles intended primarily for earth moving or over-the-road hauling.

(3) Approved trucks shall bear a label or some other identifying mark indicating approval by the testing laboratory.

(4) Modifications and additions which affect capacity and safe operation shall not be performed by the customer or user without manufacturers prior written approval. Capacity, operation, and main-

tenance instructions shall be, or shall be changed according to.

(5) If the truck is equipped with front-end attachments other than factory installed attachments, the user shall request that the truck be marked to identify the attachments and show the approximate weight of the truck and attachment combination at maximum elevation with load laterally centered.

(6) The user shall see that all nameplates and markings are in place and are maintained in a legible condition.

(7) **Definition:** As used in this section, "approved" means listed or approved by at least one of the following nationally recognized testing laboratories: Underwriters Laboratories, Inc.; Factory Mutual Engineering Corp.

(b) **Designations.** For the purpose of this standard there are eleven different designations of industrial trucks or tractors as follows: D, DS, DY, E, ES, EE, EX, G, GS, LP, and LPS.

(1) The D designated units are units similar to the G units except that they are diesel engine powered instead of gasoline engine powered.

(2) The DS designated units are diesel powered units that are provided with additional safeguards to the exhaust, fuel and electrical systems. They may be used in some locations where a D unit may not be considered suitable.

(3) The DY designated units are diesel powered units that have all the safeguards of the DS units and in addition do not have any electrical equipment including the ignition and are equipped with temperature limitation features.

(4) The E designated units are electrically powered units that have minimum acceptable safeguards against inherent fire hazards.

(5) The ES designated units are electrically powered units that, in addition to all of the requirements for the E units, are provided with additional safeguards to the electrical system to prevent emission of hazardous sparks and to limit surface temperatures. They may be used in some locations where the use of an E unit may not be considered suitable.

(6) The EE designated units are electrically powered units that have, in addition to all of the requirements for the E and ES units, the electric motors and all other electrical equipment completely enclosed. In certain locations the EE unit may be used where the use of an E and ES unit may not be considered suitable.

(7) The EX designated units are electrically powered units that differ from the E, ES, or EE units in that the electrical fittings and equipment are so designed, constructed and assembled that the units may be used in certain atmospheres containing flammable vapors or dusts.

(8) The G designated units are gasoline powered units having minimum acceptable safeguards against inherent fire hazards.

(9) The GS designated units are gasoline powered units that are provided with additional safeguards to the exhaust,

