

IDAHO ADMINISTRATIVE BULLETIN

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IDAPA 17 - INDUSTRIAL COMMISSION
17.10.25 - GENERAL SAFETY AND HEALTH STANDARDS-MATERIALS SAFETY
DOCKET NO. 17-1025-9601
NOTICE OF PROPOSED RULES

AUTHORITY: In compliance with Section 67-5221(1), Idaho Code, notice is hereby given that this agency has proposed rule-making. The action is authorized pursuant to §72-508 and §§72-720, 721, 722, and 723, Idaho Code.

PUBLIC HEARING SCHEDULE: Public hearing(s) concerning this rule-making will be scheduled if requested in writing by twenty-five (25) persons, a political subdivision, or an agency, not later than August 28, 1996. The hearing site(s) will be accessible to persons with disabilities. Requests for accommodation must be made not later than five (5) days prior to the hearing, to Patricia S. Ramey, Secretary, Industrial Commission, P. O. Box 83720, Boise, ID 83720-0041. Telephone and fax numbers are listed below.

DESCRIPTIVE SUMMARY: The following is a statement in nontechnical language of the substance of the proposed rule:

The Industrial Commission, in cooperation with the Division of Building Safety, proposes the adoption of rules to replace IDAPA 17.04.01, General Safety and Health Standards Code 1, which is being repealed in its entirety. The proposed rules update the state's minimum safety and health standards in the handling of compressed gases, flammable and combustible liquids, welding, and finishing for the public sector and bring them into line with generally accepted safety and health standards in the private sector.

ASSISTANCE ON TECHNICAL QUESTIONS, SUBMISSION OF WRITTEN COMMENTS: For assistance on technical questions concerning these proposed rules, contact Mike Poulin, Bureau of Logging and Industrial Safety, at (208) 334-2129.

Anyone may submit written comments regarding this rule. All written comments and data concerning the rule must be directed to the undersigned and must be postmarked or delivered on or before August 28, 1996.

DATED this 3rd day of June, 1996.

Patricia S. Ramey, Commission Secretary
Industrial Commission
P. O. Box 83720
Boise, Idaho 83720-0041
Telephone: (208) 334-6000
Fax: (208) 334-5145

TEXT OF DOCKET NO. 17-1025-9601

IDAPA 17
TITLE 10
Chapter 25

17.10.25 - GENERAL SAFETY AND HEALTH STANDARDS -- MATERIALS SAFETY

000. LEGAL AUTHORITY.

These rules presented in IDAPA 17, Title 10, are promulgated pursuant to the authority granted the Industrial Commission by Sections 72-508, 72-720, 72-721, 72-722, and 72-723, Idaho Code ()

001. TITLE AND SCOPE.

These rules shall be cited as IDAPA 17, Title 10, Chapter 25, General Safety and Health Standards -- Materials

Safety. For purposes of IDAPA 17, Title 10, these rules shall be applicable to places of public employment, as defined in Sections 72-205 and 72-207, Idaho Code, by the State of Idaho and its political subdivisions i.e. counties, cities, public school districts, and other taxing entities as follows: ()

01. State. Every person in the service of the state or of any political subdivision thereof, under any contract of hire, express or implied, and every official or officer thereof, whether elected or appointed, while performing their official duties. ()

02. County/City. Every person in the service of a county, city, or any political subdivision thereof, or of any municipal corporation. ()

03. National Guard. Members of the Idaho National Guard while on duty. ()

04. Youth Conservation. Participants in Idaho youth conservation project under the supervision of the Idaho State Forester. ()

05. Volunteers. Every person who is a member of volunteer fire, police department, or ambulance service shall be deemed to be in the employment of the political subdivision or municipality where the department is organized. ()

06. Civil Defense. Every person who is a regularly enrolled volunteer member or trainee of the Department of Disaster and Civil Defense, or of a civil defense corps, shall be deemed to be in the employment of the state. ()

07. Public School. Every person who is in the service of a public school or school district shall be deemed to be in the employment of the state. ()

002. WRITTEN INTERPRETATIONS.

For purposes of IDAPA 17, Title 10, there are no written statements which pertain to the interpretation of these rules. ()

003. ADMINISTRATIVE APPEALS.

For purposes of IDAPA 17, Title 10, there are no provisions for administrative appeal of these rules. The procedure for appeals in safety matters is prescribed by Sections 72-722 and 72-714 through 72-718, Idaho Code. ()

004. -- 209. (RESERVED).

210. COMPRESSED GAS.

01. Scope. Compressed gas use and storage, to include chlorine, shall conform to all other applicable requirements of this standard, as well as the following provisions. Nothing in this standard shall be construed to prohibit better or otherwise safer conditions than specified herein. ()

02. Definitions Applicable to this Section. ()

a. 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. ()

b. Bulk oxygen system is an assembly of equipment, such as oxygen storage containers, pressure regulators, safety devices, vaporizers, manifolds, and interconnecting piping which has storage capacity of more than thirteen thousand (13,000) cubic feet of oxygen; Normal Temperature and Pressure (N.T.P.), connected in service or ready for service, or more than twenty-five thousand (25,000) cubic feet of oxygen (N.T.P.) including unconnected reserves on hand at the site. The bulk oxygen system terminates at the point where oxygen at service pressure first enters the supply line. The oxygen containers may be stationary or movable, and the oxygen may be stored as gas or liquid. ()

c. Cargo Tank is any container designed to be permanently attached to any motor vehicle or other

highway vehicle and in which any compressed gas is to be transported. 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. ()

d. Code is the Boiler and Pressure Vessel Code of the American Society of Mechanical Engineers or the Code for Unfired Pressure Vessels for Petroleum Liquids and Gases of the American Petroleum Institute and the American Society of Mechanical Engineers (API-ASME). ()

e. 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. ()

f. 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 close at predetermined pressures or to open at a predetermined temperature. ()

g. Corrosion, General is a corrosion which covers considerable surface areas of the cylinder. (NOTE: 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.) ()

h. Corrosion, Line is pitting which is not isolated but are connected or nearly connected to others in a narrow band or line. (NOTE: This condition is more serious than isolated pitting. Line corrosion frequently occurs in the area of intersection of the foot-ring and bottom of a cylinder. This is sometimes referred to as "crevice corrosion.") ()

i. Corrosion, Pitting is corrosion or pitting in cylinders involving the loss of wall thickness by corrosive media. (NOTE: There are several kinds of pitting or corrosion to be considered.) ()

j. Cuts, Gouges, or Digs. Cuts, gouges, or digs (in cylinders) are deformities 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. ()

k. Dents (in cylinders) are deformities caused by the cylinder coming in contact with a blunt object in such a way that the thickness of metal is not materially impaired. ()

l. Discharge Channel is the passage or passages beyond the operating parts through which gas must pass to reach the atmosphere exclusive of any piping attached to the outlet of the device. ()

m. 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 fifteen (15) p.s.i. more than DOT design pressure, plus static head of the lading. EXCEPTION: For containers constructed in accordance with Section VIII of the ASME Boiler and Pressure Vessel Code, the maximum allowable working pressure for the purpose of these standards is considered to be twelve (12%) percent of the design pressure as provided in 49 CFR 173.315 of DOT Regulations. ()

n. DOT Regulations as used in this section, refer to the U.S. Department of Transportation Regulations for Transportation of Explosives and Other 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. ()

o. Flow Capacity of a safety relief device is the capacity in cubic feet per minute of feet air discharged at the required flow rating pressure. ()

- p. Flow Rating Pressure is the pressure at which a safety relief device is rated for capacity. ()
- q. 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. ()
- r. Free Air or Free Gas is air or gas measured at a pressure of fourteen point seven (14.7) pounds per square inch absolute and a temperature of sixty (60) degrees Fahrenheit. ()
- s. 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. ()
- t. High-pressure cylinders are those cylinders with a marked service pressure of nine-hundred (900) p.s.i. or greater. ()
- u. Isolated Pitting is isolated pits of small cross-section which do not effectively weaken the cylinder wall but are indicative of possible complete penetration and leakage. (NOTE: Since the pitting is isolated, the original wall is essentially intact.) ()
- v. Liquefied Compressed Gas is a gas which, under the charging pressure, is partially liquid at a temperature of seventy (70) degrees Fahrenheit. A flammable compressed gas which is normally nonliquefied at seventy (70) degrees Fahrenheit but which is partially liquid under the charging pressure and temperature, shall follow the requirements for liquefied compressed gases. ()
- w. Low-pressure cylinders are those with a marked service pressure less than nine-hundred (900) p.s.i. ()
- x. Minimum Allowable Wall Thickness is the minimum wall thickness required by the specification under which the cylinder was manufactured. ()
- y. Nonliquefied Compressed Gas is a gas, other than a gas in solution which under the charging pressure, is entirely gaseous at a temperature of seventy (70) degrees Fahrenheit. ()
- z. Operating Part of a safety relief device is the part of the 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 (2), permits escape of gas from the cylinder. ()
- aa. Portable Tank is any container designed primarily to be temporarily attached to a motor vehicle, other vehicle, a railroad car other than a tank car, or marine vessel, and equipped with skids, mounting, 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. ()
- bb. Pressure Opening is the orifice against which the frangible disc functions. ()
- cc. Pressurized Liquid Compressed Gas is a compressed gas other than a compressed gas in solution, which cannot be liquefied at a temperature of seventy (70) degrees Fahrenheit, and which is maintained in the liquid state at a pressure not less than forty (40) p.s.i.a. by maintaining the gas at a temperature less than seventy (70) degrees Fahrenheit. ()
- dd. 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. ()
- ee. 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. ()

ff. Resealing Pressure of a safety relief valve is the pressure at which leakage ceases through a water seal of not more than four (4) inches on the outlet of the valve. ()

gg. Safety Relief Device is a device intended to prevent rupture of a cylinder under certain conditions of exposures. (The term as used herein shall include the approach channel, the operating parts, and the discharge channel.) ()

hh. 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. ()

ii. 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. ()

jj. Set Pressure of a safety relief valve is the pressure marked on the valve and at which it is set to start-to-discharge. ()

kk. Start-to-discharge Pressure of a safety relief valve is the pressure at which the first bubble appears through a water seal of not more than four (4) inches in the outlet of the safety relief valve. ()

ll. 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. 1). ()

mm. Yield Temperature of a fusible plug is the temperature at which the fusible metal or alloy will yield when tested. ()

03. General Requirements. ()

a. 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 inspection. ()

b. The requirements contained in this section is not intended to apply to cylinders manufactured under specification DOT (ICC) 3HT (49CFR 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." ()

c. Experience in the inspection of cylinders is an important factor in determining the acceptability of a given cylinder for continued service. NOTE: Users lacking this experience and having doubtful cylinders should return them to a manufacturer of the same type of cylinders for reinspection or replacement. ()

d. The in plant handling, storage, and utilization of all compressed gases in cylinders, portable tanks, rail tank cars, or motor vehicle cargo tanks shall be in accordance with Compressed Gas Association Pamphlet P-1-1965. ()

e. A suitable cylinder truck, cart, chain, or other securing device shall be used to prevent all compressed gas cylinders from being knocked over while in use or in storage, empty or full. ()

f. Compressed gas cylinders shall be legibly marked, for the purpose of identifying the gas content, with either the chemical or trade name of the gas. Such marking shall be by means of stenciling, stamping, or labeling, and shall not be readily removable. Whenever practicable, the marking shall be located on the shoulder of the cylinder. ()

g. Compressed gas cylinders shall be equipped with connections complying with ANSI B57.1. ()

h. All cylinders with a water weight of over thirty (30) pounds shall be equipped with a means of

- connecting a valve protection cap or with a collar or recess to protect the valve. ()
- i. When transporting cylinders by a crane or derrick, boat, or other like transport a suitable cradle or platform shall be used. Slings or electric magnets shall not be used for this purpose. Valve protection caps, where the cylinder is designed to accept a cap, shall always be in place. ()
- j. Cylinders shall not be dropped, struck, or permitted to strike each other violently. ()
- k. Valve protection caps shall not used for lifting cylinders from one (1) vertical position to another. Bars shall not be used under valves or valve protection caps to fry cylinders loose when frozen to the ground or otherwise fixed; the use of warm water (not boiling) is recommended. ()
- l. Unless cylinders are secured on a special truck or cart, regulators shall be removed and valve protection caps, when provided for, shall be put in place before the cylinders are moved. ()
- m. Cylinders not having fixed hand wheels shall have keys, handles, or nonadjustable wrenches on valve stems while these cylinders are in use. In multiple cylinder installations only one (1) key, handle, or nonadjustable wrench is required for each manifold provided the valve stems are identical. ()
- n. Cylinder valves shall be closed before moving cylinders. ()
- o. Cylinder valves shall be closed when work is finished. ()
- p. Cylinders shall not be placed where they might become part of an electric current. ()
- q. Cylinders shall not be used as rollers or supports whether full or empty. ()
- r. The numbers and markings stamped into cylinders shall not be tampered with. ()
- s. No person, other than the gas supplier, shall attempt to mix gases in a cylinder. No one, except the owner of the cylinder or authorized representative, shall refill a cylinder. ()
- t. No one shall tamper with safety devices in cylinders or valves. ()
- u. Cylinders shall not be dropped or otherwise roughly handled. ()
- v. A hammer or wrench shall not be used to forcibly open cylinder valves. If valves cannot be opened by hand, the supplier shall be notified. ()
- w. Cylinder valves shall not be tampered with nor shall any attempt be made to repair them. If troubles are experienced, the supplier shall be notified indicating the nature of the trouble and the cylinder's serial number. The supplier's instructions as to its disposition shall be followed. ()
- x. Complete removal of the stem from a diaphragm type cylinder valve shall be avoided. ()
- y. Fuel gas cylinders shall be placed with the valve end up whenever they are in use. Liquefied gases shall be stored and shipped with the valve end up. ()
- z. Cylinders shall be handled carefully. Cylinders shall not be subjected to rough handling, knocks, or falls which are liable to damage the cylinder, valve, or safety devices and cause leakage. ()
- aa. If cylinders are found to have leaky valves or fittings which cannot be stopped by closing the valve, the cylinders shall be taken outdoors away from sources of ignition and slowly emptied. This procedure does not apply when highly toxic gases are involved. ()
- bb. A warning shall be placed near cylinders having leaking fuse plugs or other leaking safety devices not to approach not to approach them. The warning shall state any appropriate safety precautions to be taken. Such

cylinders shall be plainly tagged, the supplier shall be promptly notified and instructions followed as to their return. ()

cc. Safety devices shall not be tampered with. ()

dd. The cylinder valve shall always be opened slowly. ()

ee. Where a special wrench or key is required to open a cylinder valve, it shall be left in position on the stem of the valve while the cylinder is in use so that the gas flow can be quickly turned off in case of an emergency. In the case of manifold or coupled cylinders one (1) such wrench or key shall always be available for immediate use. ()

04. Low-Pressure Cylinders Exempt from Hydrostatic Testing: (including acetylene cylinders.) ()

a. This subsection 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. ()

b. Gas cylinders shall be prepared for inspection as follows: Rust, scale, caked 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. ()

c. Cylinders shall be checked externally for corrosion, general distortion, or any other defect that might indicate a weakness which would render it unfit for service. ()

d. To fix corrosion limits for all types, designs, and sizes of cylinders and include them in this section is not practicable. Failure to meet any of the following requirements is of itself cause for rejection of a cylinder. A cylinder shall be rejected when the tare weight is less than ninety-five percent (95%) of the original tare weight marked on the cylinder. When determining tare weight, be sure that the cylinder is empty. A cylinder shall be rejected when the remaining wall in an area having isolated pitting only is less than one-third (1/3) of the minimum allowable wall thickness as determined under this subsection. A cylinder shall be rejected when line corrosion on the cylinder is three (3) inches in length or over and the remaining wall is less than three-quarters (3/4) of the minimum allowable wall thickness or when line corrosion is less than three (3) inches in length and the remaining is less than one-half (1/2) the minimum allowable wall thickness as determined under this subsection. A cylinder shall be rejected when the remaining wall in an area of general corrosion is less than one-half (1/2) of the minimum allowable wall thickness as determined under this subsection. ()

e. To use the criteria in Subsection 210.04, it is necessary to know the original wall thickness of the cylinder or the minimum allowable wall thickness. Table 210.04-A lists the minimum allowable wall thickness under DOT Specifications (49 CFR Ch. 1) for a number of common size low-pressure cylinders. ()

TABLE 210.04-A			
Cylinder size O.D. x length (inches)	DOT Specification marking	Nominal water capacity (pounds)	Minimum allowable wall thickness (inches)
15 X 46	¹ 4B240	239	0.128
14 13/16 X 47	4E240	239	.140
14 15/16 X 46	4BA240	239	.086
14 11/16 X 28 3/8	4BA240	143	.086
11 29/32 X 32 11/16	4BA240	95	.078

TABLE 210.04-A			
Cylinder size O.D. x length (inches)	DOT Specification marking	Nominal water capacity (pounds)	Minimum allowable wall thickness (inches)
11 29/32 X 18 11/32	4BA240	48	.078
¹ Without longitudinal seams.			

f. When the wall thickness of the cylinder at manufacture is not known, and the actual wall thickness cannot be measured, this cylinder shall be rejected when the inspection reveals that the deepest pit in a general corrosion area exceeds three sixty-fourths (3/64) inch. This is arrived at by considering that in no case shall the pitting exceed one-half (1/2) the minimum allowable wall thickness which is zero point zero sixty-four (0.064) inch. When a pit measures zero point zero four-three (0.043) inch (approximately three sixty-fourth (3/64) inch) in a corrosion area, general corrosion will already have removed zero point zero twenty-one (0.021) inch of the original wall and the total pit depth as compared to the initial wall will be zero point zero sixty-four (0.064) inch. ()

g. When the original wall thickness is measured, this thickness less one and one-half (1 1/2) times the maximum measured pit depth shall be zero point zero sixty-four (0.064) inch or greater. If it is less, the cylinder shall be rejected. ()

h. Dents are of concern where the metal deformity is sharp and confined, or where they are near a weld. Where metal deformity is not sharp, dents of larger magnitude can be tolerated. ()

i. Where denting occurs so that any part of the deformity includes a weld, the maximum allowable dent depth shall be one-quarter (1/4) inch. ()

j. 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 (1/10) of the mean diameter of the dent. ()

k. Cuts, gouges, or digs reduce the wall thickness of the cylinder and in addition are considered to be stress points. Depth limits are set in this section, however, cylinders shall be rejected at one-half (1/2) of the limit set whenever the length of the defect is three (3) inches or more. ()

l. When the original wall thickness at manufacture is not known and the actual wall thickness cannot be measured, a cylinder shall be rejected if the cut, gouge, or dig exceeds one-half (1/2) of the minimum allowable wall thickness as determined under this subsection. ()

m. When the original wall thickness at manufacture 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 (1/2) of the minimum allowable wall thickness as determined under this subsection. ()

n. 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 shall be cause for rejection. (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, digs, gouges, or pits.) ()

o. Safety relief devices shall be tested for leaks before a charged cylinder is shipped from the cylinder filling plant. ()

p. Cylinders involved in a fire, shall be carefully inspected for evidence of exposure to fire. Common evidences of exposure to fire are charring or burning of the paint or other protective coat, burning or splintering of the metal, distortion of the cylinder, melted out fuse plugs, burning or melting of a valve. 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 the

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 within the scope of this requirement. ()

q. Cylinders which have definite visible bulges shall be removed from service and evaluated. Cylinders shall be rejected when a variation of one (1) percent or more is found in the measured circumferences or in peripheral distances measured from the valve spud to the center seam (or equivalent fixed point). ()

r. Cylinder necks shall be examined for serious cracks, folds, and flaws. Cracks in the neck are normally detected by leak testing the neck during charging operations with a soap solution. ()

s. Cylinder neck threads shall be examined whenever the valve is removed from the cylinder. Cylinders shall be rejected if the required number of effective threads is materially reduced, or if a gas tight seal cannot be obtained by reasonable valving methods. Gages shall be used to measure the number of effective threads. ()

t. If the valve is noticeably tilted, the cylinder shall be rejected. ()

u. The footing and headring of cylinders may become so distorted through service abuse that they no longer perform their functions: to cause the cylinder to remain stable and upright or to protect the valve. Rings shall be examined for distortion, for looseness, and for failure of welds. Footrings and/or headrings that do not meet these requirements shall be cause for rejection of the cylinder. ()

05. Low-pressure Cylinders Subject to Hydrostatic Testing. ()

a. Cylinders covered in this subsection are low-pressure cylinders other than those covered in Subsection 210.04. They differ essentially from such cylinders in that they require a periodic hydrostatic retest which will include an internal and external examination. ()

b. Defect limits, for the external examination of cylinders covered in this subsection , are prescribed in Subsection 210.04, with exceptions for aluminum cylinders which are covered in Subsection 210.05. ()

c. Flammable gas cylinders shall be purged before being examined with a light. Lamps used for flammable gas cylinder inspection shall be explosion proof. ()

d. 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. ()

e. The external inspection of aluminum cylinders shall meet the inspection requirements of Subsection 210.04, except as follows: Aluminum cylinders shall be rejected when impairment to the surface (corrosion or mechanical defects) exceeds a depth where the remaining wall is less than three-quarters 3/4 of the minimum allowable wall thickness required by the specification under which the cylinder was manufactured. Aluminum cylinders subjected to the action of fire shall be removed from service. ()

06. High-pressure Cylinders. ()

a. Prior to inspection cylinders shall be cleaned so that the inside and outside surfaces and all conditions can be observed. This shall include removal of scale and caked 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. ()

b. 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. Note: 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. ()

c. When the original wall thickness of the cylinder is not known and the actual wall thickness cannot be measured, the cylinder shall be rejected if corrosion exceeds one-thirty-second (1/32) inch in depth. This is arrived at by subtracting from the minimum allowable wall at manufacture zero point two hundred twenty-one (0.221) inch, the limiting wall in service zero point one-hundred ninety-five (0.195) inch, to give the maximum allowable corrosion limit of zero point zero twenty-six (0.026) inch, the equivalent of one thirty-second (1/32) inch. ()

d. 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 zero point two-hundred fifty (0.250) inch. Comparison of this with the limiting wall thickness shows that defects up to about one-sixteenth (1/16) inch are allowable provided, of course, that the actual wall is measured or is known. ()

e. Cylinders with general corrosion are evaluated by subjecting them to a hydrostatic test. Thus, a cylinder with an elastic expansion of two-hundred twenty-seven (227) cubic centimeters 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 point) and the criteria established in the first example apply. Thus, the maximum corrosion limit would be one thirty-second (1/32) inch when the wall was not known. ()

f. Any defect of appreciable depth having a sharp bottom is a stress point 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 hydrostatic test of other suitable means. ()

g. Dents can be tolerated when the cylinder wall is not deformed excessively or abruptly. Generally speaking, dents are accepted up to a depth of about one sixteenth (1/16) inch when the major diameter of the dent is equal to or greater than thirty-two (32) times the depth of the dent. Sharper dents than this are considered too abrupt and shall require rejection of the cylinder. On small diameter cylinders, these general rules may have to be adjusted. Considerations of appearance play a major factor in the evaluation of dents. ()

h. Cylinders with arc or torch burns shall be removed from service. Defects of this nature may be recognized by one (1) of the following conditions: Removal of metal by scaring or cratering; a Sintering of burning of the base metal; a hardened heat affected zone. A simple method for verifying the presence of small burns is to file the suspected area. The hardened zone will resist filing as compared to the softer base metal. ()

i. 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 causes for concern. ()

j. Cylinders shall be carefully inspected for evidences of exposure to fire in accordance with Subsection 210.04.p of this section. ()

k. Cylinder necks shall be examined for serious cracks, folds, and flaws. Cracks in the neck are normally detected by leak testing the neck during charging operations with a soap solution. ()

07. Internal Inspection. ()

a. 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. ()

b. A hammer test shall be conducted by 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 shall be made before each charging. It is an invaluable indicator of internal corrosion without the need to remove the valve. ()

08. Safety Relief Devices for Compressed Gas Cylinders. ()

a. Compressed gas cylinder, portable tanks, and cargo tanks shall have pressure relief devices installed and maintained in accordance with Compressed Gas Association Pamphlets S-1.1-1963 and 1965 addenda and S-1.2-1963. ()

b. Types of safety relief devices as covered by this section are designated as follows: Type CG-1 Frangible disc; Type CG-2 Fusible plug or reinforced fusible plug utilizing a fusible alloy with yield temperature not more than one-hundred seventy (170) degrees Fahrenheit nor less than one-hundred fifty-seven (157) degrees Fahrenheit (one-hundred sixty-five (165) degrees Fahrenheit nominal); Type CG-3 Fusible plug or reinforced fusible plug utilizing a fusible alloy with yield temperature not more than two-hundred twenty (220) degrees Fahrenheit nor less than two-hundred eight (208) degrees Fahrenheit (two-hundred twelve (212) degrees Fahrenheit nominal); Type CG-4 Combination frangible disc-fusible plugs, utilizing a fusible alloy with yield temperature not more than one-hundred seventy (170) degrees Fahrenheit, nor less than one-hundred fifty-seven (157) degrees Fahrenheit (one-hundred sixty-five (165) degrees Fahrenheit, nominal); Type CG-5 Combination frangible disc fusible plug, utilizing a fusible alloy with yield temperature not more than two-hundred twenty (220) degrees Fahrenheit nor less than two-hundred eight (208) degrees Fahrenheit (two-hundred twelve (212) degrees Fahrenheit nominal); Type CG-7 Safety relief valve; Type CG-8 Combination safety relief valve and fusible plug. ()

c. All safety relief devices covered by this section shall meet the design, construction marking, and test specification of the "Compressed Gas Association Safety Relief Device Standards Part 1 - Cylinders for Compressed Gases: S1.1-1963." ()

d. 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 Table one (1) of the Compressed Gas Associations Standard S-1.1-1963. ()

e. Only replacement parts or assemblies provided by the manufacturer shall be used unless the advisability of interchange is proved by adequate tests. ()

f. When a frangible disc is used with 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. 1) the rated bursting pressure of the device shall not exceed four-thousand five-hundred (4,500) pounds per square inch gage (p.s.i.g.). ()

g. When a safety relief valve is used on a compressed gas cylinder, the flow rating 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 normally charged cylinder at one-hundred thirty (130) degrees Fahrenheit. ()

h. When fittings and piping are used on either the upstream or downstream side or both of a safety relief device or devices, 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 operation of the device could be impaired. Fittings, piping and method of attachment shall be designed to withstand normal handling and the pressures developed when the device or devices function. ()

i. No shutoff valve shall be installed between the safety relief devices and the cylinder. ()

j. 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. ()

k. 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. ()

09. Storage of Gas Cylinders. ()

a. Cylinders shall be kept away from radiators and other sources of heat. ()

b. Inside of buildings, cylinders shall be stored in a well protected, well ventilated, dry location, at least twenty (20) feet from highly combustible materials such as oil or excelsior. Cylinders shall be stored in definitely assigned places away from elevators, stairs, or gangways. Assigned storage spaces shall be located where cylinders will not be knocked over or damaged by passing or falling objects, or subject to tampering by unauthorized persons. Cylinders shall not be kept in unventilated enclosures such as lockers and cupboards. ()

c. Empty cylinders shall have their valves closed. ()

d. Where the cylinder is designed to accept a valve protection cap, the cap shall always be in place, hand tight, except when cylinders are in use or connected for use. ()

e. Inside a building, fuel gas cylinders except those in actual use or attached ready for use, shall be limited to a total gas capacity of two-thousand (2,000) cubic feet or three-hundred (300) pounds of liquefied petroleum gas. ()

f. For storage of fuel gas cylinders in excess of two-thousand (2,000) cubic total gas capacity or three-hundred (300) pounds of liquefied petroleum gas, a separate room or compartment conforming to the following requirements shall be provided: the walls, partitions, floors, and ceiling shall be of noncombustible construction having a fire resistive rating of at least one (1) hour; the walls or partitions shall be continuous from floor to ceiling and shall be securely anchored; at least one (1) wall of the room or compartment shall be an exterior wall; openings from an inside storage room or compartment to other parts of the building shall be protected by a one (1) hour fire rated self closing door; and the room or compartment shall be well ventilated with vents located at floor and ceiling levels. ()

10. Safety Relief Devices for Cargo and Portable Tanks Storing Compressed Gases. ()

a. All safety relief devices covered by these standards shall meet the design, construction, marking, and test specifications of the "Compressed Gas Association Safety Relief Device Standards Part 2 - Cargo and Portable Tanks for Compressed Gases: S-1.2-1963." ()

b. Each container shall be provided with one (1) or more safety relief devices which, unless otherwise specified, shall be safety relief valves of the spring-loaded type. ()

c. Safety relief valves shall be set to start-to-discharge at a pressure not to exceed one-hundred ten percent (110%) of the DOT design pressure of the container nor less than the DOT design pressure of the container except as follows: If an over designed container is used, the set pressure of the safety relief valve may be between the minimum required DOT design pressure for the lading and one-hundred ten percent (110%) percent of the DOT design pressure of the container used. For sulfur dioxide containers, a minimum set pressure of one-hundred twenty (120) p.s.i.g. and one-hundred (100) p.s.i.g. is permitted for one-hundred fifty (150) p.s.i.g. and one-hundred twenty-five (125) p.s.i.g., DOT design pressure containers, respectively. For carbon dioxide (refrigerated), nitrous oxide (refrigerated), and pressurized liquid argon, nitrogen, and oxygen, there shall be no minimum set pressure. For butadiene, inhibited, and liquefied petroleum gas containers, a minimum set pressure of ninety (90%) percent of the minimum design pressure permitted for these loadings may be used. For containers constructed in accord with the Boiler and Pressure Vessel Code, the set pressure marked on the safety relief valve may be one-hundred twenty-five (125) percent of the original DOT design pressure of the container. ()

d. Only replacement parts or assemblies provided by the manufacturer of the device shall be used unless the suitability of interchange is proved by adequate tests. ()

e. Safety relief valves shall have direct communication with the vapor space of the container. ()

f. 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. ()

g. The additional restrictions of this subsection apply to safety relief devices on containers for carbon dioxide or nitrous oxide which are shipped in refrigerated and insulated containers. The maximum operating pressure in the container may be regulated by the use of one (1) or more pressure controlling devices, which devices shall not be in lieu of the safety relief valve required in Subsection 210.08.b. of this section. ()

h. All safety relief devices shall be so installed and located that the cooling effect of the contents will not prevent the effective operation of the device. ()

i. In addition to the safety relief valves required by subsection 210.08.a., each container for carbon dioxide may be equipped with one (1) or more frangible disc safety relief devices of suitable design set to function at a pressure not exceeding two (2) times the DOT design pressure of the container. ()

j. Subject to conditions of 49 CFR 173.315 (a) (1) (DOT Regulations) for Methyl chloride and sulfur dioxide optional portable tanks of two-hundred twenty five (225) p.s.i.g. minimum DOT design pressure, one (1) or more fusible plugs approved by the Bureau of Explosives, 63 Vesey Street, New York, NY 10007, may be used in lieu of safety relief valves of the spring-loaded type. If the container is more than thirty (30) inches long, a safety relief device having the total required flow capacity must be at both ends. ()

k. When storage containers for liquefied petroleum gas are permitted to be shipped in accordance with 49 CFR 173.315 (j) (DOT Regulations), they must be equipped with safety relief devices in compliance with the requirements for safety relief devices on above ground containers as specified in the National Fire Protection Association Pamphlet No. 58-1969 "Standard for the Storage and Handling of Liquefied Petroleum Gases." ()

l. When containers are filled by pumping equipment which has a discharge capacity in excess of the capacity of the container safety relief devices, and which is capable of producing pressures in excess of DOT design pressure of the container, precautions should be taken to prevent the development of pressures in the container in excess of one-hundred twenty (120) percent of its DOT design pressure. This may be done by providing additional capacity of the safety relief valves on the container by providing a bypass on the pump discharge, or by any other suitable method. ()

m. This additional requirement applies to safety relief devices on containers for liquefied hydrogen and pressurized liquid argon, nitrogen, and oxygen. The liquid container shall be protected by one (1) or more safety relief valves and one (1) or more frangible discs. ()

n. 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, pressurized liquid argon, nitrogen, and oxygen. ()

o. No shutoff valves shall be installed between the safety relief devices and the container except, in cases where two (2) or more safety relief devices are installed on the same container, a shutoff valve may be used where the arrangement of the shutoff valve or valves is such as always to insure full required capacity flow through at least one (1) safety relief device. ()

11. Maintenance Requirements for Safety Relief Devices. ()

a. Care shall be exercised to avoid damage to safety relief devices. 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 function of the device. ()

b. Only qualified personnel shall be allowed to service safety relief devices. Any servicing or repairs which require resetting of safety relief valves shall be done only by or after consultation with the valve manufacturer. ()

c. Safety relief devices periodically shall be examined externally for corrosion damage, plugging, or external safety relief device channel and mechanical defects such as leakage or extrusion of fusible metal. Valves equipped with secondary resilient seals shall have the seals inspected periodically. If there is any doubt regarding the suitability of the safety relief device for service, the container shall not be filled until it is equipped with a suitable safety relief device. ()

12. Air Receivers. ()

a. This subsection applies to compressed air receivers, and other equipment used in providing and utilizing compressed air for performing operations such as cleaning, drilling, hoisting, chipping and air operated controls. On the other hand, however, this section does not deal with the special problems created by using compressed air to convey materials nor the problems created when people work in compressed air as in tunnels and caissons. ()

b. This subsection is not intended to apply to compressed air machinery and equipment used on transportation vehicles such as steam railroad cars, electric railway cars, and automotive equipment. ()

c. All new air receivers installed after January 1, 1961 shall be constructed in accordance with the ASME Boiler and Pressure Vessel Code. ()

d. All safety valves used shall be constructed, installed and maintained in accordance with the ASME Boiler and Pressure Vessel Code. ()

e. Air receivers shall be so installed that all drains, hand holes, and manholes therein 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 or located in an inaccessible place. The receiver shall be located as close to the compressor or after-cooler as is possible in order to keep the discharge pipe short. ()

f. 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. ()

g. Air receivers five and one-half (5 1/2) cubic feet or larger, or with an operating pressure of two-hundred fifty (250) p.s.i. or greater shall receive an inspection by a boiler and pressure vessel inspector holding a current state commission every three (3) years. Inspections shall be conducted and certificates issued as required under the provisions of IDAPA 17.04.06. ()

h. Every air receiver shall be equipped with an indicating pressure gage (so located as to be readily visible) and with one (1) 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 ten (10) percent. ()

i. No valve of any type shall be placed between the air receiver and its safety valve or valves. ()

j. 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. ()

k. All safety valves shall be tested frequently and at regular intervals to determine whether they are in good operating condition. ()

13. Acetylene. ()
- a. The in plant transfer, handling, storage and utilization of acetylene in cylinders shall be in accordance with Compressed Gas Association Pamphlet G-1. ()
- b. The piped systems for the in plant transfer and distribution of acetylene shall be designed, installed, maintained and operated in accordance with Compressed Gas Association Pamphlet G-1.3. ()
- c. Under no condition shall acetylene be generated, piped (except in approved cylinder manifolds) or utilized at a pressure in excess of fifteen (15) psi gage pressure or thirty (30) psi absolute pressure. (The thirty (30) psi absolute pressure limit is intended to prevent unsafe use of acetylene in pressurized chambers such as caissons, underground excavations or tunnel constructions.) This requirement does not apply to storage of acetylene dissolved in a suitable solvent in cylinders manufactured and maintained according to U.S. Department of Transportation requirements, or to acetylene for chemical use. The use of liquid acetylene shall be prohibited. ()
- d. Acetylene cylinders shall be stored valve end up. ()
- e. Nothing shall be placed on top of an acetylene cylinder when in use which may damage the safety device or interfere with the quick closing of the valve. ()
- f. An acetylene cylinder valve shall not be opened more than one and one-half (1 1/2) turns of the valve spindle, and preferably no more than three-quarters (3/4) of a turn. ()
14. Chlorine. ()
- a. Respiratory shall be worn under the following conditions: as a minimum a respirator shall be worn when chlorine gas concentration is above one (1) ppm; a self contained breathing apparatus (SCBA) shall be worn when chlorine gas concentration is twenty five (25) ppm or greater, for sealing leaks, or for entry, escape, or rescue in unknown concentrations. ()
- b. Chlorine cylinder valves shall not be opened more than one (1) turn. ()
- c. A wrench longer than eight (8) inches long shall not be used on the cylinder valve. ()
- d. The valve wrench shall be left on the valve for emergency shut off. ()
- e. Leak detection shall be by means of ammonia vapors allowed to flow around valves fittings, or suspected leaks (a white cloud will form where ever there is a chlorine leak present). ()
- f. Leaking containers shall be positioned so that only gas escapes if possible. ()
- g. Piping, valves, and containers shall be capped off or closed when not in use to keep moisture out. ()
- h. Chlorine cylinders shall be moved only with proper equipment (lifting bars, hand trucks, etc.) and secured while moving. ()
- i. Critical isolation valves shall be conspicuously marked and access kept unobstructed. ()
- j. No employee shall be permitted to work alone with chlorine. There shall always be a second person located within the immediate area outside the work area with eye contact on the worker. The safety person shall have the required protective equipment to assist the worker to fresh air that is up wind to the chlorine in the event of an emergency. The safety person shall not assist in maintenance or re-enter the area to shut off cylinders in the event of a major leak. ()
- k. Employees working on the chlorine system under normal conditions shall have the following

personal protective equipment as a minimum: chemical goggles and face shield; an approved respirator with an approved canister for chlorine (NOTE a respirator is only good for about ten (10) minutes in atmospheres having one (1) to two (2) percent chlorine); and impervious gloves. A respirator will afford protection under normal conditions should a small amount of chlorine trapped in a line be released when making or breaking connections. ()

l. Impervious gloves shall be worn when ever working on chlorine. Moisture from hands will form hydrochloric acid if chlorine is present and cause skin burns. ()

m. Self contained breathing apparatus (SCBA) shall be used by both the employee(s) making repairs on leaks and the safety person. The safety person shall remain in the clear maintaining eye contact with the worker(s) so as to render assistance in an emergency in removing the worker(s) to fresh air. The safety person shall not assist in shutting down, leak sealing, or any other maintenance. The sole purpose of the safety person shall be to rescue the worker(s) should the need arise. ()

n. Chlorine cylinders shall be separated from other areas in an unoccupied room that is adequately ventilated and be of one (1) hour fire resistive construction. ()

o. The entry door to the chlorine room shall be from the outside with a small window installed to allow viewing of the interior prior to entry. Any light switch shall be located outside of the chlorine room. ()

p. Chlorine rooms shall be equipped with a chlorine gas detector with an outside visible/audible alarm. ()

q. The chlorine room shall be equipped with a fan that draws from the floor and exhausts to a safe area. In order to have an air change, make-up air shall be drawn in at the upper part of the room. The switch to control the ventilation fan shall be located outside the room by the entry door. ()

r. All chlorine rooms, buildings, and areas shall be posted with a danger sign, see Figure 210.14-A. ()

FIGURE 210.14-A



- s. Chlorine cylinders stored outside shall be protected from flame, heat, etc. Cylinders shall be protected from moisture (exposed to moisture corrode rapidly and bring out weak spots). ()
15. Hydrogen. ()
- a. Hydrogen containers shall comply with one (1) of the following: Designed, constructed, and tested in accordance with appropriate requirements of ASME Boiler and Pressure Vessel Code, or Designed, constructed, tested, and maintained in accordance with U.S. Department of Transportation Specifications and Regulations. ()
- b. Permanently installed containers shall be provided with substantial noncombustible supports on firm, noncombustible foundations. ()
- c. Each portable container shall be legibly marked with the name "Hydrogen" in accordance with "Marking Compressed Gas Containers to Identify the Material Contained" ANSI Z48.1. Each manifolded hydrogen supply unit shall be legibly marked with the name "Hydrogen" or a legend such as "This unit contains hydrogen." ()
- d. Hydrogen containers shall be equipped with safety relief devices as required by the ASME Boiler and Pressure Vessel Code, or the DOT Specifications and Regulations under which the container is fabricated. ()
- e. Safety relief devices shall be arranged to discharge upward and unobstructed to the open air in such a manner as to prevent any impingement of escaping gas upon the container, adjacent structures, or personnel. This requirement does not apply to DOT Specification containers having an internal volume of two (2) cubic feet or less. ()
- f. Safety relief devices or vent piping shall be designed or located so that moisture cannot collect and freeze in a manner which would interfere with proper operation of the device. ()
- g. Piping, tubing, and fittings shall be suitable for hydrogen service and for the pressures and temperatures involved. Cast iron pipe and fittings shall not be used. ()
- h. Piping and tubing shall conform to Section 2 - "Industrial Gas and Air Piping" - Code for Pressure Piping, ANSI B31.1 with addenda B31.1. ()
- i. Joints in piping and tubing may be made by welding or brazing or by use of a flange, threaded socket, or compression fittings. Gaskets and thread sealants shall be suitable for hydrogen service. ()
- j. Valves, gauge, regulators, and other accessories shall be suitable for hydrogen service. ()
- k. Installation of hydrogen systems shall be supervised by personnel familiar with proper practices with reference to their construction and use. ()
- l. Storage containers, piping, valves, regulating equipment and other accessories shall be readily accessible and shall be protected against physical damage and against tampering. ()
- m. Cabinets or housings containing hydrogen control or operating equipment shall be adequately ventilated. ()
- n. Each mobile hydrogen supply unit used as part of a hydrogen system shall be adequately secured to prevent movement. ()
- o. Mobile hydrogen supply units shall be electrically bonded to the system before discharging hydrogen. ()
- p. The hydrogen storage location shall be permanently placarded as follows: "HYDROGEN-FLAMMABLE GAS-NO SMOKING-NO OPEN FLAMES" or equivalent. ()

- q. After installation, all piping, tubing, and fittings shall be tested and proved hydrogen gas tight at maximum operating pressure. ()
- r. The hydrogen system shall be located so that it is readily accessible to delivery equipment and to authorized personnel. ()
- s. Hydrogen systems shall be located above ground. ()
- t. Hydrogen systems shall not be located beneath electrical power lines. ()
- u. Hydrogen systems shall not be located close to flammable liquid piping or piping of other flammable gases. ()
- v. Systems near above ground flammable liquid storage shall be located on ground higher than the flammable liquid storage except when dikes, diversion curbs, grading, or separating solid walls are used to prevent accumulation of flammable liquids under the system. ()
- w. The location of a system, as determined by the maximum total contained volume of hydrogen, shall be in the order of preference as indicated by Roman Numerals in Table 210.15-A. ()

TABLE 210.15-A			
Size of Hydrogen system			
Nature of Location	Less than 3,000 CF	3,000 CF to 15,000 CF	In excess of 15,000 CF
Outdoors	I	I	I
In a separate building	II	II	II
In a special room	III	III	Not permitted
Inside buildings not in a special room and exposed to other occupancies	IV	Not permitted	Not permitted

- x. The minimum distance in feet from a hydrogen system of indicated capacity located outdoors, in separate buildings or in special rooms to any specified outdoor exposure shall be in accordance with Table 210.15-A. ()
- y. The distance in Table 210.15-B, items 1, 14, 3 to 10 inclusive do not apply where protective structures such as adequate fire walls are located between the system and the exposure. ()
- z. Hydrogen systems of less than three-thousand (3,000) cubic feet when located inside buildings and exposed to other occupancies shall be situated in the building so that the system will be as follows: in an adequately ventilated area as in Subsection 210.15.aa through Subsection 210.15.jj; twenty (20) feet from stored flammable materials or oxidized gases; twenty five (25) feet from open flames, ordinary electrical equipment, or other sources of ignition; twenty five (25) feet from concentration of people; fifty (50) feet from an intake of ventilation or air-conditioning equipment and air compressors; fifty (50) feet from other flammable gas storage; protected against damage or injury due to falling objects or working activity in the area; more than one (1) system of three-thousand (3,000) cubic feet or less may be installed in the same room, provided the systems are separated by at least fifty (50) feet. Each such system shall meet all of the requirements of this section. ()
- aa. Outdoor locations where protective walls or roofs are provided, they shall be constructed of

noncombustible materials. ()

bb. Outdoor locations where the enclosing sides adjoin each other, the area shall be properly ventilated. ()

cc. Outdoor locations, electrical equipment within fifteen (15) feet shall be in accordance with section one-hundred fifty (150) of this standard. ()

dd. Separate buildings shall be built of at least noncombustible construction. Windows and doors shall be located so as to be readily accessible in case of an emergency. Windows shall be of glass or plastic in metal frames. ()

ee. Adequate ventilation to the outdoors shall be provided. Inlet openings shall be located near the floor in exterior walls only. Outlet openings shall be located at the high point of the room in exterior walls or roof. Inlet and outlet openings shall each have minimum total area of one (1) square foot per one-thousand (1,000) cubic feet of room volume. Discharge from outlet openings shall be directed or conducted to a safe location. ()

TABLE 210.15-B					
Type of outdoor exposure			Size of hydrogen system		
			Less than 3,000 CF	3,000 CF to 15,000 CF	In excess of 15,000 CF
1	Building or structure	Wood frame construction%			

ff. Explosion venting shall be provided in exterior walls or roof only. The venting area shall be equal to not less than one (1) square foot per thirty (30) cubic feet of room volume and may consist of any one (1) or any combination of the following: walls of light noncombustible material, preferably single thickness, single strength glass; lightly fastened hatch covers; lightly fastened swinging doors in exterior walls opening outward; lightly fastened walls or roof designed to relieve at a maximum pressure of twenty five (25) pounds per square foot. ()

gg. There shall be no sources of ignition from open flames, electrical equipment, or heating equipment. ()

hh. Electrical equipment shall be in accordance with section 150 of this standard for Class I, Division 2 locations. ()

ii. Heating, if provided, shall be by steam, hot water, or other indirect means. ()

jj. Special room floors, walls, and ceiling shall have a fire-resistance rating of at least two (2) hours. Walls or partitions shall be continuous from floor to ceiling and shall be securely anchored. At least one (1) wall shall be an exterior wall. Openings to other parts of the building shall not be permitted. Windows and doors shall be in exterior walls and shall be located so as to be readily accessible in case of an emergency. Windows shall be of glass or plastic in metal frames. ()

kk. For installations which require any operation of equipment by the user, legible instructions shall be maintained at operating locations. ()

ll. The equipment and functioning of each charged gaseous hydrogen system shall be maintained in a safe operating condition in accordance with the requirements of this section. The area within fifteen (15) feet of any hydrogen container shall be kept free of dry vegetation and combustible material. ()

16. Oxygen. ()

- a. Oxygen cylinders shall not be stored near highly combustible material, especially oil and grease, or near any other substance likely to cause or accelerate fire. ()
- b. Oxygen cylinders in storage shall be separated from fuel gas cylinders or combustible materials (especially oil or grease), a minimum of twenty (20) feet or by a noncombustible barrier at least five (5) feet high having a fire resistive rating of at least one-half (1/2) hour. ()
- c. Oxygen cylinders, cylinder valves, couplings, regulators, hose, piping, and apparatus shall be kept free from oily or greasy substances. Oxygen cylinders or apparatus shall not be handled with oily hands or gloves. A jet of oxygen shall never be permitted to strike any oily surface, greasy clothes, or enter a fuel oil or other storage tank. ()
- d. Oxygen shall never be vented into a confined space or other area to enrich the atmosphere. ()
- e. Bulk oxygen storage systems shall be located above ground out of doors, or shall be installed in a building of noncombustible construction, adequately vented, and used for that purpose exclusively. The location selected shall be such that containers and associated equipment shall not be exposed to electric power line, flammable or combustible liquid lines, or flammable gas lines. ()
- f. The system shall be located so that it is readily accessible to mobile supply equipment at ground level and to authorized personnel. ()
- g. Where oxygen is stored as liquid, noncombustible surfacing shall be provided in an area in which any leakage of liquid oxygen might fall during operation of the system and filling of a storage container. For purposes of this subsection, asphaltic or bituminous paving is considered to be combustible. ()
- h. When locating bulk oxygen systems near above ground flammable or combustible liquid storage which may be either indoors or outdoors, it is advisable to locate the system on ground higher than the flammable or combustible liquid storage. ()
- i. Where it is necessary to locate a bulk oxygen system on ground lower than adjacent flammable or combustible liquid storage, suitable means shall be taken (such as dikes, diversion curbs, or grading) with respect to the adjacent flammable or combustible liquid storage to prevent accumulation of liquids under the bulk oxygen system. ()
- j. The minimum distance from any bulk oxygen storage container to exposures, measured in the most direct line except as indicated in Table 210.16-B and Table 210.16-C shall be indicated in Subsection 210.16.k through 210.16.y. of this section. ()
- k. Fifty (50) feet from any combustible structure. ()
- l. Twenty-five (25) feet from any structures with fire-resistive exterior walls or sprinklers installed in buildings or other construction, but not less than one-half (1/2) the height of an adjacent side wall of the structure. ()
- m. At least ten (10) feet from any opening in adjacent walls or fire resistive structures. Spacing from such structures shall be adequate to permit maintenance, but shall not be less than one (1) foot. ()
- n. Flammable liquid storage above ground, see Table 210.16-A. ()

Distance (feet)	Capacity (gallons)
50	0-1,000

TABLE 210.16-A	
Distance (feet)	Capacity (gallons)
90	1001 or more

- o. Flammable liquid storage below ground, see Table 210.16-B. ()

TABLE 210.16-B		
Distance measured horizontally from oxygen storage container to flammable liquid tank (feet)	Distance from oxygen storage container to filling and vent connections or openings to flammable liquid tank (feet)	Capacity (gallons)
15	50	0-1,000
30	50	1,000 or more

- p. Combustible liquid storage above ground, see Table 210.16-C. ()

TABLE 210.16-C	
Distance (feet)	Capacity (gallons)
25	0-1,000
50	1,001 or more

- q. Combustible liquid storage below ground, see Table 210.16-D. ()

TABLE 210.16-D	
Distance measured horizontally from oxygen storage container to combustible liquid tank (feet)	Distance from oxygen storage container to filling and vent connections or openings to combustible liquid tank (feet)
15	40

- r. Flammable gas storage. (Such as compressed flammable gases, liquefied flammable gases and flammable gases in low pressure gas holder), see Table 210.16-E. ()

- s. Fifty (50) feet from solid materials which burn rapidly, such as excelsior or paper. ()

- t. Twenty-five (25) feet from solid materials which burn slowly, such as coal and heavy timber. ()

- u. Ventilation shall be seventy-five (75) feet in one direction and thirty-five (35) feet in approximately ninety (90) degree direction from confining walls (not including fire walls less than twenty (20) feet high) to provide adequate ventilation in courtyards and similar confining areas. ()

- v. Twenty-five (25) feet from congested areas such as offices, lunchrooms, locker rooms, time clock

- areas and similar locations where people may congregate. ()
- w. Fifty (50) feet from places of public assembly. ()
 - x. Fifty (50) feet from areas occupied by patients who are not ambulatory. ()
 - y. Ten (10) feet from any public sidewalk. ()
 - z. Five (5) feet from any line of adjoining property. ()
- aa. Exceptions. The distance in Subsection 210.16.k., 210.16.l., 210.16.n. through 210.16.p. inclusive and Subsection 210.16.u. and 210.16.v. do not apply where protective structures such as fire walls of adequate height to safeguard the oxygen storage systems are located between the bulk oxygen storage installations and the exposure. In such cases, the bulk oxygen storage may be a minimum distance of one (1) foot from the firewall. ()
- bb. Permanently installed containers shall be provided with substantial noncombustible supports on firm noncombustible foundations. ()
- cc. Liquid oxygen storage containers shall be fabricated from materials meeting the impact test requirements of ASME Boiler and Pressure Vessel Code, Unfired Pressure Vessels. Containers operating at pressures above one-hundred sixty-five (165) pounds per square inch gage (p.s.i.g.) shall be designed, constructed and tested in accordance with appropriate requirements of ASME Boiler and Pressure Vessel Code, Unfired Pressure Vessels. Insulation surrounding the liquid oxygen container shall be noncombustible. ()
- dd. High-pressure gaseous oxygen containers shall comply with one (1) of the following: designed, constructed and tested in accordance with appropriate requirements of ASME Boiler and Pressure Vessel Code, Unfired Pressure Vessels; or Designed, constructed, tested, and maintained in accordance with DOT Specifications and Regulations. ()
- ee. Piping, tubing, and fittings shall be suitable for oxygen service and for the pressures and temperatures involved. ()
- ff. Piping and tubing shall conform to Section two (2) - Gas and Air Piping Systems of Code for Pressure Piping, ANSI B31.1. ()
- gg. Piping or tubing for operating temperatures below minus twenty (-20) degrees Fahrenheit shall be fabricated from materials meeting the impact test requirements of ASME Boiler and Pressure Vessel Code, Unfired Pressure Vessels, when tested at the minimum operating temperature to which the piping may be subjected in service. ()
- hh. Bulk oxygen storage containers, regardless of design pressure shall be equipped with safety relief devices as required by the ASME code or the DOT specifications and regulations. ()
- ii. Bulk oxygen storage containers designed and constructed in accordance with DOT specifications shall be equipped with safety relief devices as required thereby. ()
- jj. Bulk oxygen storage containers designed and constructed in accordance with ASME Boiler and Pressure Vessel Code, Unfired Pressure Vessels shall be equipped with safety relief devices meeting the provisions of the Compressed Gas Association Pamphlet "Safety Relief Device Standards for Compressed Gas Storage Containers," S-1, Part 3. ()
- kk. Insulation casings on liquid oxygen containers shall be equipped with suitable safety relief devices. ()
- ll. All safety relief devices shall be so designed or located that moisture cannot collect and freeze in a manner which would interfere with proper operation of the device. ()

mm. Liquid oxygen vaporizers shall be anchored and connecting piping be sufficiently flexible to provide for the effect of expansion and contraction due to temperature changes. ()

nn. Liquid oxygen vaporizers and piping shall be adequately protected on the oxygen and heating medium sections with safety relief devices. ()

oo. Heat used in an oxygen vaporizer shall be indirectly supplied only through media such as steam, air, water, or water solutions which do not react with oxygen. ()

pp. If electric heaters are used to provide the primary source of heat, the vaporizing system shall be electrically grounded. ()

qq. Equipment making up a bulk oxygen system shall be cleaned in order to remove oil, grease, or other readily oxidizable materials before placing the system in service. ()

rr. Joints in piping and tubing may be made by welding or by use of flanged, threaded, slip, or compression fittings. Gaskets or thread sealants shall be suitable for oxygen service. ()

ss. Valves, gages, regulators, and other accessories shall be suitable for oxygen service. ()

tt. Installation of bulk oxygen systems shall be supervised by personnel familiar with proper practices with reference to their construction and use. ()

uu. After installation, all field erected piping shall be tested and proved gas tight at maximum operating pressure. Any medium used for testing shall be oil free and nonflammable. ()

vv. Storage containers, piping, valves, regulating equipment and other accessories shall be protected against physical damage and against tampering. ()

ww. Any enclosure containing oxygen control or operating equipment shall be adequately vented. ()

xx. The bulk oxygen storage location shall be permanently placarded to indicate: "OXYGEN - NO SMOKING - NO OPEN FLAMES" or an equivalent warning. ()

yy. Bulk oxygen installations are not hazardous locations as defined and covered in section 150 of this standard. Thereto for, general purpose or weather proof types of electrical wiring and equipment are acceptable depending upon whether the installation is interior or exterior. Such equipment shall be installed in accordance with the applicable provisions of section 150 of this standard. ()

zz. For installations which require any operation of equipment by the user, legible instructions shall be maintained at operating locations. ()

aaa. The equipment and functioning of each charged bulk oxygen system shall be maintained in a safe operating condition in accordance with the requirements of this Section. Wood and long dry grass shall be cut back within fifteen (15) feet of any bulk oxygen storage container. ()

17. Nitrous Oxide. ()

a. The piped systems for the in-plant transfer and distribution of nitrous oxide shall be designed, installed, maintained, and operated in accordance with Compressed Gas Association Pamphlet G8 1964. ()

211. -- 219. (RESERVED).

220. FLAMMABLE AND COMBUSTIBLE LIQUIDS.

01. Scope. ()

Fahrenheit (ninety-three point three (93.3) degrees Celsius) or higher, and the total volume of which makes up ninety-nine (99%) percent or more of the total volume of the mixture. Class IIIB Liquids shall include those with flashpoints at or above two-hundred (200) degrees Fahrenheit (ninety-three point three (93.3) degrees Celsius) This section does not cover Class IIIB liquids. Where the term Class III liquids is used in this section, it shall mean only Class IIIA liquids. ()

k. Closed Container is a container so sealed by means of a lid or other device that neither liquid nor vapor will escape from it at most ordinary temperatures. ()

l. Combustible Liquid is any liquid having a flashpoint at or above one-hundred (100) degrees Fahrenheit (thirty-seven point eight (37.8) degrees Celsius) Combustible liquids shall be divided into two (2) classes, Class II and Class III liquids. When a combustible liquid is heated for use to within thirty (30) degrees Fahrenheit (sixteen point seven (16.7) degrees Celsius) of its flashpoint, it shall be handled in accordance with the requirements for the next lower class of liquids. ()

m. Container is any can, barrel, or drum. ()

n. Crude Petroleum is a hydrocarbon mixtures that has a flash point below one-hundred fifty (150) degrees Fahrenheit and which has not been processed in a refinery. ()

o. Distillery is where flammable or combustible liquids produced by fermentation are concentrated, and where the concentrated products may also be mixed, stored, or packaged. ()

p. Fire Area is an area of a building separated from the remainder of the building by construction having a fire resistance of at least one (1) hour, and having all communicating openings properly secured and protected by an assembly which has a fire resistant rating of at least, but not restricted to, one (1) hour. ()

q. Fire Resistance or Fire Resistive Construction is construction which is resistant to the spread of fire should this danger sometime arise. ()

r. Flammable Aerosol is an aerosol which is required to be labeled as "flammable" under the Federal Hazardous Substances Labeling Act, (15 U.S.C. 1261). For the purposes of this section, such aerosols are considered to be Class IA liquids. ()

s. Flammable Liquid is any liquid having a flashpoint below one-hundred (100) degrees Fahrenheit (thirty-seven point eight (37.8) degrees Celsius), except any mixture having components with flashpoints of one-hundred (100) degrees Fahrenheit (thirty-seven point eight (37.8) degrees Celsius) or higher, the total of which make up ninety-nine (99%) percent or more of the total volume of the mixture. Flammable liquids shall be known as Class I Liquids. ()

t. Flashpoint is the minimum temperature at which the liquid in question gives off a vapor within a test vessel in sufficient enough concentration to form an ignitable mixture with air near the surface of the liquid, and this shall be determined as follows: For a liquid which has a viscosity of not less than forty-five (45) SUS at one-hundred (100) degrees Fahrenheit. (Thirty-seven point eight (37.8) degrees Celsius) does not contain suspended solids, and does not have that tendency to form a film on the surface of the liquid, while under pressure and while under test, the procedure specified in the Standard Method of Test for Flashpoint by Tag Closed Tester (ASTM D-56-70) shall be used; For a liquid which has a viscosity of forty-five (45) SUS or more at one-hundred (100) degrees Fahrenheit. (Thirty-seven point eight (37.8) degrees Celsius) or contains suspended solids, or has a tendency to form a surface film while under test, the Standard Method of Test for Flashpoint by Pensky-Martens Closed Tester (ASTM D-93-71) shall be used, except that the methods specified in Note 1 to Section 1.1 of ASTM 3-93-71 may be used for the respective materials specified in the Note; For a liquid that is a mixture of compounds that have different volatilities and flashpoints its flashpoint shall be determined by using the procedure specified in this subsection above on the liquid in the form it is shipped. If the flashpoint, as determined by this test, is one-hundred (100) degrees Fahrenheit (thirty-seven point eight (37.8) degrees Celsius) or higher, an additional flashpoint determination shall be run on a sample of the liquid evaporated to ninety (90%) percent of its original volume, and the lower value of the two (2) tests shall be considered the flashpoint of the material. Organic peroxides, which undergo auto accelerating thermal decomposition, are excluded from any of the flashpoint determination methods specified in this subsection.

()

u. Liquid is any material which has a fluidity greater than that of three-hundred (300) penetration asphalt when tested in accordance with ASTM Test for Penetration for Bituminous Materials, D-5-65. When not otherwise identified, the term liquid shall include both flammable and combustible liquids. ()

v. Low-Pressure Tank is a storage tank which has been designed to operate at pressure above zero point five (0.5) p.s.i.g. but not more than fifteen (15) p.s.i.g. ()

w. Marine service station is that portion of a property where flammable or combustible liquids used as fuel are stored and dispensed from fixed equipment on shore, piers, wharves, or floating craft, and shall include all facilities used in connection therewith. ()

x. Mercantile occupancy is the use of a building or structure or any portion thereof for the displaying, selling, or buying of goods, wares, or merchandise. ()

y. Office occupancy is the use of a building or structure or any portion thereof for the transaction of business, or the rendering or receiving of professional services. ()

z. Piping systems consist of pipe, tubing flanges, bolting, gaskets, valves, fittings, the pressure containing parts of other components such as expansion joints and strainers, and devices which serve such purposes as mixing, separating, snubbing, distribution, metering, or controlling flow. ()

aa. Portable tank is a closed container having a liquid capacity over sixty (60) U. S. Gallons and not intended for fixed installation. ()

bb. Pressure vessel is a storage tank or vessel which has been designed to operate at pressures above fifteen (15) p.s.i.g. ()

cc. Protection for Exposure is adequate fire protection for structures on property adjacent to tanks, where there are employees of the establishment. ()

dd. Safety Can is an approved container, of not more than five (5) gallons capacity, having a spring-closing lid and spout cover and so designed that it will safely relieve internal pressure when subjected to fire exposure. ()

ee. Storage the keeping of flammable or combustible liquids in a tank or in a container that complies with this section. ()

ff. "SUS" is Saybolt Universal Seconds as determined by the Standard Method of Test for Saybolt Viscosity (ASTM D-88-56), and may be determined by use of the SUS Conversion tables specified in ASTM Method D-2161-66 following determination of viscosity in accordance with the procedures specified in the Standard Method of Test for Viscosity of Transparent and Opaque Liquids (ASTM D 445-65). ()

gg. Unstable (reactive) Liquid is a liquid which in the pure state or as commercially produced or transported will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shock, pressure, or temperature. ()

hh. Vapor Pressure is the pressure, measured in pounds per square inch (absolute) exerted by a volatile liquid as determined by the "Standard Method of Test for Vapor Pressure of Petroleum Products (Reid Method)," American Society for Testing and Materials ASTM D-323-68. ()

ii. Ventilation as specified in this section is for the prevention of fire and explosion. It is considered adequate if it is sufficient to prevent assimilation of significant quantities of vapor-air mixtures in concentration over one-quarter (1/4) of the lower flammable limit. ()

jj. Viscous is a viscosity of forty-five (45) SUS or more. NOTE: The volatility of liquids is increased

when artificially heated to temperatures equal to or higher than the flashpoints. When so heated, Class II and III liquids shall be subject to the applicable requirements for Class I or II liquids. These standards may also be applied to high flashpoint liquids when so heated even though these same liquids when not heated are outside of its scope.

()

03. General Requirements.

()

a. Cabinets, tanks, storage rooms, and storage locations shall be labeled "Flammable -- Keep Fire Away", and meet specifications for color coding and signage set forth in section 170 of this standard.

()

b. Adequate precautions shall be taken to prevent the ignition of flammable vapors. Sources of ignition include but are not limited to open flames, lightning, smoking, cutting and welding, hot surfaces, frictional heat, static, electrical and mechanical sparks, spontaneous ignition, including heat-producing chemical reactions, and radiant heat.

()

c. Class I liquids shall not be dispensed into containers unless the nozzle and container are electrically inter-connected and grounded. Where the metallic floor plate on which the container stands while filling is electrically connected to the fill stem or where the fill stem is bonded to the container during filling operations by means of a bond wire, the provisions of these standards shall be deemed to have been complied with.

()

d. Rooms in which Class I liquids are stored or handled shall be heated only by means not constituting a source of ignition, such as steam or hot water. Rooms containing heating appliances involving sources of ignition shall be located and arranged to prevent entry of flammable vapors.

()

e. Class I liquids shall not be stored or handled within a building having a basement or pit into which flammable vapors may travel, unless such area is provided with ventilation designed to prevent the accumulation of flammable vapors therein.

()

f. Containers of Class I liquids shall not be drawn from or filled within buildings unless provision is made to prevent the accumulation of flammable vapors in hazardous concentrations. Where mechanical ventilation is required, it shall be kept in operation while flammable liquids are being handled.

()

g. Class I liquids shall not be handled, drawn, or dispensed where flammable vapors may reach a source of ignition. Smoking shall be prohibited except in designated localities. "No Smoking" signs shall be conspicuously posted where hazard from flammable liquid vapors is normally present.

()

04. Design and Construction of Tanks.

()

a. Tanks shall be built of steel except as provided in Subsection 220.04.b. through Subsection 220.04.e. of this section.

()

b. Tanks may be built of materials other than steel for installation underground or if required by the properties of the liquid stored. Tanks located above ground or inside buildings shall be of noncombustible construction.

()

c. Tanks built of materials other than steel shall be designed to specifications embodying principles recognized as good engineering design for the material used.

()

d. Unlined concrete tanks may be used for storing flammable or combustible liquids having a gravity of forty (40) degrees API or heavier. Concrete tanks with special lining may be used for other services provided the design is in accordance with sound engineering practice.

()

e. Special engineering consideration shall be required if the specific gravity of the liquid to be stored exceeds that of water or if the tanks are designed to contain flammable or combustible liquids at a liquid temperature below zero (0) degrees Fahrenheit (minus seventeen point eight (-17.8) degrees Celsius).

()

f. Tanks may be of any shape or type consistent with sound engineering design.

()

g. Metal tanks shall be welded, riveted and caulked, brazed, bolted, or constructed by use of a combination of these methods. Filler metal used in brazing shall be nonferrous metal or an alloy having a melting point above one-thousand (1000) degrees Fahrenheit and below that of the metal jointed. ()

h. Atmospheric tanks shall be built in accordance with acceptable good standards of design. Atmospheric tanks may be built in accordance with: Underwriters' Laboratories, Inc., Subjects No. 142, Standard for Steel Above-ground Tanks for Flammable and Combustible Liquids; No. 58, Standards for Steel Underground Tanks for Flammable and Combustible Liquids, 5th Edition; No. 80, Standard for Steel Inside Tanks for Oil-burner fuel; American Petroleum Institute Standards No. 12A, Specification for Oil Storage Tanks with Riveted Shells, or No. 650 Welded Steel Tanks for Oil Storage 1966; American Petroleum Institute Standards No. 12B, Specification for Bolted Production Tanks; No. 12D Specification for Large Welded Production Tanks; or No. 12F, Specification for Small Welded Production Tanks; Tanks built in accordance with these standards shall be used only as production tanks for storage of crude petroleum in oil producing areas. ()

i. Low-pressure tanks and pressure vessels may be used as atmospheric tanks. ()

j. Tanks designed for underground service not exceeding two-thousand five-hundred (2,500) gallons capacity may be used above-ground. ()

k. Atmospheric tanks shall not be used for the storage of a flammable or combustible liquid at a temperature at or above its boiling point. ()

l. The normal operating pressure of a low pressure tanks shall not exceed the design pressure of the tank. ()

m. Low-pressure tanks shall be built in accordance with acceptable standards of design. Low-pressure tanks may be built in accordance with: American Petroleum Institute Standard No. 620, Recommended Rules for the Design and Construction of Large, Welded, Low-pressure Storage Tanks, or the principles of the ASME Boiler and Pressure Vessels Code for Unfired Pressure Vessels. ()

n. Atmospheric tanks built according to the Underwriter's Laboratories, Inc., requirements in Subsection 220.04.h. of this section may be used for operating pressures not exceeding one (1) p.s.i.g. and shall be limited to two point five (2.5) p.s.i.g. under emergency venting conditions. Pressure Vessels may be used as low-pressure tanks. ()

o. The normal operating pressure of the pressure vessel shall not exceed the design pressure of the vessel. Pressure Vessels shall be built in accordance with the ASME Boiler and Pressure Vessel Code for Unfired Pressure Vessels. ()

p. When tanks are not designed in accordance with the American Petroleum Institute, American Society of Mechanical Engineers, or the Underwriter's Laboratories, Inc., Standards, or if corrosion is anticipated beyond that provided for in the design formulas used, additional metal thickness or suitable protective coatings or linings shall be provided to compensate for the corrosion loss expected during the design life of the tank. ()

05. Installation of Outside Above Ground Tanks. ()

a. The distance between any two (2) (shell to shell) flammable or combustible liquid storage tanks shall not be less than three (3) feet. ()

b. The distance between any two (2) adjacent tanks shall not be less than one sixth (1/6) the sum of their diameters and in no case less than three (3) feet. When the diameter of one (1) tank is less than one-half (1/2) the diameter of the adjacent tank, the distance between the two (2) tanks shall not be less than one-half (1/2) the diameter of the smaller tank and in no case less than three (3) feet. ()

c. Where unstable or combustible liquids are stored, the distance between such tanks shall not be less than one-half (1/2) half the sum of their diameters. ()

d. When tanks are compacted in three (3) or more rows or in an irregular pattern, greater spacing or other means shall be provided so that inside tanks are accessible for fire fighting purposes. ()

e. The minimum separation between a liquid gas container and a flammable or combustible liquid storage tank shall be twenty (20) feet, except in the case of flammable or combustible liquid tanks operating at pressures exceeding two point five (2.5) p.s.i.g. or equipped with emergency venting which will permit pressures to exceed two point five (2.5) p.s.i.g. in which case the provisions of Subsection 220.05.a & b. of this section shall apply. Suitable means shall be taken to prevent the accumulation of flammable or combustible liquids under adjacent liquefied petroleum gas containers such as by diversion curbs or grading. When flammable or combustible liquid storage tanks are within a diked area, the liquefied petroleum gas containers shall be outside the diked area and at least ten (10) feet away from the centerline of the wall of the diked area. The foregoing provisions shall not apply when liquefied petroleum gas containers of one-hundred twenty-five (125) gallons or less capacity are installed adjacent to fuel oil supply tanks of five-hundred fifty (550) gallons or less capacity. ()

f. Every outside above-ground tank shall be separated from important buildings on the same property by distances not less than those specified in Subsection 220.05.a through 220.05.e of this section, whichever is applicable. The appropriate distance column to be used in Table 220.05-A shall be the column reading "Minimum Distance in Feet From Nearest Side of Any Public Way or From Nearest Important Building". ()

TABLE 220.05-A		
Capacity tank gallons	Minimum distance in feet from property line which may be built upon, including the opposite side of a public way	Minimum distance in feet from nearest side of any public way or from nearest important building
275 or less	5	5
276 to 750	10	5
751 to 12,000	15	5
12,001 to 30,000	20	5
30,001 to 50,000	30	10
50,001 to 100,000	50	15
100,001 to 500,000	80	25
500,001 to 1,000,000	100	35
1,000,001 to 2,000,000	135	45
2,000,001 to 3,000,000	165	55
3,000,001 or above	175	60

g. Atmospheric storage tanks shall be adequately vented to prevent the development of vacuum or pressure sufficient to distort the roof of a cone roof tank or exceed the design pressure in the case of other atmospheric tanks, as a result of filling, emptying, and atmospheric temperature changes. ()

h. Normal vents shall be sized either in accordance with: the American Petroleum Institute Standard two-thousand (2000), Venting Atmospheric and Low-Pressure Storage Tanks; other accepted standard; or shall be at least as large as the filling or withdrawal connection, whichever is larger but in no case less than one and one-quarter (1 1/4) inch normal inside diameter. ()

i. Low-pressure tanks and pressure vessels shall be adequately vented to prevent development of

pressure or vacuum, as a result of filling, emptying, and atmospheric temperature changes, from exceeding the design pressure of the tank or vessel. Protection shall also be provided to prevent over-pressure from any pump discharging into the tank or vessel when the pump discharge pressure can exceed the design pressure of the tank or vessel. ()

j. If any tank or pressure vessel has more than one (1) fill or withdrawal connection and simultaneous filling or withdrawal can be made, the vent size shall be based on the maximum anticipated simultaneous flow. ()

k. Unless the vent is designed to limit the internal pressure of two point five (2.5) p.s.i. or less, the outlet of vents and vent drains shall be arranged to discharge in such a manner as to prevent localized overheating of any part of the tank in the event vapors from such vents are ignited. ()

l. Tanks and pressure vessels storing Class IA liquids shall be equipped with venting devices which shall be normally closed except when venting to pressures or vacuum conditions. Tanks and pressure vessels storing Class IB and IC liquids shall be equipped with venting devices which shall be normally closed except when venting under pressure or vacuum conditions, or with approved flame arresters. Exception: Tanks of three-thousand (3,000) bbls. capacity or less containing crude petroleum in crude-producing areas; and, outside above-ground atmospheric tanks under one-thousand (1,000) gallons capacity containing other than Class IA Flammable liquids may have open vents. ()

m. Flame arresters or venting devices required in Subsection 220.05 of this section may be omitted for Class IB and IC liquids where conditions are such that their use may, in case of obstruction, result in tank damage. ()

n. Every above ground storage tank shall have some form of construction or device that will relieve excessive internal pressure caused by exposure fires. ()

o. In a vertical tank the construction referred to in Subsection 220.05.n. above may take the form of a floating roof, lifter roof, a weak roof-to-shell seam, or other approved pressure relieving construction. The weak roof-to-shell seam shall be constructed to fail preferential to any other seam. ()

p. Where entire dependence for emergency relief is placed upon pressure relieving devices, the total venting capacity of both normal and emergency vents shall be enough to prevent rupture of the shell or bottom of the tank if vertical, or of the shell or heads if horizontal. If unstable liquids are stored, the effects of heat or gas resulting from polymerization, decomposition, condensation, or self-reactivity shall be taken into account. The total capacity of both normal and emergency venting devices shall be not less than that derived from Table 220.05-B except as provided in Subsection 220.05.r. and Subsection 220.05.s. of this section. Such device may be a self-closing manhole cover, or one using long bolts that permit the cover to lift under internal pressure, or an additional or large relief valve or valves. The wetted area of the tank shall be calculated on the basis of fifty-five (55) percent of the total exposed area of a sphere or spheroid, seventy-five (75) percent of the total exposed area of a horizontal Tank and the first thirty (30) feet above grade of the exposed shell area of a vertical tank. ()

TABLE 220.05-B					
WETTED AREA VERSUS CUBIC FEET FREE AIR PER HOUR					
Square feet	CFH	Square feet	CFH	Square feet	CFH
20	21,100	160	168,000	800	462,000
30	31,600	180	190,000	900	493,000
40	42,100	200	211,000	1,000	524,000
50	52,700	250	239,000	1,200	557,000
60	63,200	300	265,000	1,400	587,000

TABLE 220.05-B					
WETTED AREA VERSUS CUBIC FEET FREE AIR PER HOUR					
Square feet	CFH	Square feet	CFH	Square feet	CFH
70	73,700	350	288,000	1,600	614,000
80	84,200	400	312,000	1,800	639,000
90	94,800	500	354,000	2,000	662,000
100	105,000	600	392,000	2,400	704,000
120	126,000	700	428,000	2,800 and over	742,000
140	147,000				

q. For Tanks and storage vessels designed for pressure over one (1) p.s.i.g. the total rate of venting shall be determined in accordance with Table 220.05-A, except that when the exposed wetted area of the surface is greater than two-thousand eight-hundred (2,800) square feet, the total rate of venting shall be calculated by the following formula:

$$CFH = 1,107A(0.82)$$

Where:

CFH = Venting Requirement, in cubic feet of free air per hour

A = Exposed Wetted Surface, in square feet

NOTE: The foregoing formula is based on $Q = 21,000A (0.82)$. ()

r. The total emergency relief venting capacity for any specific stable liquid may be determined by the following formula:

$$V = 1337$$

$$L_M$$

Where:

V = Cubic Feet of Free Air per Hour from Table 220.05.b.

L = Latent Heat of Vaporization of Specific Liquid in B.T.U. per Pound

M = Molecular Weight of Specific Liquids ()

s. The required air flow rate of Subsection 220.05.p. or Subsection 220.05.r. of this section may be multiplied by the appropriate factor listed in the following schedule when protection is provided as indicated. Only one (1) factor may be used for any one tank. zero point five (0.5) for drainage in accordance with Subsection 220.05.aa. of this section for tanks over two-hundred (200) sq. feet of wetted area; zero point three (0.3) for approved water spray; zero point three (0.3) for approved insulation; zero point fifteen (0.15) for approved water spray with approved insulation. ()

t. The outlet of all vents and vent drains on tanks equipped with emergency venting to permit pressures exceeding two point five (2.5) p.s.i.g. shall be arranged to discharge in such a way as to prevent localized overheating of any part of the tank, in the event vapors from such vents are ignited. ()

u. Each tank venting device shall have stamped on it the opening pressure, the pressure at which the valve reaches the full open position, and the flow capacity at the latter pressure, expressed in cubic feet per hour of air at sixty (60) degrees Fahrenheit and at a pressure of fourteen point seven (14.7) p.s.i.a. ()

v. The flow capacity of tank venting devices twelve (12) inches and smaller in nominal pipe size shall be determined by actual test of each type and size of vent. These flow tests may be conducted by the manufacturer if

certified by a qualified impartial observer, or may be conducted by an outside agency. The flow capacity of tank venting devices larger than twelve (12) inches nominal pipe size, including manhole covers with long bolts or equivalent, may be calculated provided that the opening pressure is actually measured, the rating pressure and corresponding free orifice area are stated, the work "calculated" appears on the nameplate and the computation is based on a flow coefficient of zero point five (0.5) applied to the rated orifice area. ()

w. Vent piping shall be constructed in accordance with Subsection 220.11 of this section. ()

x. Where vent pipe outlets for tanks storing Class I liquids are adjacent to buildings or public ways, they shall be located so that the vapors are released at a safe point outside of buildings and not less than twelve (12) feet above the adjacent ground level. In order to aid their dispersion, vapors shall be discharged upward or horizontally away from closely adjacent walls. Vent outlets shall be located so that flammable vapors will not be trapped by eaves or other obstructions and shall be at least five (5) feet from building openings. ()

y. When tank vent piping is manifold, pipe sizes shall be such as to discharge within the pressure limitations of the system, the vapors they may be required to handle when manifolded tanks are subject to the same fire exposure. ()

z. The area surrounding a tank or a group of tanks shall be provided with drainage as in Subsection 220.05.aa. of this section or shall be diked as provided in Subsection 220.05.bb. of this section to prevent accidental discharge of liquid from endangering adjoining property or reaching waterways. ()

aa. Where protection of adjoining property or waterways is by means of a natural or manmade drainage system, such a system shall comply with the following: A slope of not less than one (1) percent away from the tank toward the drainage system shall be provided. The drainage system shall terminate in vacant land, other areas, or in an impounding basin having a capacity not smaller than that of the largest tank served. This termination area and the route of the drainage system shall be so located that if the flammable or combustible liquids in the drainage system are ignited, the fire will not seriously expose tanks or adjoining property. The drainage system, including automatic drainage pumps shall not discharge to adjoining property, natural water courses, public sewers, or public drains unless the discharge of flammable or combustible liquids would not constitute a hazard, or the system is so designed that it will not permit flammable or combustible liquids to be released. ()

bb. Where protection of adjoining property or waterways is accomplished by retaining the liquid around the tank by means of a dike, the volume of the diked area shall comply with the following requirements: Except as provided herein, the Volumetric capacity of the diked area shall not be less than the greatest amount of liquid that can be released from the largest tank within the diked area, assuming a full tank. The capacity of the diked area enclosing more than one (1) tank shall be calculated by deducting the volume of the tanks other than the largest tank below the height of the dike. For a tank or group of tanks with fixed roofs containing crude petroleum with Boil Over characteristics, the Volumetric capacity of the diked area shall be not less than the capacity of the largest tank served by the enclosure, assuming a full tank. The capacity of the diked enclosure shall be calculated by deducting the volume below the height of the dike of all tanks within the enclosure. Walls of the diked area shall be of earth, steel, concrete, or solid masonry designed to be liquid tight and to withstand a full hydrostatic head. Earthen walls three (3) feet or more in height shall have a flat section at the top not less than two (2) feet wide. The slope of an earthen wall shall be consistent with the angle of repose of the material of which the wall is constructed. The walls of the diked area shall be restricted to an average height of six (6) feet above interior grade. Where provision is made for draining water from diked area, drainage shall be provided at a uniform slope of not less than one (1) percent away from tanks toward a sump, drain box, or other safe means of disposal located at the greatest practical distance from the tank. Such drains shall normally be controlled in a manner so as to prevent flammable or combustible liquids from entering natural water courses, public sewers, or public drains, if their presence would constitute a hazard. Control of drainage shall be accessible under fire conditions. The drainage channels or intermediate curbs shall be located between tanks so as to take full advantage of the available space with due regard for the individual tank capacities. Intermediate curbs, where used, shall be not less than eighteen (18) inches in height. ()

cc. Connections for all tank openings shall be vapor tight and liquid tight. ()

dd. Each connection to an above-ground tank through which liquid can normally flow shall be provided with an internal or an external valve located as close as practical to the shell of the tank. Such valves, when external,

and their connections to the tank shall be of steel except when the chemical characteristics of the liquid stored are incompatible with steel. When materials other than steel are necessary, they shall be suitable for the pressures, structural stresses, and temperatures involved, including fire exposures. ()

ee. Each connection below the liquid level through which liquid does not normal flow shall be provided with a liquid tight closure. This may be a valve, plug, blind, or a combination of these. ()

ff. Openings for gaging shall be provided with a vapor tight cap or cover. ()

gg. For Class IB and Class IC liquids other than crude oil, gasoline and asphalt, the fill pipe shall be so designed and installed as to minimize the possibility of generating static electricity. A fill pipe entering the top of a tank shall terminate within six (6) inches of the bottom of the tank and shall be installed to avoid excessive vibration. ()

hh. Filling and emptying connections which are made and broken shall be located outside of buildings at a location free from any source of ignition and not less than five (5) feet away from any building opening. Such connection shall be closed and liquid tight when not in use. The connection shall be properly identified. ()

06. Installation of Underground Tanks. ()

a. Location. Excavation for underground storage tanks shall be made with due care to avoid undermining of foundations of existing structures. Underground tanks or tanks under buildings shall be so located with respect to existing building foundations and supports that the loads carried by the latter cannot be transmitted to the tank. The distance from any part of a tank storing Class I liquids to the nearest wall of any basement or pit shall be not less than one (1) foot, and to any property line that may be built upon, not less than three (3) feet. The distance from any part of a tank storing Class II or Class III liquids to the nearest wall of any basement, pit or property line shall not be less than one (1) foot. ()

b. Underground tanks shall be set on firm foundations and surrounded with at least six (6) inches of noncorrosive, inert materials such as clean sand, earth, or gravel well stamped in place. The tank shall be placed in the hole with care since dropping or rolling the tank into the hole can break a weld, puncture, damage the tank, or scrape off the protective coating of coated tanks. Tanks shall be covered with a minimum of two (2) feet of earth or shall be covered with not less than one (1) foot of earth on top of which shall be placed a slab of reinforced concrete not less than four (4) inches thick. When underground tanks are or are likely to be, subject to traffic, they shall be protected against damage from vehicles passing over them by at least three (3) feet of earth cover, or eighteen (18) inches of well-tamped earth, plus six (6) inches of reinforced concrete or eight (8) inches of asphaltic concrete. When asphaltic or reinforced concrete paving is used as part of the protection, it shall extend at least one (1) foot horizontally beyond the outline of the tank in all directions. ()

c. Where an underground storage tank could become buoyant due to a rise in the level of the water table the tank shall be anchored in place. ()

d. Corrosion protection for the underground storage tank and its piping shall be provided by one or more of the following methods: use of protective coatings or wrappings; cathodic protection; or corrosion resistant construction materials. ()

e. Vent pipes from underground storage tanks storing Class I liquids shall be so located that the discharge point is outside of buildings, higher than the fill pipe opening, and not less than twelve (12) feet above the adjacent ground level. Vent pipes shall discharge only upward in order to disperse vapors. Vent pipes two (2) inches or less in nominal inside diameter shall not be obstructed by devices that will cause excessive back pressure. Vent pipe outlets shall be so located that flammable vapors will not enter building openings, or be trapped under eaves or other obstructions. If the vent pipe is less than ten (10) feet in length, or greater than two (2) inches in nominal inside diameter, the outlet shall be provided with a vacuum and pressure relief device or shall be an approved flame arrester located in the vent line at the outlet or within the approved distance from the outlet. ()

f. Each tank shall be vented through piping adequate in size to prevent blow-back of vapor liquid at the fill opening while the tank is being filled. Vent pipes shall be not less than one-quarter (1/4) inch nominal inside

diameter, see Table 220.06-A.

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TABLE 220.06-A			
VENT LINE DIAMETERS			
Maximum Flow	Pipe Length ¹		
GPM	50'	100'	200'
	Inches	Inches	Inches
100	1 1/4	1 1/4	1 1/4
200	1 1/4	1 1/4	1 1/4
300	1 1/4	1 1/4	1 1/2
400	1 1/4	1 1/2	2
500	1 1/2	1 1/2	2
600	1 1/2	2	2
700	2	2	2
800	2	2	3
900	2	2	3
1,000	2	2	3

¹Vent lines of 50 ft., 100 ft., and 200 ft. of pipe plus 7 ells.

()

g. Vent pipes from tanks storing Class II or Class III flammable liquids shall terminate outside of the building and higher than the fill pipe opening. Vent outlets shall be above normal snow level. They may be fitted with return bends, course screens, or other devices to minimize ingress or foreign material. ()

h. Vent piping shall be constructed in accordance with Subsection 220.11 of this section. Vent pipes shall be so laid as to drain toward the tank without sags or traps in which liquid can collect. They shall be located so that they will not be subjected to physical damage. The tank end of the vent pipe shall enter the tank through the top. ()

i. When tank vent piping is manifolded, pipe sizes shall be such as to discharge, within the pressure limitations of the system, the vapors they may be required to handle when manifolded tanks are filled simultaneously. ()

j. Connections for all tank openings shall be vapor or liquid tight. ()

k. Openings for manual gaging, if independent of the fill pipe shall be provided with a liquid-tight cap or cover. If inside a building, each such opening shall be protected against liquid overflow and possible vapor release by means of a spring loaded check valve or other approved device. ()

l. Fill and discharge lines shall enter tanks only through the top. Fill lines shall be sloped toward the tank. ()

m. For Class IB and IC liquids other than crude oils, gasolines, and asphalt, the fill pipe shall be so designed and installed as to minimize the possibility of generating static electricity by terminating within six (6)

inches of the bottom of the tank. ()

n. Filling and emptying connections which are made and broken shall be located outside of buildings at a location free from any source of ignition and not less than five (5) feet away from any building openings. Such connection shall be closed and liquid-tight when not in use. The connection shall be properly identified. ()

07. Installation of Tanks Inside of Buildings. ()

a. Tanks shall not be permitted inside of buildings except in industrial operations areas, bulk facilities, and service stations. ()

b. Vents for tanks inside of buildings shall be as provided in Subsection 220.05.g. through Subsection 200.05.x. and Subsection 220.06.a. through Subsection 220.06.n. of this section, except that emergency venting by the use of weak roof seams on tanks shall not be permitted. Vents shall discharge vapors outside of buildings. ()

c. Vent piping shall be constructed in accordance with Subsection 220.11 of this section. ()

d. Connections for all tank openings shall be vapor or liquid tight. ()

e. Each connection to a tank inside of buildings through which liquid can normally flow shall be provided with an internal or an external valve located as close as practical to the shell of the tank. Such valves, when external, and their connections to the tank shall be of steel except when the chemical characteristics of the liquid stored are incompatible with steel. When materials other than steel are necessary they shall be suitable for the pressures, structural stresses, and temperatures involved, including fire exposures. ()

f. Flammable or combustible liquid tanks located inside of buildings except in one-story buildings designed and protected for flammable or combustible liquids storage shall be provided with an automatic closing heat actuated valve on each withdrawal connection below the liquid level, except for connections used for emergency disposal, to prevent continued flow in the event of fire in the vicinity of the tank. This function may be incorporated in the valve required in Subsection 220.07.e. of this section, and if a separate valve, shall be located adjacent to the valve required in Subsection 220.7.e. of this section. ()

g. Openings for manual gaging, if independent of the fill pipe (see Subsection 220.07.h. of this section), shall be provided with a vapor tight cap or cover. Each such opening shall be protected against liquid overflow and possible vapor release by means of a spring loaded check valve or other approved device. ()

h. For Class IB and IC liquids other than crude oil, gasoline, and asphalt, the fill pipe shall be so designed and installed as to minimize the possibility of generating static electricity by terminating within six (6) inches of the bottom of the tank. ()

i. The fill pipe inside of the tank shall be installed to avoid excessive vibration of the pipe. ()

j. The inlet of the fill pipe shall be located outside of buildings at a location free from any source of ignition and not less than five (5) feet away from any building opening. The inlet of the fill pipe shall be closed and liquid tight when not in use. The fill connection shall be properly identified. ()

k. Tanks inside buildings shall be equipped with a device, or other means shall be provided, to prevent overflow into the building. ()

08. Supports, Foundations, and Anchorage for all Tank Locations. ()

a. Tank supports shall be installed on firm foundations. Tank supports shall be of concrete, masonry, or protected steel. Single wood timber supports (not cribbing) laid horizontally may be used for outside above-ground tanks if not more than twelve (12) inches high at their lowest point. ()

b. Steel supports or exposed piling shall be protected by materials having a fire resistance rating of not less than two (2) hours, except that steel saddles need not be protected if less than twelve (12) inches high at their

lowest point. Water spray protection or its equivalent may be used in lieu of fire resistive materials to protect supports. ()

c. The design of the supporting structure for tanks such as spheres shall receive special engineering consideration. ()

d. Every tank shall be so supported as to prevent the excessive concentration of loads on the supporting portion of the shell. ()

e. Tanks shall rest on the ground or on foundations made of concrete, masonry, piling, or steel. Tank foundations shall be designed to minimize the possibility of uneven settling of the tank and to minimize corrosion in any part of the tank resting on the foundation. ()

f. Here a tank is located in an area that may be subjected to flooding, the applicable precautions outlined as follows: No above ground vertical storage tank containing a flammable or combustible liquid shall be located so that the allowable liquid level within the tank is below the established maximum flood stage, unless the tank is provided with a guiding structure such as described herein. Independent water supply facilities shall be provided at locations where there is no ample and dependable public water supply available for loading partially empty tanks with water. In addition to the preceding requirements, each tank so located that more than seventy (70%) percent but less than one-hundred (100) percent of its allowable liquid storage capacity will be submerged at the established maximum flood stage, shall be safeguarded by one of the following methods: Tank shall be raised or its height shall be increased, until its top extends above the maximum flood stage a distance equivalent to thirty (30) percent or more of its allowable liquid storage capacity. Provided, however, that the submerged part of the tank shall not exceed two and one-half (2 1/2) times the diameter. Or, as an alternative to the foregoing, adequate noncombustible structural guides, designed to permit the tank to float vertically without loss of product, shall be provided. ()

g. Each horizontal tank so located that more than seventy (70%) percent of its storage capacity will be submerged at the established flood stage, shall be anchored, attached to a foundation of concrete or of steel and concrete, of sufficient weight to provide adequate load for the tank when filled with flammable or combustible liquid and submerged by flood waters to the established flood stage, or adequately secured by other means. ()

h. Spherical and spheroidal tanks shall be protected by applicable methods as specified for either vertical or horizontal tanks. ()

i. At locations where there is no ample and dependable water supply, or where filling of underground tanks with liquid is impracticable because of the character of their contents, their use, or for other reasons, each tank shall be safeguarded against movement when empty and submerged by high ground water or flood waters by anchoring, weighing with concrete or other approved solid loading material, or securing by other means. Each such tank shall be so constructed and installed that it will safely resist external pressures due to high ground water or flood waters. ()

j. At locations where there is an ample and dependable water supply available, underground tanks containing flammable or combustible liquids, so installed that more than seventy (70%) percent of their storage capacity will be submerged at the maximum flood stage, shall be so anchored weighted or secured by other means, as to prevent movement of such tanks when filled with flammable or combustible liquids, and submerged by flood waters to the established flood stage. ()

k. Pipe connections below the allowable liquid level in a tank shall be provided with valves or cocks located as closely as practicable to the tank shell. Such valves and their connections to tanks shall be of steel or other material suitable for use with the liquid being stored. Cast iron shall not be used. ()

l. At locations where an independent water supply is required, it shall be entirely independent of public power and water supply. Independent source of water shall be available when flood waters reach a level not less than ten (10) feet below the bottom of the lowest tank on a property. ()

m. The self-contained power and pumping unit shall be so located or so designed that pumping into

tanks may be carried on continuously throughout the rise in flood waters from a level ten (10) feet below the lowest tank to the level of the potential flood stage. ()

n. Capacity of the pumping unit shall be such that the rate of rise of water in all tanks shall be equivalent to the established potential average rate of rise of flood waters at any stage. ()

o. Each independent pumping unit shall be tested periodically to insure that it is in satisfactory operating condition. ()

p. Structural guides for holding floating tanks above their foundations shall be so designed that there will be no resistance to the free rise of a tank and shall be constructed of noncombustible material. ()

q. The strength of the structure shall be adequate to resist lateral movement of a tank subject to a horizontal force in any direction equivalent to not less than twenty five (25) pounds per square foot acting on the projected vertical cross-sectional area of the tank. ()

r. Where tanks are situated on exposed points or bends in a shoreline where swift currents in floodwater will be present, the structures shall be designed to withstand a unit force of not less than fifty (50) pounds per square foot. ()

s. The filling of a tank to be protected by water loading shall be started as soon as flood waters reach a dangerous flood stage. The rate of filling shall be at least equal to the rate of rise of the flood waters (or the established average potential rate of rise). ()

t. Sufficient fuel to operate the water pumps shall be available at all times to insure adequate power to fill all tankage with water. ()

u. All valves on connecting pipelines shall be closed and locked in closed position when water loading has been completed. ()

v. Where structural guides are provided for the protection of floating tanks, all rigid connections between tanks and pipelines shall be disconnected and blanked off or banded before the flood waters reach the bottom of the tank, unless control valves and their connections to the tank are of a type designed to prevent breakage between the valve and the tank shell. ()

w. All valves attached to tanks other than those used in connection with water loading operations shall be closed and locked. ()

x. If a tank is equipped with a swing line, the swing pipe shall be raised to and secured at its highest position. ()

y. Detailed printed instructions of what to do in flood emergencies shall be properly posted. ()

z. Operators and other employees depended upon to carry out such instructions are thoroughly informed as to the location and operation of such valves and other equipment necessary to effect these requirements. ()

aa. Tank supports and connections shall be designed to resist damage as a result of earthquake shocks. ()

09. Sources of Ignition. ()

a. In locations where flammable vapors may be present, precautions shall be taken to prevent ignition by eliminating or controlling sources of ignition. Sources of ignition may include open flames, light, smoking, cutting and welding, hot surfaces, frictional heat, sparks, (static, electrical, and mechanical), spontaneous ignition, chemical and physical chemical reactions, and radiant heat. ()

10. Testing. ()

a. All tanks, whether shop built or field erected shall be strength tested before they are placed in service in accordance with the applicable Sections of the Code under which they were built. The American Society of Mechanical Engineers (ASME) Code stamp, American Petroleum Institute (API) monogram, or the label of the Underwriters' Laboratories, Inc., on a tank shall be evidence of compliance with this strength test. Tanks not marked in accordance with the above Codes shall be strength tested before they are placed in service in accordance with good engineering principles and reference shall be made to the references on testing in the Codes listed in Subsection 220.05.h., Subsection 220.05.m., and Subsection 220.05.o. of this section. ()

b. When the vertical length of the fill and vent pipes is such that when filled with liquid the static head imposed upon the bottom of the tank exceeds ten (10) pounds per square inch, the tank and related piping shall be tested hydrostatically to a pressure equal to the static head thus imposed. ()

c. In addition to the strength test called for in Subsection a. and b. above, all tanks and connections shall be tested for tightness. Except for underground tanks, this tightness test shall be made at operating pressure with air, inert gas, or water prior to placing the tank in service. In the case of field-erected tanks, the strength test may be considered to be the test for tank tightness. Underground tanks and piping, before being covered, enclosed, or placed in use, shall be tested for tightness hydrostatically, or with air pressure at not less than three (3) pounds per square inch and not more than five (5) pounds per square inch. ()

d. All leaks or deformations shall be corrected in an acceptable manner before the tank is placed in service. Mechanical caulking is not permitted for correcting leaks in welded tanks except pinhole leaks in the roof. ()

e. Tanks to be operated at pressures below their design pressure may be tested by the applicable provisions of Subsection a. or b. above. ()

11. Piping, Valves, and Fittings. ()

a. The design (including selection of materials) fabrication, assembly, test, and inspection of piping systems containing flammable or combustible liquids shall be suitable for the expected working pressures and structural stresses. Conformity with the applicable provisions of Pressure Piping, ANSI B31 series and the provisions of this section shall be considered prima facie evidence of compliance with the foregoing provisions. ()

b. This subsection does not apply to the following: tubing or casing on any oil or gas wells and any piping connected directly thereto; motor vehicle, aircraft, boat, or portable or stationary engines; piping within the scope of any applicable boiler and pressure vessel Code. ()

c. Materials for piping, valves or fittings shall be steel, nodular iron or malleable iron, except as provided below. ()

d. EXCEPTIONS: Materials other than steel, nodular iron, or malleable iron may be used underground or if required by the properties of the flammable or combustible liquid handled. Material other than steel, nodular iron or malleable iron shall be designed to specifications embodying principles recognized as good engineering practices for the material used. ()

e. Piping, valves, and fittings may have combustible or noncombustible linings. ()

f. When low-melting point materials such as aluminum and brass or materials that soften on fire exposure such as plastics or non-ductile materials such as cast iron, necessary special consideration shall be given to their behavior on fire exposure. If such materials are used in above ground piping systems or inside buildings, they shall be suitably protected against fire exposure or so located that any spill resulting from the failure of these materials could not unduly expose person, important buildings, or structures or can be readily controlled by remote valves. ()

g. Joints shall be made liquid tight. Welded or screwed joints or approved connectors shall be used.

Threaded joints and connections shall be made up tight with a suitable lubricant or piping compound. Pipe joints dependent upon the friction characteristics of combustible materials for mechanical continuity of piping shall not be used inside buildings. They may be used outside of buildings above or below ground. If used above ground, the piping shall either be secured to prevent disengagement at the fitting or the piping system shall be so designed that any spill resulting from such disengagement could not unduly expose person or important buildings or structures and could be readily controlled by remote valves. ()

h. Piping systems shall be substantially supported and protected against physical damage and excessive stresses arising from settlement, vibrations, expansion, contraction, or seismic activity. ()

i. All piping for flammable or combustible liquids both above ground and under ground where subject to external corrosion, shall be painted or otherwise protected. ()

j. Piping systems shall contain a sufficient number of valves to operate the system properly and to protect the plant. Piping systems in connection with pumps shall contain a sufficient number of valves to control properly the flow of liquid in normal operation and in the event of physical damage. Each connection to pipelines, by which equipment such as tank cars, or tank vehicles discharge liquids by means of pumps into storage tanks, shall be provided with a check valve for automatic protection against back flow if the piping arrangement is such that back flow from the system is possible. ()

k. All piping before being covered, enclosed, or placed in use shall be hydrostatically tested to one-hundred fifty (150) percent of the maximum anticipated pressure of the system, or pneumatically tested to one-hundred ten (110) percent of the maximum anticipated pressure of the system, but not less than five (5) pounds per square inch gage at the highest point of the system. This test shall be maintained for a sufficient time to complete visual inspection of all joints and connections but for at least ten (10) minutes. ()

12. Containers and Portable Tanks. ()

a. This subsection shall apply only to the storage of flammable or combustible liquids in drums or other containers (including flammable aerosols) not exceeding sixty (60) gallon individual capacity and those portable tanks not exceeding six-hundred sixty (660) gallons individual capacity. ()

b. EXCEPTIONS: This subsection shall not apply to the following: Class I or Class II liquids in the fuel tanks of a motor vehicle, aircraft, boat, or portable or stationary engine; or beverages when packaged in individual containers not exceeding one (1) gallon in size. ()

c. Only approved containers and portable tanks shall be used. Metal containers and portable tanks meeting the requirements of and containing products authorized by Chapter I, Title 49 of the Code of Federal Regulations, (regulations issued by the Hazardous Material Regulations Board, Department of Transportation), shall be deemed to be acceptable. ()

d. Each portable tank shall be provided with one (1) or more devices installed in the top with sufficient emergency venting capacity to limit internal pressure under fire exposure conditions to ten (10) p.s.i.g. or thirty (30) percent of the bursting pressure of the tank, whichever is greater. The total venting capacity shall be not less than that specified in Subsection 220.05.p. or 220.05.q. of this section. At least one (1) pressure-actuated vent having a minimum capacity of six-thousand (6,000) cubic feet of free air (fourteen point seven (14.7) p.s.i.a. and sixty (60) degrees Fahrenheit) shall be used. It shall be set to open at not less than five (5) p.s.i.g. If fusible vents are used, they shall be actuated by elements that operate at a temperature not exceeding three-hundred (300) degrees Fahrenheit. ()

e. Flammable and combustible liquid containers shall be in accordance with Table 220.12-A, except that glass or plastic containers of no more than one-half (1/2) gallon capacity may be used for a Class IA or IB flammable liquid if: such liquid either would be rendered unfit for its intended use by contact with metal or would excessively corrode a metal container so as to create a leakage hazard; and the user's process either would require more than one (1) pint of Class IA liquid or more than one (1) quart of a Class IB liquid of a single assay lot to be used at one time, or would require the maintenance of an analytical standard liquid of a quality which is not met by the specified standards of liquids available, and the quantity of the analytical standard liquid required to be used in

any one (1) control process exceeds one-sixteenth (1/16) the capacity of the container allowed under Table 222.02-A for the class or liquid. ()

TABLE 220.12-A					
MAXIMUM ALLOWABLE SIZE OF CONTAINERS AND PORTABLE TANKS					
Container Type	Flammable Liquids			Combustible Liquids	
	Class IA	Class IB	Class IC	Class II	Class III
Glass or approved plastic	1 pt.	1 qt.	1qt.	1 qt.	1 qt.
Metal (other than DOT drums)	1 gal.	5 gal.	5 gal.	5 gal.	5 gal.
Safety cans	2 gal.	5 gal.	5 gal.	5 gal.	5 gal.
Metal drums (DOT spec).	60 gal.	60 gal.	60 gal.	60 gal.	60 gal.
Approved portable tanks	660 gal.	660 gal.	660 gal.	660 gal.	660 gal.

f. Not more than sixty (60) gallons of Class I or Class II liquids nor more than one-hundred twenty (120) gallons of Class III liquids may be stored in a storage cabinet. ()

g. Storage cabinets shall be designed and constructed to limit the internal temperature to not more than three-hundred twenty-five (325) degrees Fahrenheit when subjected to a ten (10) minute fire test using the standard time-temperature curve as set forth in Standard Methods of Fire Tests of Building Construction and Materials, NFPA 251. ()

h. Cabinets shall be labeled "Flammable -- Keep Fire Away", to meet specifications set forth in Section 170 of this standard. ()

i. Metal cabinets constructed in the following manner shall be deemed to be in compliance. The bottom, top, door and sides of cabinet shall be at least no. eighteen (18) gage sheet iron and double walled with one and one-half (1 1/2) inch air space. Joints shall be riveted, welded or made tight by some equally effective means. The door shall be provided with a three (3) point latch, and the door sill shall be raised at least two (2) inches above the bottom of the cabinet. ()

j. Wooden cabinets constructed in the following manner shall be deemed in compliance . The bottom, sides, and top shall be constructed of an approved grade of plywood at least one (1) inch in thickness, which shall not break down or delaminate under fire conditions. All joints shall be rabbetted and shall be fastened in two (2) directions with flathead wood screws. When more than one door is used, there shall be a rabbetted overlap of not less than one (1) inch. Hinges shall be mounted in such a manner as not to lose their holding capacity due to loosening or burning out of the screws when subjected to the fire test. ()

13. Inside Storage Rooms. ()

a. Inside storage rooms shall be constructed to meet the required fire-resistive rating for their use. Such construction shall comply with the test specifications set forth in Standard Methods of Fire Tests of Building Construction and Materials, NFPA 251. Automatic sprinkler system, where required, shall be designed and installed in an acceptable manner. Openings to other rooms or buildings shall be provided with noncombustible liquid-tight raised sills or ramps at least four (4) inches below the surrounding floor. Openings shall be provided with approved self-closing fire doors. The room shall be liquid tight where the walls join the floor. A permissible alternate to the sill or ramp is an open grated trench inside of the room which drains to a safe location (not the sewerage system). Where other portions of the building or other properties are exposed, windows shall be protected as set forth in the Standard for Fire Doors and Windows NFPA no. 80, for Class E or F openings. Wood at least one (1) inch nominal thickness

may be used for shelving, racks, dunnage, scuff-boards, floor overlay, and similar installations. ()

b. Storage in inside storage rooms shall comply with Table 220.13-A. ()

TABLE 220.13-A			
STORAGE IN INSIDE ROOMS			
Fire protection ¹ provided	Fire resistance	Maximum size	Total allowable quantities (gals./sq. ft./ floor area)
Yes	2 hours	500 sq. ft.	10
No	2 hours	500 sq. ft.	4
Yes	1 hour	150 sq. ft.	5
No	1 hour	150 sq. ft.	2

¹Fire protection system shall be sprinkler, water spray, carbon dioxide, or other system.

()

c. Electrical wiring and equipment located in inside storage rooms used for Class I liquids shall be approved under section 150 of this standard and the National Electric Code (NEC) for Class I Division 2 Hazardous Location; for Class II and Class III liquids, shall be approved for general use. ()

d. Every inside storage room shall be provided with either a gravity or a mechanical exhaust ventilation system. Such system shall be designed to provide for a complete change of air within the room at least six (6) times per hour. If a mechanical exhaust system is used, it shall be controlled by a switch located outside of the door(s). The ventilation equipment and any lighting fixtures shall be operated by the same switch. A pilot light shall be installed adjacent to the switch if Class I flammable liquids are dispensed within the room. Where gravity ventilation is provided the fresh air intake, as well as the exhaust outlet from the rooms, shall be on the exterior of the building in which the room is located. ()

e. In every inside storage room there shall be maintained one (1) clear aisle at least three (3) feet wide. Containers over thirty (30) gallons capacity shall not be stacked one upon the other. Dispensing shall be by approved pump or self-closing faucet only. ()

14. Storage Inside a Building. ()

a. Flammable or combustible liquids, including stock for sale, shall not be stored so as to limit use of exits, stairways, or areas normally used for the safe egress of people. ()

b. The storage of flammable or combustible liquids in containers or portable tanks shall comply with Subsection 220.12. of this section. ()

c. Storage of Class I and II over ten (10) gallons shall be prohibited in office occupancies, except that which is required for maintenance and operation of building and operation of equipment. Such storage shall be kept inclosed metal containers stored in a storage cabinet or in safety cans or in an inside storage room not having a door that opens into that portion of the building used by the public. ()

d. Storage in mercantile occupancies and other retail stores shall be as follows:
 In rooms or areas accessible to the public, storage shall be limited to quantities needed for display and normal merchandising purposes but shall not exceed two (2) gallons per square foot of gross floor area. The gross floor area

used for computing the maximum quantity permitted shall be considered as that portion of the store actually being used for merchandising flammable and combustible liquids. Where the aggregate quantity of additional stock exceeds sixty (60) gallons of Class IA, of one-hundred twenty (120) gallons of class IB, or one-hundred eighty (180) gallons of Class IC, or two-hundred forty (240) gallons of Class II or five-hundred (500) gallons of Class III liquids, or any combination of Class I and Class II liquids exceeding two-hundred forty (240) gallons, it shall be stored in a room or portion of the building that complies with the construction provisions for an inside storage room as prescribed in Subsection 220.13 of this section. For water miscible liquids, these quantities may be doubled. Containers in a display area shall not be stacked more than three (3) feet or two (2) containers high, whichever is greater, unless the stacking is done on fixed shelving or is otherwise satisfactorily secured. Shelving shall be of stable construction, or sufficient depth and arrangement such that containers displayed thereon shall not be easily displaced. Leaking containers shall be removed to a storage room or taken to a safe location outside the building and the contents transferred to an undamaged container. ()

e. Storage in general purpose public warehouses shall be in accordance with Table 220.14-A or 220.14-B and in buildings or in portions of such buildings cut off by standard fire-walls. Material creating no fire exposure hazard to the flammable or combustible liquids may be stored in the same area. ()

TABLE 220.14-A					
INDOOR CONTAINER STORAGE					
Class liquid	Storage level	Protected storage maximum per pile		Unprotected storage maximum per pile	
		Gal.	Ht.	Gal.	Ht.
IA	Ground and upper floors	2,750 (50)	3 ft (1)	660 (12)	3 ft. (1)
	Basement	Not permitted		Not permitted	
IB	Ground and upper floors	5,500 (100)	6 ft. (2)	1,375 (25)	3 ft. (1)
	Basement	Not permitted		Not permitted	
IC	Ground and upper floors	16,500 (300)	6 ft. (2)	4,125 (75)	3 ft. (1)
	Basement	Not permitted		Not permitted	
II	Ground and upper floors	16,500 (300)	9 ft. (3)	4,125 (75)	9 ft. (3)
	Basement	5,500 (100)	9 ft. (3)	Not permitted	
III	Ground and upper floors	55,000 (1,000)	15 ft. (5)	13,750 (250)	12 ft. (4)
	Basement	8,250 (450)	9 ft. (3)	Not permitted	
Note 1: When 2 or more classes of materials are stored in a single pile, the maximum gallonage permitted in that pile shall be the smallest of the 2 or more separate maximum gallonages.					
Note 2: Aisles shall be provided so that no container is more than 12 ft. from an aisle. Main aisles shall be at least 8 ft. wide and side aisles at least 4 ft. w (Numbers in parentheses indicate corresponding number of 55-gal. drums.)					
Note 3: Each pile shall be separated from each other by at least 4 ft.					

TABLE 220.14-B					
INDOOR PORTABLE TANK STORAGE					
Class liquid	Storage level	Protected storage maximum per pile		Unprotected storage maximum per pile	
		Gal.	Ht.	Gal.	Ht.
IA	Ground and upper floors	Not permitted		Not permitted	
	Basement	Not permitted		Not permitted	
IB	Ground and upper floors	20,000	7 ft.	2,000	7 ft.
	Basement	Not permitted		Not permitted	
IC	Ground and upper floors	40,000	14 ft.	5,500	7 ft.
	Basement	Not permitted		Not permitted	
II	Ground and upper floors	40,000	14 ft.	5,500	7 ft.
	Basement	20,000	7 ft.	Not permitted	
III	Ground and upper floors	60,000	14 ft.	22,000	7 ft.
	Basement	20,000	7 ft.	Not permitted	

Note 1: When 2 or more classes of materials are stored in a single pile, the maximum gallonage permitted in that pile shall be the smallest of the 2 or more separate maximum gallonages.

Note 2: Aisles shall be provided so that no portable tank is more than 12 ft. from an aisle. Main aisles shall be at least 8 ft. wide and side aisles at least 4 ft. wide.

Note 3: Each pile shall be separated from each other by at least 4 ft.

f. Flammable and combustible liquid warehouses or storage buildings located fifty (50) feet or less from a building or line of adjoining property that may be built upon, the exposing wall shall be a blank wall having a fire-resistance rating of at least two (2) hours. ()

g. The total quantity of liquids within warehouses or storage buildings shall not be restricted, but the arrangement of storage shall comply with tables 220.14A and 220.14-B. ()

h. Containers in piles within warehouses or storage buildings shall be separated by pallets or dunnage where necessary to provide stability and to prevent excessive stress on container walls. ()

i. Portable tanks within warehouses or storage buildings stored over one (1) tier high shall be designed to nest securely, without dunnage and adequate materials handling equipment shall be available to handle tanks safely at the upper tier level. ()

j. In warehouses or storage buildings no pile shall be closer than three (3) feet to the nearest beam, chord, girder, or other obstruction, and shall be three (3) feet below sprinkler deflectors or discharge orifices of water spray, or other over head fire protection systems. ()

k. Aisles of at least three (3) feet wide shall be provided where necessary for reasons of access to doors, windows or standpipe connections. ()

15. Storage Outside of Buildings. ()

a. Storage outside buildings shall be in accordance with Table 220.15-A and 220.15-B and Subsections 220.15.b. and d. of this section. ()

TABLE 220.15-A				
OUTDOOR CONTAINER STORAGE				
1 Class	2 Maximum per pile (see note 1)	3 Distance between piles (see note 2)	4 Distance to property line that can be built upon (see notes 3 & 4)	5 Distance to street, alley, public way (see note 4)
	gal.	ft.	ft.	ft.
IA	1,100	5	20	10
IB	2,200	5	20	10
IC	4,400	5	20	10
II	8,800	5	10	5
III	22,000	5	10	5
Note 1: When 2 or more classes of materials are stored in a single pile, the maximum gallonage in that pile shall be the smallest of the 2 or more separate gallonages.				
Note 2: Within 200 ft. of each container, there shall be 12 ft. wide access way to permit approach of fire control apparatus.				
Note 3: The distances listed apply to properties that have protection for exposures as defined. If there are exposures, and such protection for exposures does not exist, the distances in column 4 shall be doubled.				
Note 4: When total quantity stored does not exceed 50 percent of maximum per pile, the distances in columns 4 and 5 may be reduced 50 percent, but not less than 3 ft.				

TABLE 220.15-B				
OUTDOOR PORTABLE TANK STORAGE				
1 Class	2 Maximum per pile	3 Distance between piles	4 Distance to property line that can be built upon	5 Distance to street, alley, public way
	gal.	ft.	ft.	ft.
IA	2,200	5	20	10
IB	4,400	5	20	10

TABLE 220.15-B				
OUTDOOR PORTABLE TANK STORAGE				
IC	8,800	5	20	10
II	17,600	5	10	5
III	44,000	5	10	5
Note 1: When 2 or more classes of materials are stored in a single pile, the maximum gallonage in that pile shall be the smallest of the 2 or more separate gallonages.				
Note 2: Within 200 ft. of each portable tank, there shall be a 12 ft. wide access way to permit approach of fire control apparatus.				
Note 3: The distances listed apply to properties that have protection for exposures as defined. If there are exposures, and such protection for exposures does not exist, the distances in column 4 shall be doubled.				
Note 4: When total quantity stored does not exceed 50 percent of maximum per pile, the distances in columns 4 and 5 may be reduced 50 percent, but not less than 3 ft.				

b. A maximum of one-thousand one-hundred (1,100) gallons of flammable or combustible liquids may be located adjacent to buildings located on the same premises and under the same management, provided the following: The building shall be a one (1) story building devoted principally to the handling and storing of flammable or combustible liquids or the building shall have two (2) hour fire-resistive exterior walls having no opening within ten (10) feet of such storage. Where quantity stored exceeds one-thousand one-hundred (1,100) gallons, or the afore mentioned provisions of this subsection cannot be met, a minimum distance of ten (10) feet between buildings and nearest container of flammable or combustible liquid shall be maintained. ()

c. The storage area shall be graded in a manner to divert possible spills away from buildings or other exposures or shall be surrounded by a curb at least six (6) inches high. When curbs are used, provisions shall be made for draining of accumulations of ground or rain water or spills of flammable or combustible liquids. Drains shall terminate at a safe location and shall be accessible to operation under fire conditions. ()

d. The storage area shall be protected against tampering or trespassers where necessary and shall be kept free of weeds, debris, and other combustible material not necessary to the storage. ()

16. Fire Control. ()

a. Suitable fire control devices, such as small hose or portable fire extinguishers shall be available at locations where flammable or combustible liquids are stored. ()

b. At least one (1) portable fire extinguisher having a rating of not less than forty (40) B units shall be located outside of, but not more than ten (10) feet from, the door opening into any room used for storage. ()

c. At least one (1) portable fire extinguisher having a rating of not less than forty (40) B units must be located not less than ten (10) feet, nor more than twenty-five (25) feet, from any Class I or Class II liquid storage area located outside of a storage room but inside a building. ()

d. When sprinklers are provided, they shall be installed in accordance with section 063 of this standard. ()

e. Open flames and smoking shall not be permitted in flammable or combustible liquid storage areas. ()

f. Materials which will react with water shall not be stored in the same room with flammable or

combustible liquids. ()

17. Industrial Operations. ()

a. This subsection shall apply to those industrial operations where: the use of flammable or combustible liquids is incidental to the principle operation, such as automobile assembly, construction of electronic equipment, furniture manufacturing, or other similar activities, or where flammable or combustible liquids are handled or used only in unit physical operations such as mixing, drying, evaporating, filtering, distillation, and similar operations which do not involve chemical reaction. This section shall not involve chemical plants, refineries, or distilleries. ()

b. The quantity of liquid that may be located outside of an inside storage room or storage cabinet in a building or in anyone fire area of a building shall not exceed: twenty-five (25) gallons of Class IA liquids in containers; one-hundred twenty (120) gallons of Class IB, IC, II or III liquids in containers; six-hundred sixty (660) gallons of Class IB, IC, II, or III liquids in a single portable tank. ()

c. Where large quantities of flammable or combustible liquids are necessary, storage may be in tanks which shall comply with the applicable requirements of Subsection 220.04 of this section. ()

d. Areas in which flammable or combustible liquids are transferred from one tank or container to another container shall be separated from other operations in the building by adequate distance or by construction having adequate fire resistance. Drainage or other means shall be provided to control spills. Adequate natural or mechanical ventilation shall be provided. ()

e. Flammable liquids shall be kept in covered containers when not actually in use. ()

f. Where flammable or combustible liquids are used or handled, except in closed containers, means shall be provided to dispose promptly and safely of leakage or spills. ()

g. Class I liquids may be used only where there are no open flames or other sources of ignition within the possible path of vapor travel. ()

h. Flammable or combustible liquids shall be drawn from or transferred into vessels, containers or portable tanks within a building only through a closed piping system, from safety cans, by means of a device drawing through the top, or from a container or portable tanks by gravity through an approved self-closing valve. Transferring by means of air pressure on the container or portable tanks shall be prohibited. ()

i. Industrial operations shall be located so that each building or unit of equipment is accessible from at least one side for fire fighting and fire control purposes. ()

j. Buildings shall be located with respect to lines of adjoining property which may be built upon as set forth in accordance with Table 220.17-A. ()

TABLE 220.17-A		
Processing vessels with emergency relief venting to permit pressure	Stable Liquids	Unstable liquids
Not in excess of 2.5 p.s.i.g.	Table 220.05-A	2 1/2 times Table 220.05-A
Over 2.5 p.s.i.g.	1 1/2 times Table 220.05-A	4 times Table 220.05-A

k. EXCEPTION: The distance required in Subsection 220.17.j. of this section may be waived when

the vessels are housed within a building and the exterior wall facing the line of adjoining property which may be built upon is a blank wall having a fire-resistance rating of not less than two (2) hours. When Class IA or unstable liquids are handled, the blank wall shall have explosion resistance in accordance with good engineering practices. ()

l. Areas where unstable liquids are handled or small scale unit chemical processes are carried on shall be separated from the remainder of the facility by a fire wall of two (2) hour minimum fire resistance rating. ()

m. Emergency drainage systems shall be provided to direct flammable or combustible liquid leakage and fire protection water to a safe location. This may require curbs, scuppers, or special drainage systems to control the spread of fire. ()

n. Emergency drainage systems, if connected to public sewers or discharged into public waterways, shall be equipped with traps or separators. ()

o. The industrial operation shall be designed and operated to prevent the normal discharge of flammable or combustible liquids into public waters, public sewers, or adjoining property. ()

p. Areas as defined in this subsection using Class I liquids shall be ventilated at a rate of not less than one (1) cubic foot per minute per square foot of solid floor area. This shall be accomplished by natural or mechanical ventilation with discharge or exhaust to a safe location outside of the building. Provisions shall be made for introduction of makeup air in such a manner as not to short circuit the ventilation. Ventilation shall be arranged to include all floor areas or pits where flammable vapors may collect. ()

q. Equipment used in a building and the ventilation of the building shall be designed so as to limit flammable vapor-air mixtures under normal operation conditions to the interior of equipment, and to not more than five (5) feet from equipment which exposes Class I liquids to the air. Examples of such equipment are dispensing stations, open centrifuges, plate and frame filters, open vacuum filters, and surfaces of open equipment. ()

r. The storage, transfer, and handling of liquid shall comply with other portions of this section along with the following: an approved flexible connector may be used where vibration exists or where frequent movement is necessary; an approved hose may be used at transfer stations; piping containing flammable or combustible liquids shall be identified; the transfer of large quantities of flammable or combustible liquids shall be through piping by means of pumps or water displacement; except as required in process equipment, gravity flow shall not be used; the use of compressed air as a transferring medium is prohibited; positive displacement pumps shall be provided with pressure relief discharging back to the tank or to pump suction; equipment shall be designed and arranged to prevent the unintentional escape of liquids and vapors and to minimize the quantity escaping in the event of accidental release. ()

s. Rooms in which flammable or combustible liquids are stored or handled by pumps shall have exit facilities arranged to prevent occupants from being trapped in the event of fire. ()

t. Where the vapor space of equipment is usually within the flammable range, the probability of explosion damage to the equipment can be limited by inerting, by providing an explosion suppression system, or by designing the equipment to contain the peak explosion pressure which may be modified by explosion relief. Where the special hazards of operation, sources of ignition, or exposures indicate a need, consideration shall be given to providing protection by one (1) or more of the above means. ()

u. Portable fire extinguishment and control equipment shall be provided in such quantities and types as are needed for the special hazards of operations and storage. ()

v. Water shall be available in volume and at an adequate pressure to supply water hose streams, foam-producing equipment, automatic sprinklers, or water spray systems as the need is indicated by the special hazards of operations, dispensing, and storage. ()

w. Special extinguishing equipment such as that utilizing foam, inert gas, or dry chemical shall be provided as the need is indicated by the special hazards of operations, dispensing, and storage. ()

x. Where the need is indicated by special hazards of operation, flammable or combustible liquid processing equipment, major piping, and supporting steel shall be protected by approved water spray, deluge systems, approved fire resistant coating, insulation, or any combination of these. ()

y. All facility fire protection facilities shall be adequately maintained and periodically inspected and tested to make sure they are always in satisfactory operating condition, and will serve their purpose in time of emergency. ()

18. Electrical. ()

a. All electrical wiring and equipment shall be installed according to the requirements of section 150 of this standard and the National Electrical Code (NEC). ()

b. Locations where flammable vapor-air mixtures may exist under normal operations shall be classified Class I Division I according to the requirements of section 150 of this standard and the National Electrical Code (NEC). For those pieces of equipment installed in accordance with Subsection 220.17.q., the Division I area shall extend five (5) feet in all directions from all points of vapor liberation. All areas within pits shall be classified Division I if any part of the pit is within a Division I or II classified area, unless the pit is provided with mechanical ventilation. ()

c. Locations where flammable vapor-air mixtures may exist under abnormal conditions and for a distance beyond Division I locations shall be classified Division II according to the requirements of Section 150 of this standard and the National Electrical Code (NEC). These locations include an area within twenty (20) feet horizontally, three (3) feet vertically beyond a Division I area, and up to three (3) feet above floor or grade level within twenty-five (25) feet, if indoors, or ten (10) feet if outdoors, from any pump, bleeder, withdrawal fitting, meter, or similar device handling Class I liquids. Pits provided with adequate mechanical ventilation within a Division I or II area shall be classified Division II. If class II or Class III liquids only are handled, then ordinary electrical equipment is satisfactory though care shall be used in locating electrical apparatus to prevent hot metal from falling into open equipment. ()

d. Where the provisions of Subsection 220.18.a., b., and c. of this Subsection require the installation of electrical equipment suitable for Class I, Division I or Division II locations, ordinary electrical equipment including switch gear may be used if installed in a room or enclosure which is maintained under positive pressure with respect to the hazardous area. Ventilation makeup air shall be uncontaminated by flammable vapors. ()

e. So far as it applies Table 220.05-A shall be used to delineate and classify hazardous areas for the purpose of installation of electrical equipment under normal circumstances. In Table 224.18-A a classified area shall not extend beyond an unpierced wall, roof, or other solid partition. The area classifications listed shall be based on the premise that the installation meets the applicable requirements of this section in all respects. ()

TABLE 220.18-A		
ELECTRICAL EQUIPMENT HAZARDOUS AREAS		
LOCATION	NEC Class I Group D Division	EXTENT OF CLASSIFIED AREA
TANK VEHICLE AND TANK CAR: ¹		
Loading through open dome	I	Within 3 feet of edge of dome, extending in all directions.
	II	Area between 3 feet and 5 feet from edge of dome, extending in all directions

TABLE 220.18-A		
ELECTRICAL EQUIPMENT HAZARDOUS AREAS		
Loading through bottom connections with atmospheric venting	I	Within 3 feet of point of venting to atmosphere, extending in all directions.
	II	Area between 3 feet and 5 feet from point of venting to atmosphere, extending in all directions. Also up to 18 inches above grade within a horizontal radius of 10 feet from point of loading connection.
Loading through closed dome with atmospheric venting	I	Within 3 feet of open end of vent, extending in all directions.
	II	Area between 3 feet and 5 feet from open end of vent, extending in all directions. Also within 3 feet of edge of dome, extending in all directions.
Loading through closed dome with vapor recovery	II	Within 3 feet of point of connection of both fill and vapor lines, extending in all directions
Bottom loading with vapor recovery or any bottom unloading	II	Within 3 feet of point of connections extending in all directions. Also up to 18 inches above grade within horizontal radius of 10 feet from point of connection.
DRUM AND CONTAINER FILLING:		
Outdoors, or indoors with adequate ventilation.	I	Within 3 feet of vent and fill opening, extending in all directions.
	II	Area between 3 feet and 5 feet from vent or fill opening, extending in all directions. Also up to 18 inches above floor or grade level within a horizontal radius of 10 feet from vent or fill opening.
Tank - Above ground		
Shell, ends, or roof and dike area	II	Within 10 feet from shell, ends, or roof of tank. Area inside dikes to level of top of dike.
Vent	I	Within 5 feet of open end of vent, extending in all directions.
	II	Area between 5 feet and 10 feet from open end of vent, extending in all directions.
Floating roof	I	Area above the roof and within the shell.
Pits		
Without mechanical ventilation	I	Entire area within pit if any part is within a Division I or II classified area.
With mechanical ventilation	II	Entire area within pit if any part is within a Division I or II classified area.
Containing valves, fittings, or piping, and not within a Division I or II classified area.	II	Entire pit.

TABLE 220.18-A		
ELECTRICAL EQUIPMENT HAZARDOUS AREAS		
Pumps, bleeders, withdrawal fittings, meters, and similar devices		
Indoors	II	Within 5 feet of any edge of such devices, extending in all directions. Also up to 3 feet above floor or grade level within 25 feet horizontally from any edge of such devices.
Outdoors	II	Within 3 feet of any edge of such devices, extending in all directions. Also up to 18 inches above grade level within 10 feet horizontally from any edge of such devices.
Storage and repair garage for tank vehicles	I	All pits or spaces below floor level.
	II	Area up to 18 inches above floor or grade level for entire storage or repair garage.
Drainage ditches, separators, impounding basins	II	Area up to 18 inches above ditch, separator, or basin. Also up to 18 inches above grade within 15 feet horizontally from any edge.
Garages for other than tank vehicles	Ordinary	If there is any opening to these rooms within the extent of an outdoor classified area, the entire room shall be classified the same as the area classification at the point of the opening.
Out door drum storage	Ordinary	
Indoor warehousing where there is not flammable liquid transfer	Ordinary	If there is any opening to these rooms within the extent of an indoor classified area, the room shall be classified the same as if the wall, curb or partition did not exist.
Office and rest rooms	Ordinary	
¹ When classifying the extent of the area, consideration shall be given to the fact that tank cars or tank vehicles may be spotted at varying points. Therefore, the extremities of the loading or unloading positions shall be used		

19. Repairs to Equipment. ()

a. Hot work, such as welding or cutting operations, use of spark producing power tools, and chipping operations shall be permitted only under supervision of an individual in responsible charge. The individual in responsible charge shall make an inspection of the area to be sure that it is safe for the work to be done and that safe procedures will be followed for the work specified. ()

20. Housekeeping. ()

a. Maintenance and operating practices shall be in accordance with established procedures which will tend to control leakage and prevent the accidental escape of flammable or combustible liquids. Spills shall be cleaned up promptly. ()

b. Adequate aisles shall be maintained for unobstructed movement of personnel and so that fire protection equipment can be brought to bear on any part of flammable or combustible liquid storage, use, or any unit physical operation. ()

c. Combustible waste material and residues in a building or unit operating areas shall be kept to a minimum, stored in covered metal receptacles, and disposed of daily. ()

d. Ground area around buildings and unit operation areas shall be kept free of weeds, trash, or other

unnecessary combustible materials. ()

e. Crankcase drainings and flammable or combustible liquid spills shall be cleaned up promptly and shall not be dumped into sewers. ()

f. Crankcase drainings and flammable or combustible liquid shall be stored in accordance with the provisions of this section in tanks or drums until removed from the premises. ()

21. Tank Vehicle and Tank Car Loading and Unloading. ()

a. Tank vehicle and tank care loading or unloading facilities shall be separated from above ground tanks, warehouses, other buildings or nearest line of adjoining property which may be built upon by a distance of twenty-five (25) feet for Class I liquids and fifteen (15) feet for Class II and Class III liquids measured from the nearest position of any fill stem. Buildings for pumps or shelters for personnel may be a part of the facility. ()

22. Service stations. ()

a. Above ground tanks, located in an adjoining bulk plant, may be connected by piping to service station underground tanks if, in addition to valves at above-ground tanks, a valve is also installed within control of service station personnel. ()

b. Apparatus dispensing class I liquids into the fuel tanks of motor vehicles of the public shall not be located at a bulk facility unless separated by a fence or similar barrier from the area in which bulk operations are conducted. ()

c. The provisions of this section shall not prohibit the dispensing of flammable liquids in the open from a tank vehicle to a motor vehicle or aircraft. Such dispensing shall be permitted provided: The tank vehicle complies with the requirements covered in the Standard on Tank Vehicles for Flammable Liquids, NFPA 385. The dispensing is done on premises not open to the public. The dispensing hose does not exceed fifty (50) feet in length. The dispensing nozzle is a listed automatic-closing type without a latch-open device. Both vehicles are grounded and the vehicles are bonded to each other. ()

d. Class I liquids shall not be stored or handled within a building having a basement or pit into which flammable vapors may travel, unless such area is provided with ventilation designed to prevent the accumulation of flammable vapors therein. ()

e. Accurate inventory records shall be maintained and reconciled on all flammable or combustible liquid storage tanks for possible indication of leakage from tanks or piping. ()

f. When installation of tanks in accordance with Subsection 220.05. through 220.06 of this section, is impractical because of property or building limitations, tanks for flammable or combustible liquids may be installed in buildings if properly enclosed. The enclosure shall be substantially liquid and vapor tight without backfill. Sides, top, and bottom of the enclosure shall be of reinforced concrete at least six (6) inches thick, with openings for inspection through the top only. Tank connections shall be so piped or closed that neither vapors nor liquid can escape into the enclosed space. Means shall be provided whereby portable equipment may be employed to discharge to the outside any liquid or vapors which might accumulate should leakage occur. ()

g. At automotive service stations provided in connection with tenant or customer parking facilities at or below grade level in large buildings of commercial, mercantile, or residential occupancy, tanks containing Class I liquids, installed of necessity in accordance with Subsection 220.22.f. above, shall not exceed ten-thousand (10,000) gallons individual or forty-thousand (40,000) gallons aggregate capacity. ()

h. Except where stored in tanks as provided in Subsection 220.22.f. of this subsection, no Class I liquids shall be stored within any service station building except in closed containers of aggregate capacity not exceeding sixty (60) gallons capacity. One (1) container not exceeding sixty (60) gallons capacity equipped with an approved pump is permitted. ()

- i. Class I liquids may be transferred from one (1) container to another in lubrication or service rooms of a service station building provided the electrical installation complies with Table 220.18-A and provided that any heating equipment complies with Subsection 220.03.d. of this section. ()
- j. Class II and Class III liquids may be stored and dispensed inside service station buildings from tanks of not more than one-hundred twenty (120) gallons capacity each. ()
- k. Containers shall be clearly marked with the name of the product contained. ()
- l. No delivery of any Class I liquid shall be made into portable containers unless the container is constructed of metal has a tight closure with screwed or spring cover, and is fitted with a spout or so designed that the contents can be poured without spilling. ()
- m. Service stations not accessible to or open to the public do not require an attendant or supervisor. Such stations may be used by commercial, industrial, governmental, or manufacturing establishments. ()
- n. Dispensing devices at automotive service stations shall be so located that all parts of the vehicle being serviced will be on the premises of the service station. ()
- o. Approved dispensing units may be located inside of buildings. The dispensing area shall be separated from other areas in an approved manner. The dispensing unit and its piping shall be mounted on a concrete island and protected against collision damage by suitable means and shall be located in a position where it cannot be struck by a vehicle descending a ramp or other slope out of control. The dispensing area shall be provided with an approved mechanical or gravity ventilation system. When dispensing units are located below grade, only approved mechanical ventilation shall be used and the entire dispensing area shall be protected by an approved automatic sprinkler system. Ventilating systems shall be electrically interlocked with gasoline dispensing units so that the dispensing units cannot be operated unless the ventilating fan motors are energized. ()
- p. A clearly identified and easily accessible switch(es) or a circuit breaker(s) shall be provided at a location remote from dispensing devices, including remote pumping systems, to shut off the power to all dispensing devices in the event of an emergency. ()
- q. Class I liquids shall be transferred from tanks only by means of fixed manual or powered pumps so designed and equipped as to allow control of the flow and prevent leakage or accidental discharge. ()
- r. Only listed devices may be used for dispensing class I liquids. No such device shall be used if it shows evidence of having been dismantled. Every dispensing device for Class I liquids installed after December 31, 1978, shall contain evidence of listing so placed that any attempt to dismantle the device will result in damage to such evidence, visible without disassembly or dismantling of the nozzle. ()
- s. Class I liquids shall not be dispensed by pressure or gravity from drums, barrels, tanks, and similar containers. Approved pumps taking suction through the top of the container with approved self-closing nozzles shall be used. ()
- t. The dispensing units, except those attached to containers, shall be mounted on a concrete island and protected against collision damage by suitable means. Dispensing units and their containers shall be protected against collision damage by suitable means. ()
- u. Pumps for remote pumping systems shall be designed or equipped so that no part of the system will be subjected to pressures above its allowable working pressure. Pumps installed above grade, outside of buildings, shall be located not less than ten (10) feet from lines of adjoining property which is or may be built upon, and not less than five (5) feet from any building opening. When an outside pump location is impractical, pumps may be installed inside of buildings as provided for dispensers in Subsection 220.22.o. of this section, or in pits as provided in Subsection 220.22.v. of this section. Pumps shall be substantially anchored and protected against physical damage by vehicles. ()
- v. Pits for subsurface pumps or piping manifolds of submersible pumps shall withstand the external

forces to which they may be subjected without damage to the pump, tanks, or piping. The pit shall be no larger than necessary for inspection and maintenance and shall be provided with a fitted cover. ()

w. A control shall be provided that will permit the remote pump to operate only when a dispensing nozzle is removed from its bracket on the dispensing unit and the switch on this dispensing unit is manually actuated. This control shall also stop the remote pump when all nozzles have been returned to their brackets. ()

x. An approved impact valve, incorporating a fusible link, designed to close automatically in the event of severe impact or fire exposure shall be properly installed in the dispensing supply line at the base of each individual dispensing device. ()

y. After the completion of the installation, including any paving, that section of the pressure piping system between the pump discharge and the connection for the dispensing facility shall be tested for at least thirty (30) minutes at the maximum operating pressure of the system. Such tests shall be repeated at five (5) year intervals thereafter. ()

z. Hose-nozzle valves of either the manual or automatic closing type for dispensing Class I liquids into a fuel tank or into a container shall be manually held open during the dispensing operation except as herein provided, a listed automatic type nozzle with hold-open latch is permitted. ()

aa. Emergency controls shall be installed at an acceptable location, but controls shall not be more than one-hundred (100) feet from dispensers. ()

bb. Instructions for the operation of dispensers shall be conspicuously posted. ()

cc. In addition to the previous restrictions of this section, the following shall apply: there shall be no smoking or open fumes in the areas used for fueling, servicing fuel systems for internal combustion engines, and receiving or dispensing of flammable or combustible liquids. Conspicuous and legible signs prohibiting smoking shall be posted within sight of the customer being served. The motors of all equipment being field shall be shut off during the fueling operation. ()

dd. Provisions shall be made in the area where Class I liquids are dispensed to prevent spilled liquids from flowing into the interior of service station buildings. Such provision may be by grading driveways, raising door sills, or other equally effective means. ()

ee. Each service station shall be provided with at least one (1) fire extinguisher having a minimum approved classification of 10 B, C located so that an extinguisher will be within seventy-five (75) feet of each pump, dispenser, underground fill pipe opening, and lubrication or service room. ()

23. Marine Service Stations. ()

a. The dispensing area shall be located away from other structures so as to provide room for safe ingress and egress of craft to be fueled. Dispensing units shall in all cases be at least twenty (20) feet from any activity involving fixed sources of ignition. ()

b. Dispensing shall be by approved dispensing units with or without integral pumps and may be located on open piers, wharves, floating docks, on shore, or on piers of the solid fill type. ()

c. Dispensing nozzles shall be automatic-closing without a hold-open latch. ()

d. Tanks and pumps not integral with the dispensing unit, shall be on shore or on a pier of the solid fill type, except as provided below. Pumps shall be substantially anchored and protected against physical damage by vehicles. ()

e. Where a shore location would require excessively long supply lines to dispensers, tanks may be installed on a pier provided that applicable portions of this section relative to spacing, diking, and piping, are complied with and the quantity so stored does not exceed one-thousand one-hundred (1,100) gallons aggregate

capacity. ()

f. Shore tanks supplying marine service stations may be located above ground where rock ledge or high water table make underground tanks impractical. ()

g. Where tanks are at an elevation which would produce gravity head on the dispensing unit, the tank outlet shall be equipped with a pressure control valve positioned adjacent to and outside the tank block valve specified in Subsection 220.05.dd. of this section, so adjusted that liquid cannot flow by gravity from the tank in case of piping or hose failure. ()

h. Piping between wharf tanks and dispensing units shall be as described in Subsection 220.11 of this section, except that, where dispensing is from a floating structure, suitable lengths of oil-resistive flexible hose may be employed between the shore piping and the piping on the floating structure as made necessary by change in water level or shoreline. ()

i. A readily accessible valve to shut off the supply from shore shall be provided in each pipeline at or near the approach to the pier and at the shore end of each pipeline adjacent to the point where flexible hose is attached. ()

j. Piping shall be located so as to be protected from physical damage. ()

k. Piping handling Class I liquids shall be grounded to control stray currents. ()

l. In addition to the previous restrictions of this section, the following shall apply: there shall be no smoking or open flames in the areas used for fueling, servicing fuel systems for internal combustion engines, and receiving or dispensing of flammable or combustible liquids. Conspicuous and legible signs prohibiting smoking shall be posted within sight of the customer being served. The motors of all equipment being field shall be shut off during the fueling operation. ()

m. Each marine service station shall be provided with at least one (1) fire extinguisher having a minimum approved classification of 10 B, C located so that an extinguisher will be within seventy-five (75) feet of each pump, dispenser, and fill pipe opening. ()

24. Heating Equipment. ()

a. Heating equipment may be installed in a special room separated from an area classified by Table 220.18-A by walls having a fire resistance rating of at least - hour and without any openings in the walls within eight (8) feet of the floor into an area classified in Table 220.18-A. This room shall not be used for combustible storage and all air for combustible purposes shall come from outside the building. ()

b. Heating equipment using gas or oil fuel may be installed in the work areas, lubrication, sales, or service room where there is no dispensing or transferring of Class I liquids provided the bottom of the combustion chamber is at least eighteen (18) inches above the floor and the heating equipment is protected from physical damage by vehicles. Heating equipment using gas or oil fuel listed for use in garages may be installed in the lubrication or service room where Class I liquids are dispensed provided the equipment is installed at least eight (8) feet above the floor. ()

c. Electrical heating equipment shall conform to Subsection 220.18 of this section. ()

221. -- 229. (RESERVED).

230. WELDING, CUTTING, AND BRAZING.

01. Scope. ()

a. Welding, cutting, and brazing shall conform to all other applicable requirements of this standard, as

well as the following provisions. Nothing in this standard shall be construed to prohibit better or otherwise safer conditions than specified herein. ()

02. Definitions Applicable to this Section. ()

a. Welder and welding operator is any operator of electric or gas welding and cutting equipment. ()

b. All other welding terms are used in accordance with American Welding Society terms and definitions - A3.0. ()

03. General Requirements. ()

a. First-aid equipment shall be available at all times. All injuries shall be reported as soon as possible for medial attention. First aid shall be rendered until medical attention can be provided. ()

b. A job hazard analysis shall be made, by qualified personnel, of the operations to be performed to determine the safeguards and personal protective equipment that shall be used for each job. ()

c. Periodic inspection shall be made by qualified maintenance personnel and records of the same maintained. The welder/operator shall be instructed to report any equipment defects to his supervisor and the use of the welding/cutting equipment shall be discontinued until safety repairs have been completed. ()

04. Protection of Employees. ()

a. A welder or helper working on a platform, scaffold or runways shall be protected against falling. This may be accomplished by the use of guard railings, safety belts, life lines, or some other equally effective safeguards. ()

b. Welders shall place welding cable, hoses, and other equipment so that it is clear of passageways, ladders, and stairways. ()

c. Helmets or hand shields shall be used during all arc welding or arc cutting operations, excluding submerged arc welding. Goggles should also be worn during arc welding or cutting operations to provide protection against injurious rays from adjacent work, and from flying objects. The goggles may have either clear or colored glass, depending upon the amount of exposure to adjacent welding operations. Helpers or attendants shall be provided with proper eye protection. ()

d. Goggles or other suitable eye protection shall be used during all gas welding or oxygen cutting operations. Spectacles without side shields, with suitable filter lenses are permitted for use during gas welding operation on light work, for torch brazing or for inspection. ()

e. All operators and attendants of resistance welding or resistance brazing equipment shall use transparent face shields or goggles, depending on the particular job, to protect their faces and eyes, as required. ()

f. Eye protection in the form of suitable goggles shall be provided where needed for brazing operations not covered in Subsection 230.04.c., 230.04.d., and 230.04.e. of this section. ()

g. Helmets and hand shields shall be made of a material which is an insulator for heat and electricity. Helmets, shields and goggles shall be not readily flammable and shall be capable of undergoing sterilization. ()

h. Helmets and hand shields shall be arranged to protect the face, neck and ears from direct radiant energy from the arc. ()

i. Helmets shall be provided with filter plates and cover plates designed for easy removal.()

- j. All parts of eye and face protectors shall be constructed of a material which will not readily corrode or discolor the skin. ()
- k. Goggles shall be ventilated to prevent fogging of the lenses as much as possible. ()
- l. Cover lenses or plates shall be provided to protect each helmet, hand shield or goggle filter lens or plate. ()
- m. All glass for lenses shall be tempered, substantially free from striae, air bubbles, waves and other flaws. Except when a lens is ground to provide proper vision, the front and rear surfaces of lenses and windows shall be smooth and parallel. ()
- n. Lenses shall bear some permanent distinctive marking by which the source and shade may be readily identified. ()
- o. Table 230.04-A is a guide for the selection of the proper shade numbers. These recommendations may be varied to suit the individual's needs. ()

TABLE 230.04-A		
Welding Operation	Shade No.	
Shielded Metal-arc welding - 1/16, 3/32, 1/8, 5/32 - inch electrodes	10	
Gas - shielded arc welding (nonferrous) - 1/16, 3/32, 1/8, 5/32 - inch electrodes	11	
Gas - shielded arc welding (ferrous) - 1/16, 3/32, 1/8, 5/32 - inch electrodes	12	
Shielded metal - arc welding:	3/16, 7/32, 1/4 - inch electrodes	12
	5/16, 3/8 - inch electrodes	14
Atomic hydrogen welding	10 - 14	
Carbon arc welding	14	
Soldering	2	
Torch brazing	3 or 4	
Light cutting, up to 1 inch	3 or 4	
Medium cutting, 1 inch to 6 inches	4 or 5	
Heavy cutting, 6 inches and over	5 or 6	
Gas welding (light) up to 1/8 inch	4 or 5	
Gas welding (medium) 1/8 inch to 1/2 inch	5 or 6	
Gas welding (heavy) 1/2 inch and over	6 or 8	

p. All filter lenses and plates shall meet the test for transmission of radiant energy prescribed in ANSI Z87.1 American National Standard Practice for Occupational and Educational Eye and Face Protection. ()

q. Where work permits, the welder shall be enclosed in an individual booth painted with a finish of low reflectivity such as zinc oxide (an important factor for absorbing ultra-violet radiations) and lamp black, or shall be enclosed with noncombustible screens similarly painted. Booths and screens shall permit circulation of air at floor

level. Workers or other persons adjacent to the welding areas shall be protected from the rays by noncombustible or flame proof screens or shields or shall be required to wear appropriate goggles. ()

r. For the protection of the operators of nearby equipment, fire-resistant curtains or suitable shields shall be set up around welding operations and in such a manner that the welder's movements are not hampered. If the welding process cannot be isolated, all persons who may be exposed to the hazard of arc flash shall be properly protected. ()

s. Employees exposed to the hazards created by welding, cutting, or brazing operations shall be protected by personal protective equipment in accordance with the requirements of Section 050 of this standard. ()

t. Except when engaged in light work, all welders shall wear flameproof gauntlet gloves. ()

u. Flameproof aprons made of leather, or other suitable material shall be worn as protection against radiated heat and sparks. ()

v. Woolen clothing is preferable to cotton because it is not so readily ignited and helps protect the welder from changes in temperature. Cotton clothing, if used, shall be chemically treated to reduce its combustibility. All outer clothing such as jumpers or overalls shall be reasonably free of gas, oil, or grease. ()

w. Sparks may lodge in rolled-up sleeves or pockets of clothing, or cuffs of overalls or trousers. Sleeves and collars shall be kept buttoned and pockets shall be eliminated from the front of overalls and aprons. Trousers or overalls shall not be turned up on the outside. NOTE: For heavy work, fire-resistant leggings, high boots, or other equivalent means shall be used. ()

x. In production work, a sheet metal screen in front of the workers legs can provide further protection against sparks and molten metal in cutting operations. ()

y. Capes or shoulder covers made of leather or other suitable materials should be worn during overhead cutting or welding operations. Leather skull caps may be worn under helmets to prevent head burns. ()

z. For overhead welding and cutting, or welding and cutting in extremely confined spaces, ear protection shall be used. ()

aa. When there is a hazard or exposure to sharp or heavy falling objects, or a hazard of bumping in confined spaces, hard hats or head protectors shall be used. ()

05. Work in Confined Spaces. ()

a. As used herein, confined space is intended to mean a relatively small or restricted space such as a tank, boiler, pressure vessel, etc., and the requirements of Section 043 of this standard shall be complied with. ()

b. Ventilation is a prerequisite to work in confined spaces. For ventilation requirements see Subsection 230.08 of this section. ()

c. When welding or cutting is being performed in any confined spaces the gas cylinders and welding machines shall be left on the outside. Before operations are started, portable equipment mounted on wheels shall be securely blocked to prevent accidental movement. ()

d. Where a welder must enter a confined space through a manhole or other small opening, means shall be provided for quickly removing him in case of emergency. When safety harnesses and lifelines are used for this purpose, they shall be so attached to the welder's body that his body cannot be jammed in a small exit opening. An attendant with a pre-planned rescue procedure shall be stationed outside to observe the welder at all times and be capable of putting rescue operations into effect. ()

e. When arc welding is to be suspended for any substantial period of time, such as during lunch or

overnight, all electrodes shall be removed from the holders and the holders carefully located so that accidental contact cannot occur and the machine disconnected from the power source. ()

f. In order to eliminate the possibility of gas escaping through leaks or improperly closed valves, when gas welding or cutting, the torch valves shall be closed and the fuel-gas and oxygen supply shut off at some point outside the confined area whenever the torch is not to be used for a substantial period of time, such as during lunch hour or overnight. Where practicable, the torch and hose shall also be removed from the confined space. ()

g. After welding operations are completed, the welder shall mark the hot metal or provide some other means of warning other workers. ()

06. Health Protection and Ventilation. ()

a. The requirements in this Subsection have been established on the basis of the following three (3) factors in arc and gas welding which govern the amount of contamination to which welders may be exposed and are as follows: dimensions of space in which welding is to be done (with special regard to height of ceiling); number of welders; and possible evolution of hazardous fumes, gases, or dust according to the metals involved. ()

b. It is recognized that in individual instances other factors may be involved in which case ventilation or respiratory protective devices shall be provided as needed to meet the equivalent requirements of this subsection. Such factors would include: atmospheric conditions; heat Generated; and presence of volatile solvents. ()

c. When welding must be performed in a space entirely screened on all sides, the screens shall be so arranged that no serious restriction of ventilation exists. It is desirable to have the screens so mounted that they are about two (2) feet above the floor unless the work is performed at so low a level that the screen must be extended nearer to the floor to protect nearby workers from the glare of welding. ()

d. Local exhaust or general ventilating systems shall be provided and arranged to keep the amount of toxic fumes, gases, or dusts below the maximum allowable concentration as specified in Section 300 of this standard. NOTE: A number of potentially hazardous materials are employed in fluxes, coatings, coverings, and filler metals used in welding and cutting or are released to the atmosphere during welding and cutting. These include but are not limited to the materials itemized in Subsections 230.09 through 230.16. of this section. ()

e. The employer shall ascertain the potentially hazardous materials, associated with welding, cutting, etc. from the suppliers of welding materials and inform the employees of the same either through signs, labels, or other appropriate means. ()

f. All filler metals and fusible granular materials shall carry the following notice, as a minimum, on tags, boxes, or other containers, "CAUTION" Welding may produce fumes and gases hazardous to health. Avoid breathing these fumes and gases. Use adequate ventilation. See ANSI Z49.1 Safety in Welding and Cutting published by the American Welding Society. ()

g. Brazing (welding filler metals containing significant amounts of cadmium shall carry the following notice on tags, boxes, or other containers: WARNING CONTAINS CADMIUM-POISONOUS FUMES MAY BE FORMED ON HEATING. Do not breathe fumes. Use only with adequate ventilation such as fume collectors, exhaust ventilators, or air supplied respirators. See ANSI Z49.1. If chest pain, cough or fever develops after use, call physician immediately. Keep children away when using. ()

h. Brazing and gas welding fluxes containing fluorine compounds shall have a cautionary wording to indicate that they contain fluorine compounds. One such cautionary wording recommended by the American Welding Society for brazing and gas welding fluxes reads as follows: CAUTION CONTAINS FLUORIDES. This flux when heated gives off fumes that may irritate eyes, nose and throat. Avoid fumes - use only in well ventilated spaces. Avoid contact of flux with eyes or skin. Do not take internally. ()

i. Mechanical ventilation shall be provided when welding and cutting is done on metals not covered in Subsections 230.09 through 230.16 of this section (for specific material, see the ventilation requirements of Subsections 230.09 through 230.16 of this section.) ()

j. Mechanical ventilation shall be provided for in a space of less than ten-thousand (10,000) cubic feet per welder. ()

k. Mechanical ventilation shall be provided in a room having a ceiling height of less than sixteen (16) feet. ()

l. Mechanical ventilation shall be provided for in confined spaces or where the welding space contains partitions, balconies, or other structural barriers to the extent that they significantly obstruct cross ventilation. ()

m. Mechanical ventilation shall be at the minimum rate of two-thousand (2,000) cubic feet per minute per welder, except where local exhaust hoods and booths as per Subsection 230.07 of this section, or airline respirators approved by the U.S. Bureau of Mines for such purposes are provided. Natural ventilation is considered sufficient for welding or cutting operations where the restrictions in Subsection 230.06.i. through 230.06.l. of this section are not present. ()

07. Local Exhaust Hoods and Booths. ()

a. Freely movable hoods intended to be placed by the welder as near as practicable to the work being welded and provided with a rate of airflow sufficient to maintain a velocity in the direction of the hood of one-hundred (100) linear feet per minute in the zone of welding when the hood is at its most remote distance from the point of welding. The rates of ventilation required to accomplish this control velocity using a three (3) inch wide flanged suction opening are shown in Table 230.07-A. ()

TABLE 230.07-A		
Welding zone	Minimum air flow ¹ cubic feet/minutes	Duct diameter inches ²
4 to 6 inches from arc or torch	150	3
6 to 8 inches from arc or torch	275	3 1/2
8 to 10 inches from arc or torch	425	4 1/2
10 to 12 inches from arc or torch	600	5 1/2
¹ When brazing with cadmium bearing materials or when cutting on such materials increased rates of ventilation may be required.		
² Nearest half-inch duct diameter based on 4,000 feet per minute velocity in pipe.		

b. A fixed enclosure with a top and not less than two (2) sides which surround the welding or cutting operation and with a rate of airflow sufficient to maintain a velocity away from the welder of not less than one-hundred (100) linear feet per minute. ()

08. Ventilation in Confined Spaces. ()

a. All welding and cutting operations carried on in confined spaces shall be adequately ventilated to prevent the accumulation of toxic materials or possible oxygen deficiency. This applies not only to the welder, but also to helpers and other personnel in the immediate vicinity. All air replacing that withdrawn shall be clean and respirable. ()

b. In such circumstances where it is impossible to provide such ventilation, airline respirators or hose masks approved by the U.S. Bureau of Mines or NIOSH for this purpose shall be used. ()

c. In areas immediately hazardous to life, hose masks with blowers or self-contained breathing equipment shall be used. The breathing equipment shall be approved by the U.S. Bureau of Mines or NIOSH. ()

d. Where welding operations are carried on in confined spaces and where welders and helpers are provided with hose masks, hose masks with blowers or self-contained breathing equipment approved by the U.S. Bureau of Mines or NIOSH, a worker shall be stationed on the outside of such confined spaces to insure the safety of those working within. ()

e. Oxygen shall not be used for ventilation. ()

09. Fluorine Compounds. ()

a. In confined spaces, welding, or cutting involving fluxes, coverings, or other materials which contain fluorine compounds shall be done in accordance with Subsection 230.08. of this section. A fluorine compound is one that contains fluorine, as an element in chemical combination, not as a free gas. ()

b. The need for local exhaust ventilation or airline respirators for welding or cutting in other than confined spaces will depend upon the individual circumstances. However, experience has shown that such protection is desirable for fixed-location production welding and for all production welding and for all production welding on stainless steels. Where air samples taken at the welding location indicate that the fluorides liberated are below the maximum allowable concentration, such protection is not necessary. ()

10. Zinc. ()

a. In confined spaces welding or cutting involving zinc-bearing base or filler metals or metals coated with zinc-bearing materials shall be done in accordance with Subsection 230.08 of this section. ()

b. Indoors, welding or cutting involving zinc-bearing base or filler metals coated with zinc-bearing materials shall be done in accordance with Subsections 230.07.a. and 230.07.b. of this section. ()

11. Lead. ()

a. In confined spaces, welding involving lead-base metals (erroneously called lead-burning) shall be done in accordance with Subsection 230.08 of this section. ()

b. Indoors, welding involving lead-base metals shall be done in accordance with Subsections 230.07.a. and 230.07.b. of this section. ()

c. In confined spaces or Indoors, welding or cutting involving metals containing lead, other than as an impurity, or involving metals containing lead, or coated with lead-bearing materials, including paint shall be done using local exhaust ventilation or airline respirators. ()

d. Outdoors, welding or cutting involving metals containing lead, other than as an impurity, or involving metals containing lead, or coated with lead-bearing materials, including paint shall be done using respiratory protective equipment approved by the U.S. Bureau of Mines or NIOSH for such purposes. In all cases, workers in the immediate vicinity of the cutting operation shall be protected as necessary by local exhaust ventilation or airline respirators. ()

12. Beryllium. ()

a. Welding or cutting indoors, outdoors, or in confined spaces involving beryllium-containing base or filler metals shall be done by using local exhaust ventilation and airline respirators unless atmospheric tests under the most adverse conditions have established that the workers' exposure is within the acceptable concentration. In all cases, workers in the immediate vicinity of the welding or cutting operations shall be protected as necessary by local exhaust ventilation or airline respirators. ()

13. Cadmium. ()
- a. Welding or cutting indoors or in confined spaces involving cadmium-bearing or cadmium-coated base metals shall be done using local exhaust ventilation or airline respirators unless atmospheric tests under the most adverse conditions have established that the workers' exposure is within the acceptable concentration. Outdoors, such operations shall be done using respiratory protective equipment such as fume respirators approved by the U.S. Bureau of Mines or NIOSH for such purposes. ()
- b. Welding, or cutting indoors or in confined spaces involving cadmium-bearing filler metals shall be done using ventilation as prescribed in Subsections 230.06 of this section. If the work is to be done in a confined space then the requirements of Subsection 230.08 of this section shall be used. ()
14. Mercury. ()
- a. Welding or cutting indoors or in a confined space involving metals coated with mercury-bearing materials including paint, shall be done using local exhaust ventilation or airline respirators unless atmospheric tests under the most adverse conditions have established that the workers' exposure is within the acceptable concentration. ()
- b. Outdoors, such operations shall be done using respiratory protective equipment approved by the U.S. Bureau of Mines or NIOSH for such purposes. ()
15. Cleaning Compounds. ()
- a. In the use of cleaning materials, because of their possible toxicity or flammability, appropriate precautions such as manufacturer's instructions shall be followed. ()
- b. Degreasing or other cleaning operations involving chlorinated hydrocarbons shall be so located that no vapors from these operations will reach or be drawn into the atmosphere surrounding any welding operation. In addition, trichlorethylene and perchlorethylene shall be kept out of atmospheres penetrated by the ultraviolet radiation of gas-shielded welding operations. ()
16. Cutting of Stainless Steels. ()
- a. Oxygen cutting, using either a chemical flux or iron powder or gas-shielded arc cutting of stainless steel, shall be done using mechanical ventilation adequate to remove the fumes generated. ()
17. Fire Prevention and Protection. ()
- a. For elaboration of these basic precautions and of the special precautions of Subsection 230.17.c. through 230.17.r. of this section as well as a delineation of the fire protection and prevention responsibilities of welders and cutters, their supervisors (including outside contractors), and those in management on whose property cutting and welding is to be performed, see Standard for Fire Prevention in Use of Cutting and Welding Processes, NFPA 51B. ()
- b. The basic precautions for fire prevention in welding or cutting work are: if the object to be welded or cut cannot be readily moved, all movable fire hazards in the vicinity shall be taken to a safe place; if the object to be welded or cut cannot be moved and if all the fire hazards cannot be removed, then guards shall be used to confine the heat, sparks, and slag, and to protect the immovable fire hazards; or if the requirements stated above cannot be followed, then welding and cutting shall not be performed. ()
- c. Whenever there are floor openings or cracks in the flooring that cannot be closed, precautions shall be taken so that no readily combustible materials on the floor below will be exposed to sparks which might drop through the floor. The same precautions shall be observed with regard to cracks or holes in walls, open doorways, and open or broken windows. ()
- d. Suitable fire extinguishing equipment shall be maintained in a state of readiness for instant use.

Such equipment may consist of pails of water, buckets of sand, hose, or portable extinguishers depending upon the nature and quantity of the combustible material exposed. ()

e. Fire watchers shall be required whenever welding or cutting is performed in locations where other than a minor fire might develop, if any of the following conditions exist: appreciable combustible material, in building construction or contents, closer than thirty-five (35) feet to the point of operation; wall or floor openings within a thirty-five (35) foot radius expose combustible material in adjacent areas including concealed spaces in walls or floors; appreciable combustibles are more than thirty-five (35) feet away but are easily ignited by sparks; combustible materials are adjacent to the opposite side of metal partitions, walls, ceilings, or roofs and are likely to be ignited by conduction or radiation. ()

f. Fire watchers shall have fire extinguishers equipment readily available and be trained in its use. They shall be familiar with facilities for sounding an alarm in the event of a fire. They shall watch for fires in all exposed areas, try to extinguish them only when obviously within the capacity of the equipment available, or otherwise sound the alarm. A fire watch shall be maintained for at least a one-half (1/2) hour after completion of welding or cutting operations to detect and extinguish possible smoldering fires. ()

g. Before cutting or welding, the area shall be inspected by the individual responsible for authorizing cutting and welding procedures. He shall disseminate precautions to be followed in granting authorization to proceed in the form of a written procedure. ()

h. Where combustible materials such as paper clippings, wood shavings or textile fibers are on the floor, the floor shall be swept clean for a radius of thirty-five (35) feet. Combustible floors shall be kept wet, covered with damp sand, or protected by fire-resistant shields. Where floors have been wet down, personnel operating arc welding and cutting equipment shall be protected from possible shock. ()

i. Cutting or welding shall not be permitted in the following areas or situations: in areas not authorized by management; in sprinklered buildings while such protection is impaired; in the presence of explosive atmospheres (mixtures of flammable gases, vapors, liquids, or dusts with air), or explosive atmospheres that may develop inside uncleaned or improperly prepared tanks or equipment which have previously contained such materials, or that may develop in areas with an accumulation of combustible dusts; or in areas near the storage of large quantities of exposed, readily ignitable materials, such as bulk sulphur, baled paper, or cotton. ()

j. Where practicable, all combustibles shall be relocated at least thirty-five (35) feet from the work site. Where relocation is impossible, combustibles shall be protected with a flameproof cover or otherwise shielded with metal or fire proof curtains. Edges of covers at the floor should be tight to prevent sparks from going under them. This precaution is also important at overlaps where several covers are used to protect a large pile. ()

k. Ducts and conveyor systems that might carry sparks to distant combustibles shall be suitably protected or shut down. ()

l. Where cutting or welding is done near walls, partitions, ceiling, or roof of combustible construction, fire resistant shields or guards shall be provided to prevent ignition. ()

m. If welding is to be done on a metal wall, partition, ceiling, or roof, precautions shall be taken to prevent ignition of combustibles on the other side, due to conduction or radiation, preferably by relocation of combustibles. Where combustibles are not relocated, a fire watch on the opposite side from the work shall be provided, to prevent ignition. ()

n. Welding shall not be attempted on a metal partition, wall, ceiling, or roof having a combustible covering nor on walls or partitions of combustible sandwich-type panel construction. ()

o. Cutting or welding on pipes or other metal in contact with combustible walls, partitions, ceilings, or roofs shall not be undertaken if the work is close enough to cause ignition by conduction. ()

p. Management shall recognize its responsibility for the safe usage of cutting and welding equipment on its property, and: based on fire potentials of facilities, establish areas for cutting and welding, in other areas;

designate an individual responsible for authorizing cutting and welding operations in areas not specifically designed for such processes; insist that cutters or welders and their supervisors are suitably trained in the safe operation of their equipment and the safe use of the process; and advise all contractors about flammable materials or hazardous conditions of which they may not be aware. ()

q. The supervisor: shall be responsible for the safe handling of the cutting or welding equipment and the safe use of the cutting and welding process; shall determine the combustible materials and hazardous areas present or likely to be present in the work location; shall protect combustibles from ignition in accordance with Subsection 230.17.b. of this section; shall see that authorizations from the proper management representative are secured; shall determine that the cutter or welder secures his approval that conditions are safe before going ahead; shall determine that fire protection and extinguishing equipment are properly located at the site; and where fire watchers are required, shall see that they are available at the site. ()

r. Cutting or welding shall be permitted only in areas that are or have been made fire safe. Within the confines of a building or specifically designated facility or area, cutting and welding should preferably be done in a specific area designed for such work, such as a maintenance shop or a detached outside location. Such areas should be of non-combustible and nonflammable contents, and suitably segregated from adjacent areas. When work cannot be moved practically, as in most construction work, the area shall be made safe by removing combustibles or protecting combustibles from ignition areas. ()

s. Before welding, cutting, or heating is commenced on any surface covered by a preservative coating whose flammability is not known, a test shall be made by a competent person to determine its flammability. Preservative coatings shall be considered to be highly flammable when scrapings burn with extreme rapidity. ()

t. Precautions shall be taken to prevent ignition of highly flammable hardened preservative coatings. When coatings are determined to be highly flammable, they shall be stripped from the area to be heated to prevent ignition. ()

u. In enclosed spaces, all surfaces covered with toxic preservatives shall be stripped of all toxic coatings for a distance of at least four (4) inches from the area of heat application, or the employees shall be protected by airline respirators, meeting the requirements specified in this section for this type of work.()

v. The preservative coatings shall be removed a sufficient distance from the area to be heated to ensure that the temperature of the unstripped metal will not be appreciably raised. Artificial cooling of the metal surrounding the heating area may be used to limit the size of the area required to be cleaned. ()

18. Welding on or Cutting of Containers. ()

a. No welding, cutting, or other hot work shall be performed on used drums, barrels, tanks, or other containers until they have been cleaned so thoroughly as to make absolutely certain that there are no flammable materials present or any substances such as greases, tars, acids, or other materials which when subjected to heat, might produce flammable or toxic vapors. Any pipe lines or connections to the drum or vessel shall be disconnected or blanked. ()

b. All hollow spaces, cavities, or containers shall be vented to permit the escape of air or gases before preheating, cutting, or welding. Purging with inert gas is recommended. ()

19. Oxygen/Fuel Gas Systems for Welding and Cutting. ()

a. Mixtures of fuel gases and air or oxygen may be explosive and shall be guarded against. No device or attachment facilitating or permitting mixtures of air or oxygen with flammable gases prior to consumption, except at the burner or in a standard torch, shall be allowed unless approved for the purpose. ()

b. Only approved apparatus such as torches, regulators, or pressure-reducing valves, acetylene generators, and manifolds shall be used. ()

c. Workers in charge of the oxygen or fuel-gas supply equipment including any oxygen or fuel-gas

distribution piping systems shall be instructed and judged competent by their employers for this important work before being left in charge. Rules and instructions covering the operation and maintenance of oxygen or fuel-gas supply equipment including oxygen or fuel-gas distribution piping systems shall be readily available. ()

d. All portable cylinders used for the storage and shipment of compressed gases shall be constructed and maintained in accordance with the regulations of the U.S. Department of Transportation, 49 CFR Parts 171-179 and shall meet the requirements of Section 210 of this standard. ()

e. Oxygen cylinders shall not be stored near highly combustible material, especially oil and grease; or near reserve stocks of carbide and acetylene or other fuel-gas cylinders, or near any other substance likely to cause or accelerate fire; or in an acetylene generator compartment. ()

f. Oxygen cylinders in storage shall be separated from fuel-gas cylinders or combustible materials (especially oil or grease), a minimum distance of twenty (20) feet or by a noncombustible barrier at least five (5) feet high having a fire-resistant rating of at least one-half (1/2) half hour. ()

g. Where a liquid oxygen system is to be used to supply gaseous oxygen for welding or cutting and the system has a storage capacity of more than thirteen-thousand (13,000) cubic feet of oxygen (measured at fourteen point seven (14.7) psia and seventy (70) degrees Fahrenheit), connected in service or ready for service, or more than twenty-five thousand (25,000) cubic feet of oxygen (measured at fourteen point seven (14.7) psia and seventy (70) degrees Fahrenheit), including unconnected reserved on hand at the site, it shall comply with the provisions of the Standard for Bulk Oxygen Systems at Consumer Sites, NFPA 50. ()

h. Cylinders, cylinder valves, couplings, regulators, hose, and apparatus shall be kept free from oily or greasy substances. Oxygen cylinders or apparatus shall not be handled with oily hands or gloves. A jet of oxygen must never be permitted to strike any oily surface, greasy clothes, or enter a fuel oil or other storage tank. ()

i. Unless cylinders are secured on a special truck regulators shall be removed and valve protection caps, when provided for, shall be put in place before cylinders are moved. ()

j. Cylinders not having fixed hand wheels shall have keys, handles, or non-adjustable wrenches on valve stems while these cylinders are in service. In multiple cylinder installations only one (1) key or handle is required for each manifold. ()

k. Cylinder valves shall be closed before moving cylinders. ()

l. Cylinder valves shall be closed when work is finished. ()

m. Valves of empty cylinders shall be closed. ()

n. Cylinders shall be kept far away from the actual welding or cutting operation so that sparks, hot slag or flame will not reach them, or fire-resistant shields shall be used. ()

o. Cylinders shall not be placed where they might become part of an electric current. Contacts with third rails, trolley wires, etc., shall be avoided. Cylinders shall be kept away from radiators, piping systems, layout tables, etc., that may be used for grounding electric circuits such as for arc welding machines. Any practice such as the tapping of an electrode against a cylinder to strike an arc shall be prohibited. ()

p. Cylinders shall never be used as rollers or supports, whether full or empty. ()

q. Unless connected to a manifold, oxygen from a cylinder shall not be used without first attaching an oxygen regulator to the cylinder valve. Before connecting the regulator to the cylinder valve, the valve shall be opened slightly for an instant and then closed. (Always stand to one side of the outlet when opening the cylinder valve.) ()

r. A hammer or wrench shall not be used to open cylinder valve. If valves cannot be opened by hand, the supplier shall be notified. ()

- s. Complete removal of the stem from a diaphragm type cylinder valve shall be avoided. ()
- t. Fuel-gas cylinders shall be placed with valve end up whenever they are in use. Liquefied gases shall be stored and shipped with the valve end up. ()
- u. Cylinders shall be handled carefully. Cylinders shall not be subjected to rough handling, knocks, or falls which are liable to damage the cylinder, valve or safety devices and cause leakage. ()
- v. Before connecting a regulator to a cylinder valve, the valve shall be opened slightly and closed immediately. The valve shall be opened while standing to one side of the outlet; never in front of it. Fuel-gas cylinder valves shall not be cracked near other welding work or near sparks, flame, or other possible sources of ignition. ()
- w. Before a regulator is removed from a cylinder valve, the cylinder valve shall be closed and the gas released from the regulator. ()
- x. Nothing shall be placed on top of an acetylene cylinder when in use which may damage the safety device or interfere with the quick closing of the valve. ()
- y. If cylinders are found to have leaky valves or fittings which cannot be stopped by closing of the valve, the cylinders shall be taken outdoors away from sources of ignition and slowly emptied. ()
- z. A warning shall be placed near cylinders having leakage, fuse plugs, or other leaking safety devices not to approach them with a lighted cigarette or other source of ignition. Such cylinders should be plainly tagged; the supplier should be promptly notified and his instructions followed as to their return. ()
- aa. Safety devices shall not be tampered with. ()
- bb. Fuel-gas shall not be used from cylinders through torches or other devices equipped with shutoff valves without reducing the pressure through a suitable regulator attached to the cylinder valve or manifold. ()
- cc. The cylinder valve shall always be opened slowly. ()
- dd. An acetylene cylinder valve shall not be opened more than one and one-half (1 1/2) turns of the spindle, and preferably no more than three-quarters (3/4) of a turn. ()
- ee. Where a special wrench is required, it shall be left in position on the stem of the valve while the cylinder is in use so that the fuel-gas flow can be quickly turned off in case of emergency. In the case of manifolded or coupled cylinders at least one (1) such wrench shall always be available for immediate use. ()
- ff. When cylinders are transported by powered vehicle, they shall be secure in a vertical position. ()
- gg. A suitable cylinder truck, cart, chain, or other steadying device shall be used to prevent all cylinders from being knocked over while in use, or in storage, empty or full. ()
- hh. Each oxygen and fuel gas cylinder shall have a back flow valve and a flash back arrester between the torch and the regulator. ()
20. Manifolding of Oxygen/Fuel Gas Cylinders. ()
- a. Manifolds shall be approved either separately for each component part or as an assembled unit. ()
- b. Except as provided in Subsection 230.20.c. of this section, oxygen or fuel gas cylinders connected to one (1) manifold inside a building shall be limited to a total capacity not exceeding six-thousand (6,000) cubic feet

of oxygen, three-hundred (300) pounds of liquefied petroleum gas, or three-thousand (3,000) cubic feet of other fuel-gas. More than one such manifold with connected cylinders may be located in the same room provided the manifolds are at least fifty (50) feet apart or separated by a fire-resistant barrier at least five (5) feet high having a fire-resistance rating of at least one-half-(1/2) hour. ()

c. Oxygen cylinders or fuel-gas cylinders connected to one (1) manifold having an aggregate capacity exceeding six-thousand (6,000) cubic feet of oxygen, three-hundred (300) pounds of liquefied petroleum gas, or three-thousand (3,000) cubic feet of other fuel-gas shall be located outdoors, or in a separate building or room constructed in accordance with the following: The walls, partitions, floors, and ceilings shall be of noncombustible construction having a fire-resistance rating of at least one (1) hour. The walls or partitions shall be continuous from floor to ceiling and shall be securely anchored. At least one (1) wall of the room shall be an exterior wall. Openings from an inside generator room to other parts of the building shall be protected by a swinging type self-closing fire door for a Class B opening and having a rating of at least one (1) hour. Windows in partitions shall be wired glass and approved metal frames with fixed sash. Installation shall be in accordance with the Standard for the Installation of Fire Doors and Windows, NFPA 80. Rooms or outside houses shall be well ventilated with vents located at floor and ceiling levels. ()

d. Separate manifold buildings or rooms may also be used for the storage of cylinders containing fuel gases as provided in Subsection 230.19. of this section and Section 210 of this standard. Such building or rooms shall have no open flames for heating or lighting and shall be well ventilated. ()

e. High-pressure fuel gas manifolds shall be provided with approved pressure regulating devices. ()

f. An oxygen manifold or oxygen bulk supply system which has storage capacity of more than thirteen-thousand (13,000) cubic feet of oxygen (measured at fourteen point seven (14.7) psia and seventy (70) degrees Fahrenheit), connected in service or ready for service, or more than twenty-five thousand (25,000) cubic feet of oxygen (measured at fourteen point seven (14.7) psia and seventy (70) degrees Fahrenheit), including unconnected reserves on hand at the site, shall comply with the provisions of the Standard for Bulk Oxygen Systems at Consumer Sites, NFPA No. 50. ()

g. High-pressure oxygen manifolds shall be provided with approved pressure-regulating devices. ()

h. Manifolds shall be of substantial construction suitable for use with oxygen at a pressure of two-hundred fifty (250) psig. They shall have a minimum bursting pressure of one-thousand (1,000) psig and shall be protected by a safety relief device which will relieve at a maximum pressure of five-hundred (500) psig. NOTE: DOT-4L200 cylinders have safety devices which relieve at a maximum pressure of two-hundred fifty (250) psig (or two-hundred thirty-five (235) psig if vacuum insulation is used). ()

i. Hose and hose connections subject to cylinder pressure shall comply with Subsection 230.25. of this section. Hose shall have a minimum bursting pressure of one-thousand (1,000) psig. ()

j. The assembled manifold including leads shall be tested and proven gas-tight at a pressure of three-hundred (300) psig. The fluid used for testing oxygen manifolds shall be oil-free and not combustible. ()

k. The location of manifolds shall comply with the provisions of this subsection. ()

l. The following sign shall be conspicuously posted at each manifold: "Low Pressure Manifold, Do not Connect High-Pressure Cylinders; Maximum Pressure, two-hundred fifty (250) psig." ()

21. Portable Outlet Headers. ()

a. Portable outlet headers shall not be used indoors except for temporary service where the conditions preclude a direct supply from outlets located on the service piping system. ()

b. Each outlet on the service piping from which oxygen or fuel-gas is withdrawn to supply a portable ()

outlet header shall be equipped with a readily accessible shutoff valve. ()

c. Hose and hose connections used for connecting the portable outlet header to the service piping shall comply with Subsection 230.22. of this section. ()

d. Master shutoff valves for both oxygen and fuel-gas shall be provided at the entry end of the portable outlet header. ()

e. Portable outlet headers for fuel-gas service shall be provided with an approved hydraulic back-pressure valve installed at the inlet and preceding the service outlets, unless an approved pressure-reducing regulator, an approved back-flow check valve, or an approved hydraulic back-pressure valve is installed at each outlet. Outlets provided on headers for oxygen service may be fitted for use with pressure-reducing regulators or for direct hose connection. ()

f. Each service outlet on portable outlet headers shall be provided with a valve assembly that includes a detachable outlet seal cap, chained or otherwise attached to the body of the valve. ()

g. Materials and fabrication procedures for portable outlet headers shall comply with Subsection 230.23.a. through 230.23. aa. of this section. ()

h. Portable outlet headers shall be provided with frames which will support the equipment securely in the correct operating position and protect them from damage during handling and operation. ()

22. Manifold Operating Procedures. ()

a. Cylinder manifolds shall be installed under the supervision of someone familiar with the proper practices with reference to their construction and use. ()

b. All manifolds and parts used in manifolding shall be used only for the gas or gases for which they are approved. ()

c. When acetylene cylinders are coupled, approved flash arresters shall be installed between each cylinder and the coupler block. For outdoor use only, and when the number of cylinders coupled does not exceed three (3), one (1) flash arrester installed between the coupler block and regulator is acceptable. ()

d. Each fuel-gas cylinder lead shall be provided with a back-flow check valve. ()

e. The aggregate capacity of fuel-gas cylinders connected to a portable manifold inside a building shall not exceed three-thousand (3,000) cubic feet of gas. ()

f. Acetylene and liquefied fuel-gas cylinders shall be manifolded in a vertical position. ()

g. The pressure in the gas cylinders connected to and discharged simultaneously through a common manifold shall be approximately equal. ()

23. Service Piping Systems. ()

a. Piping and fittings shall comply with Section 2, Industrial Gas and Air Piping Systems, of the American National Standard Code for Pressure Piping, ANSI B31.1, insofar as it does not conflict with Subsections 230.23.b. and 230.23.c. of this section. ()

b. Pipe shall be schedule forty (40) and fittings shall be at least standard weight in sizes up to and including six (6) inch nominal. ()

c. Copper tubing shall be Types K or L in accordance with the Standard Specification for Seamless Copper Water Tube, ASTM B88-66a. ()

d. Piping shall be steel, wrought iron, brass, or copper pipe, or seamless copper, brass, or stainless steel tubing except as provided in Subsections 230.23.e. through Subsection 230.23.i. of this section. ()

e. Oxygen piping and fittings at pressures in excess of seven-hundred (700) psig shall be stainless steel or copper alloys. ()

f. Hose connections and hose complying with Subsection 230.24. of this section may be used to connect the outlet of a manifold pressure regulator to piping providing the working pressure of the piping is two-hundred fifty (250) psig or less and the length of the hose does not exceed five (5) feet. Hose shall have a minimum bursting pressure of one-thousand (1,000) psig. ()

g. When oxygen is supplied to a service piping system from a low-pressure oxygen manifold without an intervening pressure regulating device, the piping system shall have a minimum design pressure of two-hundred fifty (250) psig. A pressure regulating device shall be used at each station outlet when the connected equipment is for use at pressures less than two-hundred fifty (250) psig. ()

h. Piping for acetylene or acetylenic compounds shall be steel or wrought iron. ()

i. Unalloyed copper shall not be used for acetylene or acetylenic compounds except in listed equipment. ()

j. Joints in steel or wrought iron piping shall be welded, threaded, or flanged. Fittings, such as "L", "T", couplings, and unions may be rolled, forged, or cast steel, malleable iron, or nodular iron. Gray or white cast iron fittings are prohibited. ()

k. Joints in brass or copper pipe shall be welded, brazed, threaded, or flanged. If of the socket type, they shall be brazed with silver-brazing alloy or similar high melting point (not less than eight-hundred (800) degrees Fahrenheit) filler metal. ()

l. Joints in seamless copper, brass, or stainless tubing shall be approved gas tubing fittings or the joints shall be brazed. If of the socket type, they shall be brazed with silver-brazing alloy or similar high melting point (not less than eight-hundred (800) degrees Fahrenheit) filler metal. ()

m. Distribution lines shall be installed and maintained in a safe operating condition. ()

n. Piping located inside or outside of buildings may be placed above or below ground. All piping shall be run as directly as practicable, protected against physical damage, proper allowance being made for expansion and contraction, jarring and vibration. Pipe laid underground in earth shall be located below the frost line and protected against corrosion. After assembly piping shall be thoroughly blown out with air or nitrogen to remove foreign materials. For oxygen piping, only oil-free air, oil-free nitrogen, or oil-free carbon dioxide shall be used. ()

o. Only piping which has been welded or brazed shall be installed in tunnels, trenches, or ducts. Shut-off valves shall be located outside such conduits. Oxygen piping may be placed in the same tunnel, trench or duct with fuel-gas pipelines, provided there is good natural or forced ventilation. ()

p. Low points in piping carrying moist gas shall be drained into drip pots constructed so as to permit pumping or draining out the condensate at necessary intervals. Drain valves shall be installed for this purpose having outlets normally closed with screw caps or plugs. No drips located out of doors, underground, and not readily accessible, valves may be used at such points if they are equipped with means to secure them in the closed position. Pipes leading to the surface of the ground shall be cased or jacketed where necessary to prevent loosening or breaking. ()

q. Gas cocks or valves shall be provided for all buildings at points where they will be readily accessible for shutting off the gas supply to these buildings in any emergency. Underground valve boxes or manholes should be avoided whenever possible. There shall also be provided a shutoff valve in the discharge line from the generator, gas holder, manifold or other source of supply. ()

r. Shutoff valves shall not be installed in such a manner that the safety relief device can be rendered ineffective. ()

s. Fitting and lengths of pipe shall be examined internally before assembly and, if necessary, freed from scale or dirt. Oxygen piping and fittings shall be washed out with a suitable solution which will not react with the oxygen. NOTE: Hot water solutions of caustic soda or trisodium phosphate are effective cleaning agents for this purpose. ()

t. Piping shall be thoroughly blown out after assembly to remove foreign materials. For oxygen piping, oil-free air, oil free nitrogen, or oil-free carbon dioxide shall be used. For other piping, air or inert gas may be used. ()

u. When flammable gas lines or other parts of equipment are being purged of air or gas, open lights or other sources of ignition shall not be permitted near uncapped openings. ()

v. No welding or cutting shall be performed on an acetylene or oxygen pipeline, including the attachment of hangers or supports, until the line has been purged. Only oil-free air, oil-free nitrogen, or oil-free carbon dioxide shall be used to purge oxygen lines. ()

w. Underground pipe and tubing and outdoor ferrous pipe and tubing shall be covered or painted with a suitable material for protection against corrosion. ()

x. Above ground piping systems shall be marked in accordance with the American National Standard Scheme for the Identification of Piping Systems, ANSI A13.1. ()

y. Station outlets shall be marked to indicate the name of the gas. ()

z. Piping systems shall be tested and proved gas-tight at one and one-half (1 1/2) times the maximum operating pressure, and shall be thoroughly purged of air before being placed in service. The material used for testing oxygen lines shall be oil free and noncombustible. Flames shall not be used to detect leaks. ()

aa. When flammable gas lines or other parts of equipment are being purged of air or gas, sources of ignition shall not be permitted near uncapped openings. ()

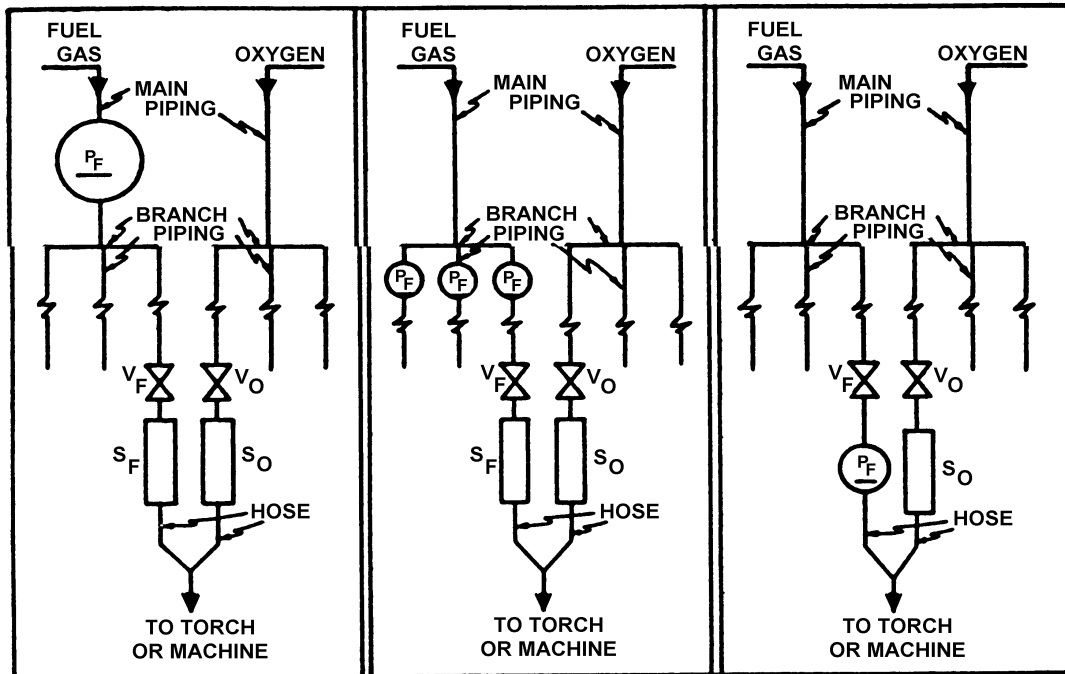
24. Protective Equipment. ()

a. Equipment shall be installed and used only for the service for which it is approved and as recommended by the manufacturer. ()

b. Service piping systems shall be protected by pressure relief devices set to function at not more than the design pressure of the systems, and discharging upwards to a safe location. ()

c. The fuel-gas and oxygen piping systems, including portable outlet headers shall incorporate the protective equipment shown in Figures 230.24-A, 230.24-B, and 230.24-C. When only a portion of a fuel-gas system is to be used with oxygen, only that portion need comply with Subsection 230.24.c. of this subsection. ()

FIGURE 230.24-A-B-C



d. Approved protective equipment (designated Pf in Figures 230.24-A, 230.24-B, and 230.24-C) shall be installed in fuel-gas piping to prevent: back-flow of oxygen into the fuel gas supply system; passage of a flashback into the fuel gas supply system; excessive back pressure of oxygen in the fuel gas supply system. The three (3) functions of the protective equipment may be combined in one (1) device or may be provided by separate devices. ()

e. The protective equipment shall be located in the main supply line, as in Figure 230.24-A or at the head of each branch line as in Figure 230.24-B, or at least location where fuel gas is withdrawn, as in Figure 230.24-C. Where branch lines are of two (2) inch pipe size or larger or of substantial length, protective equipment (designated as Pf) shall be located as shown in either Figure 230.24-B or 230.24-C. ()

f. Back-flow protection shall be provided by an approved device that will prevent oxygen from flowing into the fuel-gas system or fuel from flowing into the oxygen system (see Sf, Figures 230.24-A and 230.24-B.) ()

g. Flash back protection shall be provided by an approved device that will prevent flame from passing into the fuel-gas system. ()

h. Back-pressure protection shall be provided by an approved pressure-relief device set at a pressure not greater than the pressure rating of the back-flow or the flashback protection device, whichever is lower. The pressure-relief device shall be located on the downstream side of the back-flow and flashback protection devices. The vent from the pressure-relief device shall be at least as large as the relief device inlet and shall be installed without low points that may collect moisture. If low points are unavoidable, drip pots with drains closed with screw plugs or caps shall be installed at the low points. The vent terminus shall not endanger personnel or property through gas discharge; shall be located away from ignition sources; and shall terminate in a hood or bend. ()

i. If pipeline protective equipment incorporates a liquid, the liquid level shall be maintained, and a suitable antifreeze shall be used to prevent freezing. ()

j. Fuel gas for use with equipment not requiring oxygen shall be withdrawn upstream of the piping protective devices. ()

k. A check valve pressure regulator, hydraulic seal, or combination of these devices shall be provided at each station outlet, including those on portable headers to prevent back-flow, as shown in Figures 230.24-A, 230.24-B, and 230.24-C and designated as Sf and So. ()

l. When approved pipeline protective equipment (designated Pf) is located at the station outlet as in Figure 230.24-C, no additional check valve, pressure regulator, or hydraulic seal is required. ()

m. A shutoff valve (designated Vf and Vo) shall be installed at each station outlet and shall be located on the upstream side of other station outlet equipment. ()

n. If the station outlet is equipped with a detachable regulator, the outlet shall terminate in a union connection that complies with the Regulator Connection Standards, Compressed Gas Association. ()

o. If the station outlet is connected directly to a hose, the outlet shall terminate in a union connection complying with the Standard Hose Connection Specifications, Compressed Gas Association. ()

p. Station outlets may terminate in pipe threads to which permanent connections are to be made, such as to a machine. ()

q. Station outlets shall be equipped with a detachable outlet seal cap secured in place. This cap shall be used to seal the outlet except when a hose, a regulator, or piping is attached. ()

r. When station outlets are equipped with approved back-flow and flashback protective devices, as many as four (4) torches may be supplied from each station outlet through rigid piping, provided each outlet from such piping is equipped with a shutoff valve and provided the fuel gas capacity of any one (1) torch does not exceed fifteen (15) cubic feet per hour. This rule does not apply to machines. ()

25. Hose and Hose Connections. ()

a. Hose for oxygen gas service shall comply with Specification for Rubber Welding Hose, Compressed Gas and Rubber Manufacturers Association. ()

b. The colors for hose shall be red for acetylene and other fuel-gas hose, green for oxygen hose, and black for inert gas and air hose. ()

c. When parallel lengths of oxygen and acetylene hose are taped together for convenience and to prevent tangling, not more than four (4) inches out of twelve (12) inches shall be covered by tape. ()

d. Hose connections shall comply with the Standard Hose Connection Specifications, Compressed Gas Association. ()

e. Hose connections shall be clamped or otherwise securely fastened in a manner that will withstand, without leakage, twice the pressure to which they are normally subjected in service, but in no case less than a pressure of three-hundred (300) psi. Oil free air or an oil free inert gas shall be used for this test. ()

f. Hose showing leaks burns, worn places, or other defects rendering it unfit for service shall be repaired or replaced. ()

26. Pressure-Reducing Regulators. ()

a. Pressure-reducing regulators shall be used only for the gas and pressures for which they are intended. The regulator inlet connections shall comply with Regulator Connection Standards, Compressed Gas Association. ()

- b. When regulators or parts of regulators, including gages, need repair, the work shall be performed by skilled mechanics who have been properly instructed. ()
- c. Gages on oxygen regulators shall be marked "USE NO OIL". ()
- d. Union nuts and connections on regulators shall be inspected before use to detect faulty seats which may cause leakage of gas when the regulators are attached to the cylinder valves. ()
27. Exhibitions and Demonstrations. ()
- a. Installation and operation of welding, cutting, and related equipment shall be done by, or under the supervision of a competent operator to insure the personal protection of viewers and demonstrator as well as the protection from fire, for materials in and around the site and the building itself. ()
- b. Cylinders containing compressed gases for use at the site shall not be charged in excess of one-half (1/2) their maximum permissible content. (Cylinders of non-liquefied gases shall be charged to not more than one-half (1/2) of their maximum permissible charged pressure in psig. Cylinders of liquefied gases shall be charged to not more than one-half (1/2) the maximum permissible capacity in pounds). ()
- c. Cylinders located at the site shall be connected for use except that enough additional cylinders may be stored at the site to furnish approximately one (1) days consumption of each gas used. Other cylinders shall be stored, in an approved storage area preferably outdoors, but this storage area shall not be located near a building. ()
- d. Cylinders in excess of forty (40) pounds total weight being transported to or from the site shall be carried on a hand or motorized truck. ()
- e. The site shall be constructed, equipped and operated in such a manner that the demonstration will be carried out so as to minimize the possibility of injury to viewers. ()
- f. Sites involving the use of compressed gases shall be located so as not to interfere with the egress of people during an emergency. ()
- g. The fire department shall be notified in advance of use of the site. ()
- h. Each site shall be provided with a portable fire extinguishers of appropriate size and type and with a pail of water. ()
- i. The observers and combustible materials at the site shall be protected from flames, sparks, and molten metal. ()
- j. Hoses shall be located and protected so that they will not be physically damaged. ()
- k. Cylinder valves shall be closed when equipment is unattended. ()
- l. Where caps are provided for valve protection, such caps shall be in place except when the cylinders are in service or connected ready for service. ()
- m. Cylinders shall be located or secured so that they cannot be knocked over. ()
28. Arc Welding and Cutting. ()
- a. Welding equipment shall be chosen for safe application to the work to be done as specified in Subsection 230.28. of this section. ()
- b. Welding equipment shall be installed safely as specified by Subsection 230.28. of this section.

()

c. Workmen designated to operate arc welding equipment shall have been properly instructed and qualified to operate such equipment as specified in Subsection 230.28. of this section. ()

d. Assurance of consideration of safety in design is obtainable by choosing apparatus complying with the requirements of Electric Arc Welding Apparatus NEMA EW-1, National Electrical Manufacturers Association or the Safety Standard of Transformer-Type Arc Welding Machines. ANSI C33.2, Underwriters Laboratories. ()

e. Standard machines for arc welding service shall be designed and constructed to carry their rated load with rated temperature rises where the temperature of the cooling air does not exceed one-hundred four (104) degrees Fahrenheit and where the altitude does not exceed three-thousand three-hundred (3,300) feet, and shall be suitable for operation in atmospheres containing gases, dust, and light rays produced by the welding arc. ()

f. Unusual service conditions may exist, and in such circumstances, machines shall be especially designed to safely meet the requirements of the intended service. Chief among these conditions are: unusually corrosive fumes, steam or excessive humidity, excessive oil vapor, flammable gases, abnormal vibration or shock, excessive dust, or weather. ()

g. Open circuit (no load) voltages or arc welding and cutting machines shall be as low as possible consistent with satisfactory welding or cutting being done. The following limits shall not be exceeded: alternate current machines, manual arc welding and cutting -- eighty (80) volts; automatic (machine or mechanized) arc welding and cutting -- one-hundred (100) volts; direct current machines, manual arc welding and cutting -- one-hundred (100) volts; automatic (machine or mechanized) arc welding and cutting -- one-hundred (100) volts. ()

h. When special welding and cutting processes require values of open circuit voltages higher than the above, means shall be provided to prevent the operator from making accidental contact with the high voltage by adequate insulation or other means. NOTE: For a.c. welding under wet conditions or warm surroundings where perspiration is a factor, the use of reliable automatic controls for reducing no load voltage is recommended to reduce the shock hazard. ()

i. A controller integrally mounted in an electric motor driven welder shall have capacity for carrying rated motor current, shall be capable of making and interrupting stalled rotor current of the motor, and may serve as the running over-current device if provided with the number of over-current units as specified by the National Electric Code. Starters with magnetic under voltage release shall be used with machines installed more than one (1) to a circuit to prevent circuit overload caused by simultaneously starting of several motors upon return of voltage. ()

j. On all types of arc welding machines, control apparatus shall be enclosed except for the operating wheels, levers, or handles. Control handles and wheels shall be large enough to be easily grasped by a gloved hand. ()

k. Input power terminals, tap change devices, and live metal parts connected to input circuits shall be completely enclosed and accessible only by means of tools. ()

l. Terminals for welding leads shall be protected from accidental electrical contact by employees or by metal objects i.e., vehicles, crane hooks, etc. Protection may be obtained by use of: dead-front receptacles for plug connections, recessed openings with nonremovable hinged covers, heavy insulating sleeving or taping or other equivalent electrical and mechanical protection. If a welding lead terminal which is intended to be used exclusively for connection to the work is connected to the grounded enclosure, it must be done by a conductor at least two (2) AWG sizes smaller than the grounding conductor and the terminal shall be marked to indicate that it is grounded. ()

m. No connections for portable control devices such as push buttons to be carried by the operator shall be connected to an a.c. circuit of higher than one-hundred twenty (120) volts. Exposed metal parts of portable control devices operating on circuits above fifty (50) volts shall be grounded by a grounding conductor in the control cable. ()

- n. Auto transformers or a.c. reactors shall not be used to draw welding current directly from any a.c. power source having a voltage exceeding eighty (80) volts. ()
- o. Installation including power supply shall be in accordance with the requirements of the National Electrical Code. ()
- p. The frame or case of the welding machine (except engine driven machines) shall be grounded under the conditions and according to the methods prescribed in National Electrical Code. ()
- q. Conduits containing electrical conductors shall not be used for completing a work-lead circuit. Pipe-lines shall not be used as a permanent part of a work-lead circuit, but may be used during construction, extension or repair providing current is not carried through threaded joints, flanged bolted joints, or caulked joints and that special precautions are used to avoid sparking at connection of the work-lead cable. ()
- r. Chains, wire ropes, cranes, hoists, and elevators shall not be used to carry welding current. ()
- s. Where a structure, conveyor, or fixture is regularly employed as a welding current return circuit, joints shall be bonded or provided with adequate current collecting devices and appropriate periodic inspection shall be conducted to ascertain that no condition of electrolysis or shock, or fire hazard exists by virtue of such use. ()
- t. All ground connections shall be checked to determine that they are mechanically strong and electrically adequate for the required current. ()
- u. A disconnecting switch or controller shall be provided at or near each welding machine which is not equipped with such a switch or controller mounted as an integral part of the machine. The switch shall be in accordance with the National Electrical Code. Over-current protection shall be provided as specified in the National Electrical Code. A disconnect switch with overload protection or equivalent disconnect and protection means, permitted by the National Electrical Code shall be provided for each outlet intended for connection to a portable welding machine. ()
- v. For individual welding machines, the rated current carrying capacity of the supply conductors shall be not less than the rated primary current of the welding machines. ()
- w. For groups of welding machines, the rated current carrying capacity of the rated primary currents of the welding machines supplied. The conductor rating shall be determined in each case according to the machine loading based on the use to be made of each welding machine and the allowance permissible in the event that all the welding machines supplied by the conductors will not be in use at the same time. ()
- x. In operations involving several welders on one structure, d.c. welding process requirements may require the use of both polarities; or supply circuit limitations for a.c. welding may require distribution of machines among the phases of the required distribution of machines among the phases of the supply circuit. In such cases, no load voltages between electrode holders will be two (2) times normal in d.c. or one (1), 1.4, 1.73, or two (2) times normal on a.c. machines. Similar voltage differences will exist if both a.c. and d.c. welding are done on the same structure. All d.c. machines shall be connected with the same polarity. All a.c. machines shall be connected to the same phase of the supply circuit and with the same instantaneous polarity. ()
- y. Workmen assigned to operate or maintain arc welding equipment shall be acquainted with the requirements of Subsections 230.28 and 230.17. of this section, if doing gas-shielded arc welding, also Recommended Safe Practices for Gas-Shielded Arc Welding, A6.1 American Welding Society. ()
- z. Before starting operations, all connections to the machine shall be checked to make certain they are properly made. The work load shall be firmly attached to the work; magnetic work clamps shall be freed of adherent metal particles of spatter on contact surfaces. Coiled welding cable shall be spread out before use to avoid serious over-heating and damage to insulation. ()
- aa. Grounding of the welding machine frame shall be checked. Special attention shall be given to

- safety ground connections of portable machines. ()
- bb. There shall be no leaks of cooling water, shielding gas, or engine fuel. ()
 - cc. It shall be determined that proper switching equipment for shutting down the machine is provided. ()
 - dd. Printed rules and instructions covering operation of equipment supplied by the manufacturers shall be strictly followed. ()
 - ee. Electrode holders when not used shall be so placed that they cannot make electrical contact with persons, conducting objects, fuel, or compressed gas tanks. ()
 - ff. Cables with splices within ten (10) feet of the holder shall not be used. The welder shall not coil or loop welding electrode cable around parts of his body. ()
 - gg. The operator shall report any equipment defect or safety hazard to his supervisor and the use of the equipment shall be discontinued until its safety has been assured. Repairs shall be made only by qualified personnel. ()
 - hh. Machines which have become wet shall be thoroughly dried and tested before being used. ()
 - ii. Work and electrode lead cables should be frequently inspected for wear and damage. Cables with damaged insulation or exposed bare conductors shall be replaced. Jointing lengths of work and electrode cables shall be done by the use of connecting means specifically intended for the purpose. The connecting means shall have insulation adequate for the service conditions. ()
29. Resistance Welding. ()
- a. All equipment shall be installed by a qualified electrician in conformance with the National Electrical Code. There shall be a safety-type disconnecting switch or a circuit breaker or circuit interrupter to open each power circuit to the machine, conveniently located at or near the machine, so that the power can be shut off when the machine or its controls are to be serviced. ()
 - b. Ignition tubes used in resistance welding equipment shall be equipped with a thermal protection switch. ()
 - c. Workmen designated to operate resistance welding equipment shall have been properly instructed and judged competent to operate such equipment. ()
 - d. Controls of all automatic or air and hydraulic clamps shall be arranged or guarded to prevent the operator from accidentally activating them. ()
 - e. Spot and seam welding machines (nonportable) shall have all external weld initiating control circuits operating on low voltages, not over one-hundred twenty (120) volts. ()
 - f. Stored energy or capacitor discharge type of resistance welding equipment and control panels involving high voltage (over five-hundred fifty (550) volts) shall be suitably insulated and protected by complete enclosures, all doors of which shall be provided with suitable interlocks and contacts wired into the control circuit (similar to elevator interlock). Such interlocks or contacts shall be so designed as to effectively interrupt power and short circuit all capacitors when the door or panel is open. A manually operated switch or suitable positive device shall be installed, in addition to the mechanical interlocks or contacts, as an added safety measure assuring absolute discharge of all capacitors. ()
 - g. All doors and access panels of all resistance welding machines and control panels shall be kept locked and interlocked to prevent access by unauthorized persons, to live portions of the equipment. ()

h. All press welding machine operations, where there is a possibility of the operators fingers being under the point of operation, shall be effectively guarded by the use of a device such as an electronic eye safety circuit, two (2) hand controls or protections similar to that prescribed for mechanical press operations in Subsection 250.21. of this standard. All chains, gears, operating bus linkage, and belts shall be protected by adequate guards, in accordance with Subsection 250.04. of this standard. ()

i. The hazard of flying sparks shall be wherever practical, eliminated by installing a shield guard of safety glass or suitable fire resistant plastic at the point of operation. Additional shields or curtains shall be installed as necessary to protect passing persons from flying sparks. (See Subsection 230.04 of this section.) ()

j. All foot switches shall be guarded to prevent accidental operation of the machine. ()

k. Two (2) or more safety emergency stop buttons shall be provided on all special multi-spot welding machines, including two (2) post and four (4) post weld presses. ()

l. On large machines, four (4) safety pins with plugs and receptacles (one in each corner) shall be used so that when safety pins are removed and inserted in the ram or platen, the press becomes inoperative. ()

m. Where technically practical, the secondary of all welding transformers used in multi-spot, protection and seam welding machines shall be grounded. This may be done by permanently grounding one side of the welding secondary current circuit. Where not technically practical, a center tapped grounding reactor connected across the secondary for the use of a safety disconnect switch in conjunction with the welding control are acceptable alternates. Safety disconnect shall be arranged to open both sides of the line when welding current is not present. ()

n. All portable welding guns shall have suitable counter-balanced devices for supporting the guns, including cables, unless the design of the gun or fixture makes counterbalancing impractical or unnecessary. ()

o. All portable welding guns, transformers and related equipment that is suspended from overhead structures, eye beams, trolleys, etc., shall be equipped with safety chains or cables. Safety chains or cables shall be capable of supporting the total shock load in the event of failure of any component of the support system. ()

p. When trolleys are used to support portable welding equipment, they shall be equipped with suitable forged steel clevis for the attachment of safety chains. Each clevis shall be capable of supporting the total shock load of the suspended equipment in the event of trolley failure. ()

q. All initiating switches, including retraction and dual schedule switches, located on the portable welding gun shall be equipped with suitable guards capable of preventing accidental initiation through contact with fixturing, operator's clothing, etc. Initiating switch voltage shall not exceed twenty-four (24) volts. ()

r. The movable holder, where it enters the gun frame shall have sufficient clearance to prevent the shearing of fingers carelessly placed on the operating movable holder. ()

s. Grounding. The secondary and case of all portable welding transformers shall be grounded. Secondary grounding may be by center tapped secondary or by a center tapped grounding reactor connected across the secondary. ()

30. Flash Welding Equipment. ()

a. Flash welding machines shall be equipped with a hood to control flying flash. In cases of high production, where materials may contain a film of oil, and where toxic elements and metal fumes are given off, ventilation shall be provided in accordance with Subsections 230.06 through 230.07 of this section. ()

b. For the protection of the operators of nearby equipment, fire-resistant curtains or suitable shields shall be set up around the machine and in such a manner that the operators movements are not hampered. ()

c. If the welding process cannot be isolated, all persons who may be exposed to the hazard of arc flash

shall be properly protected. ()

231. -- 239. (RESERVED).

240. SPRAY FINISHING USING FLAMMABLE AND COMBUSTIBLE MATERIALS.

01. Scope. ()

a. Spray finishing using flammable and combustible materials shall conform to all other applicable requirements of this standard, as well as the following provisions. Nothing in this standard shall be construed to prohibit better or otherwise safer conditions than specified herein. ()

b. This section applies to flammable and combustible finishing materials when applied as a spray by compressed air, airless, or hydraulic atomization, steam, electrostatic methods, or by any other means in continuous or intermittent processes. This section also covers the application of combustible powders by powder spray guns, electrostatic powder spray guns, fluidized beds, or electrostatic fluidized beds. The section does not apply to outdoor spray application of buildings, tanks, or other similar structures, nor to small portable spraying apparatus not used repeatedly in the same location. ()

c. Spray booths or spray rooms are to be used to enclose or confine all spray finishing operations covered by this section. ()

02. Definitions Applicable to this Section. ()

a. Aerated Solid Powders are any powdered material used as a coating material which shall be fluidized within a container by passing air uniformly from below. It is common practice to fluidize such material to form a fluidized powder bed and then dip the part to be coated into the bed in a manner similar to that used in liquid dipping. Such beds are also used as sources for powder spray operations. ()

b. Fluidized Bed is a container holding material which is aerated from below so as to form an air-supported expanded cloud of such material through which the preheated object to be coated is immersed and transported. ()

c. Fluidized Bed, Electrostatic, is a container holding powder coating material which is aerated from below so as to form an air supported expanded cloud of such material which is electrically charged with a charge opposite to the charge of the object to be coated; such object is transported through the container immediately above the charged and aerated materials in order to be coated. ()

d. Minimum Maintained Velocity is the velocity of air movement which must be maintained in order to meet minimum specified requirements for health and safety. ()

e. Spraying Area is any area in which dangerous quantities of flammable vapors or mists or combustible residues, dusts, or deposits are present due to the operation of spraying processes. ()

f. Spray Booth is a power ventilated structure provided to enclose or accommodate a spraying operation, to confine and limit the escape of spray, vapor, and residue, and to safely conduct or direct them to an exhaust system. ()

g. Spray Booth, Waterwash, is a spray booth equipped with a water washing system designed to minimize dusts or residues entering exhaust ducts and to permit the recovery of over-spray finishing material. ()

h. Spray Booth., Dry, is a spray booth not equipped with a water washing system as described in Subsection d. of this section. A dry spray booth may be equipped with: distribution or baffle plates to promote an even flow of air through the booth or cause the deposit of over-spray before it enters the exhaust duct; or over-spray dry filters to minimize dusts; or over-spray dry filters to minimize dusts or residues entering exhaust ducts; or over-spray dry filter rolls designed to minimize dusts or residues entering exhaust ducts; or where dry powders are being sprayed, with powder collection systems so arranged in the exhaust to capture over-sprayed material. ()

i. Spray-Finishing Operation are employment of methods wherein organic or inorganic materials are utilized in dispersed form for deposit on surfaces to be coated, treated, or cleaned. Such methods of deposit may involve either automatic, manual, or electrostatic deposition but do not include metal spraying or metalizing, dipping, flow coating, roller coating, tumbling, centrifuging, or spray washing and degreasing as conducted in self-contained washing and degreasing machines or systems. ()

j. Spray Room is a room in which spray-finishing operations, not conducted in a spray booth, are performed separately from other areas. ()

03. General Requirements. ()

A. Respiratory protection is to meet the requirements of Section 050 of this standard. ()

04. Spray Booths and Rooms. ()

a. Spray booths shall be substantially constructed of steel, securely and rigidly supported, or of concrete or masonry except that aluminum or other substantial noncombustible material may be used for intermittent or low volume spraying. Spray booths shall be designed to sweep air currents toward the exhaust outlet. ()

b. The interior surfaces of spray booths and rooms shall be smooth and continuous without edges and otherwise designed to prevent pocketing of residues and facilitate cleaning and washing without injury. ()

c. The floor surface of a spray booth or room and operator's working area, if combustible, shall be covered with noncombustible material of such character as to facilitate the safe cleaning and removal of residues. ()

d. Distribution of baffle plates, if installed to promote an even flow of air through the booth/room or cause the deposit of over-spray before it enters the exhaust duct, shall be of noncombustible material and readily removal be or accessible on both sides for cleaning. Such plates shall not be located in exhaust ducts. ()

e. The spraying operations except electrostatic spraying operations shall be so designed, installed, and maintained that the open face of the booth (or booth cross section during spraying operations) shall be not less than one-hundred (100) linear feet per minute. Electrostatic spraying operations may be conducted with an air velocity over the open face of the booth of not less than sixty (60) linear feet per minute, or more, depending on the volume of the finishing material being applied and its flammability and explosion characteristics. Visible gauges or audible alarm or pressure activated devices shall be installed to indicate or insure that the required air velocity is maintained. Dry spray booths equipped with a filter roll which is automatically advanced should be arranged to cause shutdown of spraying operations if the filter roll fails to advance automatically. Maintenance procedures should be established to assure replacing filter pads before excessive restriction to air-flow occurs. Filter pads should be inspected after each period of use and clogged filter pads discarded and replaced. Filter rolls shall be inspected to insure proper replacement of filter media. ()

f. All discarded filter pads and filter rolls shall be immediately removed to a safe, well-detected location or placed in a water-filled metal container and disposed of at the close of the day's operation unless maintained completely in water. ()

g. The location of filters in a spray booth/room shall be so as to not reduce the effective booth/room enclosure of the articles being sprayed. ()

h. Space within the spray booth/room on the downstream and upstream sides of filters shall be protected with approved automatic sprinklers. ()

i. Filters or filter rolls shall not be used when applying a spray material known to be highly susceptible to spontaneous heating and ignition. ()

j. Clean filters or filter rolls shall be noncombustible or of a type having a combustibility not in excess

of Class two (2) filters as listed by Underwriters' Laboratories, Inc. Filters and filter rolls shall not be alternately used for different types of coating materials, where the combination of materials may be conducive to spontaneous ignition. ()

k. Each spray booth having a frontal area larger than nine (9) square feet shall have a metal deflector or curtain not less than two and one-half (2 1/2) inches deep installed at the upper outer edge of the booth over the opening. ()

l. Where conveyors are arranged to carry work into or out of spray booths/rooms, the openings therefor shall be as small as practical. ()

m. Each spray booth shall be separated from other operations by not less than three (3) feet, or by a greater distance, or by such partition or wall as to reduce the danger from juxtaposition of hazardous operations. ()

n. Spray booths shall be so installed that all portions are readily accessible for cleaning. A clear space of not less than three (3) feet on all sides shall be kept free from storage of combustible construction. ()

o. When Spraying areas are illuminated through glass panels or other transparent materials, only fixed lighting units shall be used as a source of illumination. Panels shall effectively isolate the spraying area from the area in which the lighting unit is located, and shall be of a noncombustible material of such a nature or so protected that breakage will be unlikely. Panels shall be so arranged that normal accumulations of residue on the exposed surface of the panel will not be raised to a dangerous temperature by radiation or conduction from the source of illumination. ()

p. Spray booths or spray rooms are to be used to enclose or confine all spray-finishing operations. ()

q. Spray booths shall be designed and constructed in accordance with this subsection and NFPA No. 33 for general construction specifications. For a more detailed discussion of fundamentals relating to this subject, see ANSI Z9.2. ()

r. Lights, motors, electrical equipment, and other sources of ignition shall conform to the requirements of Subsection 240.05., Section 150, and the National Electric Code ()

s. In no case shall combustible material be used in the construction of a spray booth or room and supply or exhaust duct connected to it. ()

t. Unobstructed walkways shall not be less than six point five (6.5) feet high and shall be maintained clear of obstruction from any work location in the booth to a booth exit or open booth front. In booths where the open front is the only exit, such exits shall be not less than three (3) feet wide. In booths having multiple exits, such exits shall not be less than two (2) feet wide, provided that the maximum distance from the work location to the exit is twenty-five (25) feet or less. Where booth exits are provided with doors, such doors shall open outward from the booth. ()

u. Over-spray filters shall be installed in a location easily accessible for inspection, cleaning, or replacement. ()

v. Where effective means, independent of the over-spray filters, are installed which will result in design air distribution across the booth cross section, it is permissible to operate the booth without the filters in place. ()

w. For wet or water-wash spray booths/rooms, the water-chamber enclosure within which intimate contact of contaminated air and cleaning water or other cleaning medium is maintained, if made of steel, shall be eighteen (18) gage or heavier and adequately protected against corrosion. ()

x. Water chambers may include scrubber spray nozzles, headers, troughs, or other devices. Chambers

shall be provided with adequate means for creating and maintaining scrubbing action for removal of particulate matter from the exhaust air stream. ()

y. Collecting tanks shall be of welded steel construction or other suitable non-combustible material. If pits are used as collecting tanks, they shall be concrete, masonry, or other material having similar properties. ()

z. Collecting tanks shall be provided with tiers, skimmer plates, or screens to prevent sludge and floating materials from entering the pump suction box. Means for automatically maintaining the proper water level shall also be provided. Fresh water inlets shall not be submerged. They shall terminate at least one (1) pipe diameter above the safety overflow level of the tank. ()

aa. Collecting tanks shall be so constructed as to discourage accumulation of hazardous deposits. ()

bb. Pump manifolds, risers, and headers shall be adequately sized to insure sufficient water flow to provide efficient operation of the water chamber. ()

cc. Spray rooms, including floors, shall be constructed of masonry, concrete, or other noncombustible material. ()

dd. Spray rooms shall have noncombustible fire doors and shutters. ()

ee. Spray rooms shall be adequately ventilated so that the atmosphere in the breathing zone of the operator shall be maintained in accordance with the requirements of Subsection 241.06. of this section. ()

ff. Spray rooms used for production spray-finishing operations shall conform to the requirements for spray booths. ()

05. Electrical and Other Sources of Ignition. ()

a. Conformance. All electrical equipment, open flames and other sources of ignition shall conform to the requirements of this section, except as follows: Electrostatic apparatus shall conform to the requirements of Subsections 240.11 and 240.12 of this section. Drying, curing and fusion apparatus shall conform to the requirements of Subsection 240.13 of this section. Automobile undercoating spray operations in garages shall conform to the requirements of Subsection 240.14 of this section. Powder coating equipment shall conform to the requirements of Subsection 240.15 of this section. ()

b. There shall be no open flame or spark producing equipment in any spraying area nor within twenty (20) feet thereof, unless separated by a partition. ()

c. Space-heating appliances, steam pipes, or hot surfaces shall not be located in a spraying area where deposits of combustible residues may readily accumulate. ()

d. Electrical wiring and equipment shall conform to the provisions of this section and shall otherwise be in accordance with Section 150 of this standard. ()

e. Unless specifically approved for locations containing both deposits of readily ignitable residue and explosive vapors, there shall be no electrical equipment in any spraying area, whereon deposits of combustible residues may readily accumulate, except wiring in rigid conduit, in boxes, or fittings containing no taps, splices, or terminal connections. ()

f. Electrical wiring and equipment not subject to deposits of combustible residues but located in a spraying area as herein defined shall be of explosion-proof type approved for Class I, Group D locations and shall otherwise conform to the provisions of Section 150 of this standard, for Class I, Division I Locations. Electrical wiring, motors, and other equipment outside of but within twenty (20) feet of any spraying area, and not separated therefrom by partitions shall not produce sparks under normal operating conditions and shall otherwise conform to the provisions of Section 150 of this standard, for Class I, Division 2 Hazardous Locations. ()

g. Electric lamps outside of but within twenty (20) feet of any spraying area, and not separated therefrom by a partition, shall be totally enclosed to prevent the falling of hot particles and shall be protected from mechanical injury by suitable guards or by location. ()

h. Portable electric lamps shall not be used in any spraying area during spraying operations. Portable electric lamps, if used during cleaning or repairing operations, shall be of the type approved for hazardous Class I locations. ()

i. All metal parts of spray booths, exhaust ducts, and piping systems conveying flammable or combustible liquids or aerated solids shall be properly electrically grounded in an effective and permanent manner. ()

j. Airless high-fluid pressure spray guns and any conductive object being sprayed shall be properly electrically grounded. ()

06. Ventilation. ()

a. Ventilation and exhaust systems shall be in accordance with NFPA 91 where applicable and shall also conform to the provisions of this section and Section 300 of this standard. ()

b. Ventilation shall be provided in accordance with provisions of NFPA No. 33, and in accordance with the following: Where a fan plenum is used to equalize or control the distribution of exhaust air movement through the booth, it shall be of sufficient strength or rigidity to withstand the differential air pressure or other superficially imposed loads for which the equipment is designed and also to facilitate cleaning. Construction specifications shall be at least equivalent to those of Subsection c. of this section. ()

c. All spraying areas shall be provided with mechanical ventilation adequate to remove flammable vapors, mists, or powders to a safe location and to confine and control combustible residues so that life is not endangered. Mechanical ventilation shall be kept in operation at all times while spraying operations are being conducted and for a sufficient time thereafter to allow vapors from drying coated articles and drying finishing material residue to be exhausted. ()

d. Each spray booth shall have an independent exhaust duct system discharging to the exterior of the building, except that multiple cabinet spray booths in which identical spray finishing material is used with a combined frontal area of not more than eighteen (18) square feet may have a common exhaust. If more than one (1) fan serves one booth, all fans shall be so interconnected that one fan cannot operate without all fans being operated. Exhaust discharge shall be so directed that it is not reintroduced into buildings through air intakes of heating/ventilation equipment. ()

e. The fan rotating element shall be nonferrous or nonsparking or the casing shall consist of or be lined with such material. There shall be ample clearance between the fan rotating element and the fan casing to avoid a fire by friction, necessary allowance being made for ordinary expansion and loading to prevent contact between moving parts and the duct or fan housing. Fan blades shall be mounted on a shaft sufficiently heavy to maintain perfect alignment even when the blades of the fan are heavily loaded, the shaft preferably to have bearings outside the duct and booth. All bearings shall be of the self lubricating type, or lubricated from the outside of the duct. ()

f. Clean fresh air, free from contamination from adjacent industrial exhaust systems, chimneys, stacks, or vents, shall be supplied to a spray booth or room in quantities equal to the volume of air exhausted through the spray booth/room. ()

g. Where a spray booth or room receives make-up air through self-closing doors, dampers, or louvers, they shall be fully open at all times when the booth or room is in use for spraying. The velocity of air through such doors, dampers, or louvers shall not exceed two-hundred (200) feet per minute. If the fan characteristics are such that the required air flow through the booth will be provided, higher velocities through the doors, dampers, or louvers may be used. ()

h. Where the air supply to a spray booth or room is filtered, the fan static pressure shall be calculated on the assumption that the filters are dirty to the extent that they require cleaning or replacement. The rating of filters shall be governed by test data supplied by the manufacturer of the filter. A pressure gage shall be installed to show the pressure drop across the filters. This gage shall be marked to show the pressure drop at which the filters require cleaning or replacement. Filters shall be replaced or cleaned whenever the pressure drop across them becomes excessive or whenever the air flow through the face of the booth falls below that specified in Table 240.07-B. ()

i. Means for heating make-up air to any spray booth or room, before or at the time spraying is normally performed, shall be provided in all places where the outdoor temperature may be expected to remain below fifty-five (55) degrees Fahrenheit for appreciable periods of time during the operation of the booth except where adequate and safe means of radiant heating for all operating personnel affected is provided. The replacement air during the heating seasons shall be maintained at not less than sixty-five (65) degrees Fahrenheit at the point of entry into the spray booth or spray room. When otherwise unheated make-up air would be at a temperature of more than ten (10) degrees Fahrenheit below room temperature, its temperature shall be regulated as provided in ANSI Z9.2. ()

j. As an alternative to an air replacement system complying with the preceding subsection, general heating of the building in which the spray room or booth is located may be employed provided that all occupied parts of the building are maintained at not less than sixty-five (65) degrees Fahrenheit when the exhaust system is in operation or the general heating system supplemented by other sources of heat may be employed to meet this requirement. ()

k. No means of heating make-up air shall be located in a spray booth/room. ()

l. Where make-up air is heated by coal or oil, the products of combustion shall not be allowed to mix with the makeup air, and the products of combustion shall be conducted outside the building through a flue terminating at a point remote from all points where make-up air enters the building. ()

m. Where make-up air is heated by gas, and the products of combustion are not mixed with the make-up air but are conducted through an independent flue to a point outside the building remote from all points where make-up air enters the building, it is not necessary to comply with Subsection 240.06.i. of this section. ()

n. Where make-up air to any manually operated spray booth or room is heated by gas and the products of combustion are allowed to mix with the supply air, the following precautions shall be taken: The gas must have a distinctive and strong enough odor to warn workers in a spray booth or room of its presence if in an unburned state in the make-up air. The maximum rate of gas supply to the make-up air heater burners must not exceed that which would yield in excess of two-hundred (200) p.p.m. (parts per million) of carbon monoxide or two-thousand (2,000) p.p.m. of total combustible gases in the mixture if the unburned gas upon the occurrence of flame failure were mixed with all of the make-up air supplied. A fan must be provided to deliver the mixture of heated air and products of combustion from the plenum chamber housing the gas burners from the spray booth or room. ()

o. Inlet or supply ductwork used to transport makeup air to spray booths/rooms or surrounding areas shall be constructed of noncombustible materials. ()

p. If negative pressure exists within inlet ductwork, all seams and joints shall be sealed if there is a possibility of infiltration of harmful quantities of noxious gases, fumes, or mists from areas through which ductwork passes. ()

q. Inlet ductwork shall be sized in accordance with volume flow requirements and provide design air requirements at the spray booth. ()

r. Inlet ductwork shall be adequately supported throughout its length to sustain at least its own weight plus any negative pressure which is exerted upon it under normal operating conditions. ()

s. Electric motors driving exhaust fans shall not be placed inside booths or ducts. ()

t. Belts shall not enter the duct or booth unless the belt and pulley within the duct or booth are

thoroughly enclosed. ()

u. Exhaust ducts shall be constructed of steel and shall be substantially supported. Exhaust ducts without dampers are preferred; however, if dampers are installed, they shall be maintained so that they will be in a full open position at all times the ventilating system is in operation. ()

v. Exhaust ductwork shall be adequately supported throughout its length to sustain its weight plus any normal accumulation in its interior during normal operating conditions and any negative pressure exerted upon it. ()

w. Exhaust ductwork shall be sized in accordance with good design practice which shall include consideration of fan capacity, length of duct, number of turns and elbows, variation in size, volume, and character of materials being exhausted. ()

x. Exhaust ducts shall be protected against mechanical damage and have a clearance from unprotected combustible construction or other combustible material of not less than eighteen (18) inches. ()

y. If combustible construction is provided with the following protection applied to all surfaces within eighteen (18) inches, clearances may be reduced to the distances indicated: twenty-eight (28) gage sheet metal on one-quarter (1/4) inch cement mill board - twelve (12) inches; twenty-eight (28) gage sheet metal on one-eighth (1/8) inch cement mill board space out one (1) inch on noncombustible spacers - nine (9) inches; twenty-two (22) gage sheet metal on one (1) inch rockwool batts reinforced with wire mesh or the equivalent - three (3) inches. Where ducts are protected with an approved automatic sprinkler system, properly maintained, the clearance required in Subsection 240.06.s. of this section may be reduced to six (6) inches. ()

z. Longitudinal joints in sheet steel ductwork shall be either lock-seamed riveted, or welded. For other than steel construction, equivalent securing of joints shall be provided. ()

aa. Circumferential joints in ductwork shall be substantially fastened together and lapped in the direction of air-flow. At least every fourth joint shall be provided with connecting flanges, bolted together, or of equivalent fastening security. ()

bb. Unless spray booth exhaust duct terminal is from a water-wash spray booth, the terminal discharge point shall be not less than six (6) feet from any combustible exterior wall or roof nor discharge in the direction of any combustible construction or unprotected opening in any noncombustible exterior wall within twenty-five (25) feet. ()

cc. Where ductwork passes through a combustible roof or wall, the roof or wall shall be protected at the point of penetration by open space or fire-resistive material between the duct and the roof or wall. When ducts pass through firewalls, they shall be provided with automatic fire dampers on both sides of the wall, except that three-eighth (3/8) inch steel plates may be used in lieu of automatic fire dampers for ducts not exceeding eighteen (18) inches in diameter. ()

dd. Air exhaust from spray operations shall not be directed so that it will contaminate makeup air being introduced into the spraying area or other ventilating intakes, nor directed so as to create a nuisance. Air exhausted from spray operations shall not be recirculated. ()

ee. Ductwork used for ventilating and processes covered in this section shall not be connected to ducts ventilating any other process or any chimney or flue used for conveying any products of combustion. ()

ff. When necessary to facilitate cleaning, exhaust ducts shall be provided with an ample number of access doors. Inspection or clean-out doors shall be provided for every nine (9) to twelve (12) feet of running length for ducts up to twelve (12) inches in diameter, but the distance between clean-out doors may be greater for larger pipes. A clean-out door or doors shall be provided for servicing the fan, and where necessary, a drain shall be provided. ()

gg. Air intake openings to rooms containing spray finishing operations shall be adequate for the

efficient operation of exhaust fans and shall be so located as to minimize the creation of dead air pockets. ()

hh. Freshly sprayed articles shall be dried only in spaces provided with adequate ventilation to prevent the formation of explosive vapors. In the event adequate and reliable ventilation is not provided such drying spaces shall be considered a spraying area. ()

07. Velocity and Air Flow Requirements. ()

a. Except where a spray booth/room has an adequate air replacement system, the velocity of air into all openings of a spray booth/room shall be not less than that specified in Table 240.07-A for the operating conditions specified. An adequate air replacement system is one which introduces replacement air upstream or above the object being sprayed and is so designed that the velocity of air in the booth/room cross section is not less than that specified in Table 240.07-A when measured upstream or above the object being sprayed. ()

TABLE 240.07-A			
MINIMUM MAINTAINED VELOCITIES INTO SPRAY BOOTHS			
Operating conditions for objects completely inside booth	Crossdraft, f.p.m.	Airflow velocities, f.p.m.	
		Design	Range
Electrostatic and automatic airless operation contained in booth without operator	Negligible	50 large booth	50 - 75
		100 small booth	75 - 125
Air operated guns, manual or automatic	Up to 50	100 large booth	75 - 125
Air operated guns, manual or automatic	Up to 100	150 small booth	125 - 175
		150 large booth	125 - 175
		200 small booth	150 - 250
NOTES: 1. Attention is invited to the fact that the effectiveness of the spray booth is dependent upon the relationship of the depth of the booth to its height and width. 2. Cross drafts can be eliminated through proper design and such design should be sought. Cross drafts in excess of 100 fpm (feet per minute) should not be permitted. 3. Excessive air pressures result in loss of both efficiency and material waste in addition to creating a backlash that may carry over-spray and fumes into adjacent work areas. 4. Booths should be designed with velocities shown in the column headed "Design". However, booths operating with velocities shown in the column headed "Range" are in compliance with this standard.			

b. In addition to the requirements Subsection 240.07.a. of this section, the total air volume exhausted through a spray booth shall be such as to dilute solvent vapor to at least twenty-five (25%) percent of the lower explosive limit of the solvent being sprayed. An example of the method of calculating this volume is given below. EXAMPLE: To determine the lower explosive limits of the most common solvents used in spray finishing, see Table 240.07-B. Column 1 gives the number of cubic feet of vapor per gallon of solvent and column 2 gives the lower explosive limit (LEL) in percentage by column of air. Note that the quantity of solvent will be diminished by the quantity of solids and nonflammables contained in the finish. To determine the volume of air in cubic feet necessary to dilute the vapor from one (1) gallon of solvent to twenty-five (25%) percent of the lower explosive limit, apply the following formula: Dilution volume required per gallon of solvent = four (4) (one-hundred (100) LEL) (Cubic feet of vapor per gallon) ÷ LEL. Using toluene as the solvent, LEL of toluene from Table 241.18-B, Column 2, is one point four (1.4%) percent; cubic feet of vapor per gallon from Table 241.18-B Column 1, is thirty point four (30.4) cubic

feet per gallon; dilution volume required = four (4) (one-hundred (100) one point four (1.4)) thirty point four (30.4) ÷ one point four (1.4) = eight-thousand five-hundred sixty-four (8,564) cubic feet. To convert cubic feet per minute of required ventilation, multiply the dilution volume required per gallon of solvent by the number of gallons of solvent evaporated per minute. ()

TABLE 240.07-B		
LOWER EXPLOSIVE LIMIT OF SOME COMMONLY USED SOLVENTS		
Solvent	Cubic feet per gallon of vapor of liquid at 70° Fahrenheit	Lower explosive limit in percent by volume of air at 70° Fahrenheit
	Column 1	Column 2
Acetone	44.0	2.6
Amyl Acetate (iso)	21.6	1.0 ¹
Amyl Alcohol (n)	29.6	1.2
Amyl Alcohol (iso)	29.6	1.2
Benzene	36.8	1.4 ¹
Butyl Acetate (n)	24.8	1.7
Butyl Alcohol (n)	35.2	1.4
Butyl Cellosolve	24.8	1.1
Cellosolve	33.6	1.8
Cellosolve Acetate	23.2	1.7
Cyclohexanone	31.2	1.1 ¹
1.1 Dichloroethylene	42.4	5.9
1.2 Dichloroethylene	42.4	9.7
Ethyl Acetate	32.8	2.5
Ethyl Alcohol	55.2	4.3
Ethyl Lactate	28.0	1.5 ¹
Methyl Acetate	40.0	3.1
Methyl Alcohol	80.8	7.3
Methyl Cellosolve	40.8	2.5
Methyl Ethyl Ketone	36.0	1.8
Methyl n-Propyl Ketone	30.4	1.5
Naphtha (VM&P) (76° Naphtha)	22.4	0.9
Naphtha (100° Flash) Safety Solvent - Stoddard Solvent	23.2	1.0
Propyl Acetate (n)	27.2	2.8
Propyl Acetate (iso)	28.0	1.1
Propyl Alcohol (n)	44.8	2.1

TABLE 240.07-B		
LOWER EXPLOSIVE LIMIT OF SOME COMMONLY USED SOLVENTS		
Propyl Alcohol (iso)	44.0	2.0
Toluene	30.4	1.4
Turpentine	20.8	0.8
Xylene (o)	26.4	1.0
¹ At 212° Fahrenheit		

()

c. When an operator must position himself in a booth/room downstream of the object being sprayed, an air-supplied respirator or other type of respirator approved by NIOSH or the Bureau of Mines, U. S. Department of the Interior or specified in ANSI Z88.2 for the material being sprayed should be used by the operator. Where down-draft booths/rooms are provided with doors, such doors shall be closed when spray painting. ()

08. Flammable and Combustible Liquids - Storage and Handling. ()

a. Conformance. The storage of flammable or combustible liquids in connection with spraying operations shall conform to the requirements of Section 220 of this standard, where applicable. ()

b. The quantity of flammable or combustible liquids kept in the vicinity of spraying operations shall be the minimum required for operations and should ordinarily not exceed a supply for one (1) day or one (1) shift. Bulk storage of portable containers of flammable or combustible liquids shall be in accordance with the requirements for flammable combustible liquid storage of Section 220 of this standard. ()

c. Original closed containers, approved portable tanks, approved safety cans or a properly arranged system of piping shall be used for bringing flammable or combustible liquids into spray finishing room. Open or glass containers shall not be used. ()

d. Except as provided in Subsection 240.08.e. of this section, the withdrawal of flammable and combustible liquids from containers having a capacity of greater than sixty (60) gallons shall be by approved pumps. The withdrawal of flammable or combustible liquids from containers and the filling of containers, including portable mixing tanks, shall be done only in a suitable mixing room or in a spraying area when the ventilating system is in operation. Adequate precautions shall be taken to protect against liquid spillage and sources of ignition. ()

e. Containers supplying spray nozzles shall be of closed type or provided with metal covers that are kept closed. Containers not resting on floors shall be on metal supports or suspended by wire cables. Containers supplying spray nozzles by gravity flow shall not exceed ten (10) gallons capacity. Original shipping containers shall not be subject to air pressure for supplying spray nozzles. Containers under air pressure supplying spray nozzles shall be of limited capacity, not exceeding that necessary for one (1) day's operation; shall be designed and approved for such use; shall be provided with a visible pressure gage; and shall be provided with a relief valve set to operate in conformance with the requirements of the ASME Boiler and Pressure Vessel Code. Containers under air pressure supplying spray nozzles air-storage tanks and coolers shall conform to the standards of the ASME Boiler and Pressure Vessel Code. ()

f. All containers or piping to which is attached a hose or flexible connection shall be provided with a shutoff valve at the connection. Such valves shall be kept shut when spraying operations are not being conducted. ()

g. When a pump is used to deliver products, automatic means shall be provided to prevent pressure in excess of the design working pressure of accessories, piping, and hose. ()

h. All pressure hose and couplings shall be inspected at regular intervals appropriate to their service. The hose and couplings shall be tested with the hose extended, and using the inservice maximum operating pressures. Any hose showing material deteriorations, signs of leakage, or weakness in its carcass or at the couplings, shall be withdrawn from service and repaired or discarded. ()

i. Piping systems conveying flammable or combustible liquids shall be of steel or other material having comparable properties of resistance to heat and physical damage. Piping systems shall be properly bonded and grounded. ()

j. Electrically powered spray liquid heaters shall be approved and listed for the specific location in which used (see Subsection 240.05). Heaters shall not be located in spray booths nor other locations subject to the accumulation of deposits or combustible residue. Agitators, if used, should preferably be driven by compressed air, water, or low-pressure steam. If an electric motor is used, see Subsection 240.05 of this section. ()

k. If flammable or combustible liquids are supplied to spray nozzles by positive displacement pumps, the pump discharge line shall be provided with an approved relief valve discharging to a pump suction, a safe detached location, or a device provided to stop the prime-mover if the discharge pressure exceeds the safe operating pressure of the system. ()

l. Whenever flammable or combustible liquids are transferred from one container to another, both containers shall be effectively bonded and grounded to prevent discharge sparks of static electricity. ()

09. Protection. ()

a. In sprinklered buildings, the automatic sprinkler system in rooms containing spray finishing operations shall conform to the Standard for the Installation of Sprinkler Systems. NFPA 13, Provisions for Extra Hazard Occupancy, and in unsprinklered buildings where sprinklers are installed only to protect spraying areas, the installations shall conform to such standards insofar as they may be applicable. Sprinkler installations shall also conform to the provisions of this section. Sprinkler heads shall be located to effect water distribution throughout the entire booth/room. ()

b. Automatic sprinklers protecting each spray booth (together with its connecting exhaust) shall be under an accessibility located separate outside stem and yoke (OS&Y) subcontrol valve. ()

c. Sprinklers protecting spraying areas shall be kept as free from deposits as practical by cleaning daily if necessary. ()

d. An adequate supply of suitable portable fire extinguishers shall be installed near all spraying areas. ()

10. Operations and Maintenance. ()

a. Spraying shall not be conducted outside of predetermined spraying areas. ()

b. All spraying areas shall be kept as free from the accumulation of deposits of combustible residues as practical, with cleaning conducted daily if necessary. Scrapers, spuds, or other such tools used for cleaning purposes shall be of nonsparking material. ()

c. Residue scrapings and debris contaminated with residue shall be immediately removed from the premises and properly disposed. Approved metal waste cans shall be provided wherever rags or waste are impregnated with finishing material and all such rags or waste deposited therein immediately after use. The contents of waste cans shall be properly disposed of at least once daily or at the end of each shift. ()

d. Spray finishing employee clothing shall not be left on the premises overnight unless kept in metal lockers. ()

e. The use of solvents for cleaning operations shall be restricted to those having flash points not less

than one-hundred (100) degrees Fahrenheit; however, for cleaning spray nozzles and auxiliary equipment, solvents having flash points not less than those normally used in spray operations may be used. Such cleaning shall be conducted inside spray booths and ventilating equipment operated during cleaning. ()

f. Spray booths/rooms shall not be alternately used for different types of coating materials, where the combination of the materials may be conducive to spontaneous ignition, unless all deposits of the first used material are removed from the booth and exhaust ducts prior to spraying with the second used material. ()

g. "No Smoking" signs in large letters on contrasting color background shall be conspicuously posted at all spraying areas and paint storage rooms. (See Section 170 of this standard.) ()

11. Fixed Electrostatic Apparatus. ()

a. Where installation and use of electrostatic spraying equipment is used, such installation and use shall conform to all other requirements contained in this section, and shall also conform to the requirements of this subsection. ()

b. Electrostatic apparatus and devices used in connection with coating operations shall be of approved types. ()

c. Transformers, power packs, control apparatus, and all other electrical portions of the equipment with the exception of high-voltage grids, electrodes, and electrostatic atomizing heads and their connections, shall be located outside of the spraying area, or shall otherwise conform to the requirements of Subsection 240.05 of this section. ()

d. Electrodes and electrostatic atomizing heads shall be adequately supported in permanent locations and shall be effectively insulated from the ground. Electrodes and electrostatic atomizing heads which are permanently attached to their bases, supports, or reciprocator, shall be deemed to comply with this section. Insulators shall be nonporous and noncombustible. ()

e. High-voltage leads to electrodes shall be properly insulated and protected from mechanical injury or exposure to destructive chemicals. Electrostatic atomizing heads shall be effective and permanently supported on suitable insulators and shall be effectively guarded against accidental contact or grounding. An automatic means shall be provided for grounding the electrode system when it is electrically de-energized for any reason. All insulators shall be kept clean and dry. ()

f. A safe distance shall be maintained between goods being painted and electrodes or electrostatic atomizing heads or conductors of at least twice the sparking distance. A suitable sign indicating this safe distance shall be conspicuously posted near the assembly. ()

g. Goods being painted using this process are to be supported on conveyors. The conveyors shall be so arranged as to maintain safe distances between the goods and the electrodes or electrostatic atomizing head at all times. Any irregularly shaped or other goods subject to possible swinging or movement shall be rigidly supported to prevent such swinging or movement which would reduce the clearance to less than that specified in Subsection 240.11.f. of this section. ()

h. This process is not acceptable where goods being coated are manipulated by hand. When finishing equipment which is manipulated by hand, see Subsection 240.12 of this section. ()

i. Electrostatic apparatus shall be equipped with automatic controls which will operate without time delay to disconnect the power supply to the high voltage transformer and to signal the operator under any of the following conditions: stoppage of ventilating fans or failure of ventilating equipment from any cause; stoppage of the conveyor carrying goods through the high voltage field; occurrence of a ground or of an imminent ground at any point on the high voltage system; or a reduction of clearance below that specified in Subsection 240.11. f. of this section. ()

j. Adequate booths, fencing, railings, or guards shall be so placed about the equipment that they,

either by their location or character or both, assure that a safe isolation of the process is maintained from plant storage or personnel. Such railings, fencing, and guards shall be conducting material, adequately grounded. ()

k. Where electrostatic atomization is used, the spraying area shall be so ventilated as to insure safe conditions from a fire and health standpoint. ()

l. All areas used for spraying, including the interior of the booth, shall be protected by automatic sprinklers where this protection is available. Where this protection is not available, other approved automatic extinguishing equipment shall be provided. ()

12. Electrostatic Hand Spraying Equipment. ()

a. This subsection shall apply to any equipment using electrostatically charged elements for the atomization and/or precipitation of materials for coatings on articles, or for other similar purposes in which the atomizing device is hand held and manipulated during the spraying operation. ()

b. Conformance. Electrostatic hand spraying equipment shall conform with the other provisions this section, and shall also conform to the requirements of this subsection. ()

c. Electrostatic hand spray apparatus and devices used in connection with coating operations shall be of approved types. The equipment should be so designed that the maximum surface temperature of the equipment in the spraying area shall not exceed one-hundred fifty (150) degrees Fahrenheit under any condition. The high voltage circuits shall be designed so as to not produce a spark of sufficient intensity to ignite any vapor-air mixtures nor result in appreciable shock hazard upon coming in contact with a grounded object under all normal operating conditions. The electrostatically charged exposed elements of the handgun shall be capable of being energized only by a switch which also controls the coating material supply. ()

d. Transformers, powerpacks, control apparatus, and all other electrical portions of the equipment, with the exception of the handgun itself and its connections to the powder supply shall be located outside of the spraying area or shall otherwise conform to the requirements of Subsection 240.05 of this section. ()

e. The handle of the spraying gun shall be electrically connected to ground by a metallic connection and to be so constructed that the operator in normal operating position is in intimate electrical contact with the grounded handle. ()

f. All electrically conductive objects in the spraying area shall be adequately grounded. This requirement shall apply to paint containers, wash cans, and any other objects or devices in the area. The equipment shall carry a prominent permanently installed warning regarding the necessity for this grounding feature. ()

g. Objects being painted or coated shall be maintained in metallic contact with the conveyor or other grounded support. Hooks shall be regularly cleaned to insure this contact and areas of contact shall be sharp points or knife edges where possible. Points of support of the object shall be concealed from random spray where feasible and where the objects being sprayed are supported from a conveyor, the point of attachment to the conveyor shall be so located as to not collect spray material during normal operation. ()

h. The electrical equipment shall be so interlocked with the ventilation of the spraying area that the equipment cannot be operated unless the ventilation fans are in operation. ()

i. The spraying operation shall take place within a spray area which is adequately ventilated to remove solvent vapors released from the operation. ()

13. Drying, Curing, or Fusion Apparatus. ()

a. Drying, curing, or fusion apparatus in connection with spray application of flammable and combustible finishes shall conform to the Standard for Ovens and Furnaces, NFPA 86A, where applicable and shall also conform with other requirements of this section, and shall also conform to the requirements of this subsection. ()

b. Spray booths, rooms, or other enclosures used for spraying operations shall not alternately be used for the purpose of drying by any arrangement which will cause a material increase in the surface temperature of the spray booth, room, or enclosure. ()

c. Except as specifically provided in Subsection 240.13.d. of this section, drying, curing or fusion units utilizing a heating system having open flames or which may produce sparks shall not be installed in a spraying area, but may be installed adjacent thereto when equipped with an interlocked ventilation system arranged to: thoroughly ventilate the drying space before the heating system can be started; maintain a safe atmosphere at any source of ignition; and automatically shut down the heating system in the event of failure of the ventilating system. ()

d. Automobile refinishing spray booths or enclosures, otherwise installed and maintained in full conformity with this section may alternatively be used for drying with portable electrical infrared drying apparatus when conforming with the following: interior (especially floors) of spray enclosures shall be kept free of overspray deposits; during spray operations, the drying apparatus and electrical connections and wiring thereto shall not be located within spray enclosure nor in any other location where spray residues may be deposited thereon; the spraying apparatus, the drying apparatus and the ventilating system of the spray enclosure shall be equipped with suitable interlocks so arranged that; the spraying apparatus cannot be operated while the drying apparatus is inside the spray enclosure, the spray enclosure will be purged of spray vapors for a period of not less than three (3) minutes before the drying apparatus can be energized, the ventilating system will maintain a safe atmosphere within the enclosure during the drying process and the drying process apparatus will automatically shut off in the event of failure of the ventilating system; all electrical wiring and equipment of the drying apparatus shall conform with the applicable sections of Section 150 of this standard; and the drying apparatus shall contain a prominently located, permanently attached warning sign indicating that ventilation should be maintained during the drying period and that spraying should not be conducted in the vicinity that spray will deposit on apparatus. ()

14. Automobile Undercoating in Garages. ()

a. Automobile undercoating spray operations in garages, conducted in areas having adequate natural or mechanical ventilation, are exempt from the requirements pertaining to spray finishing operations, when using undercoating materials not more hazardous than kerosene (as listed by Underwriters' Laboratories in respect to fire hazard rating thirty (30) forty (40)) or undercoating materials using only solvents listed as having a flash point in excess of one-hundred (100) degrees Fahrenheit. Undercoating spray operations not conforming to these provisions are subject to all requirements of this section, and shall also conform to the requirements of this subsection pertaining to spray finishing operations. ()

15. Powder Coating. ()

a. Electrical equipment and other sources of ignition shall conform to the requirements of Section 150 of this standard, the National Electric Code, this section, and shall also conform to the requirements of this subsection. ()

b. In addition to the provisions of subsections 240.06. and 240.07. where applicable, exhaust ventilation shall be sufficient to maintain the atmosphere below the lowest explosive limits for the materials being applied. All non-deposited air-suspended powders shall be safely removed via exhaust ducts to the powder recovery cyclone or receptacle. Each installation shall be designed and operated to meet the foregoing performance specifications. ()

c. Powders shall not be released to the outside atmosphere. ()

d. The provisions of the Standard for ovens and furnaces, NFPA No. 86A shall apply where applicable. ()

e. All areas shall be kept free of the accumulation of powder coating dusts, particularly such horizontal surfaces as ledges, beams, pipes, hoods, booths, and floors. ()

f. Surfaces shall be cleaned in such manner as to avoid scattering dust to other places or creating dust clouds. ()

g. "No Smoking" signs in large letters on contrasting color background shall be conspicuously posted at all powder coating areas and powder storage rooms. ()

h. The provisions of Subsection 240.11 and other subsections of this section shall apply to fixed electrostatic equipment, except that electrical equipment not covered therein shall conform to Subsection 240.15.a. of this section. ()

i. The provisions of Subsection 240.12 and other subsections of this section shall apply to electrostatic handguns when used in powder coating, except that electrical equipment not covered therein shall conform to Subsection 240.15.a. of this section. ()

j. Electrostatic fluidized beds and associated equipment shall be of approved types. The maximum surface temperature of this equipment in the coating area shall not exceed one-hundred fifty (150) degrees Fahrenheit. The high voltage circuits shall be so designed as to not produce a spark of sufficient intensity to ignite any powder-air mixtures nor result in appreciable shock hazard upon coming in contact with a grounded object under normal conditions. ()

k. Transformers, power-packs, control apparatus, and all other electrical portions of the equipment, with the exception of the charging electrodes and their connections to the power supply shall be located outside of the powder coating area or shall otherwise conform to the requirements of Subsection 240.15.a. of this section. ()

l. All electrically conductive objects within the charging influence of the electrodes shall be adequately grounded. The powder coating equipment shall carry a prominent, permanently installed warning regarding the necessity for grounding these objects. ()

m. Objects being coated shall be maintained in contact with the conveyor or other support in order to insure proper grounding. Hangers shall be regularly cleaned to insure effective contact and areas of contact shall be sharp points or knife edges where possible. ()

n. The electrical equipment shall be so interlocked with the ventilation system that the equipment cannot be operated unless the ventilation fans are in operation. ()

16. Organic Peroxides and Dual Component Coatings. ()

a. All spraying operations involving the use of organic peroxides and other dual component coatings shall be conducted in approved sprinklered spray booths meeting the requirements of this section. ()

b. Smoking shall be prohibited and "No Smoking" signs shall be prominently displayed and only nonsparking tools shall be used in any area where organic peroxides are stored, mixed, or applied. ()

241. DIP TANKS CONTAINING FLAMMABLE OR COMBUSTIBLE LIQUIDS.

01. Scope. ()

a. Dip tanks containing flammable or combustible liquids shall conform to all other applicable requirements of this standard, as well as the following provisions. Nothing in this standard shall be construed to prohibit better or otherwise safer conditions than specified herein. ()

02. Definitions Applicable to this Section. ()

a. Dip Tank is a tank, vat, or container of flammable or combustible liquid in which articles or materials are immersed for the purpose of coating, finishing, treating or similar processes. ()

b. Molten Materials Handling Operations are all operations, other than welding, burning, and

soldering operations involving the use, melting, smelting, or pouring of metals, alloys, salts, or other similar substances in the molten state. Such operations also include heat treating baths, descaling baths, die casting stereotyping, galvanizing, tanning, and similar operations. ()

c. Surface Coating Operations are all operations involving the application of protective, decorative, adhesive, or strengthening coating or impregnation to one or more surfaces, or into the interstices of any object or material, by means of spraying, spreading, flowing, brushing, roll coating, pouring, cementing, or similar means; and any subsequent draining or drying operations, excluding open-tank operations. ()

d. Vapor Area is any area containing dangerous quantities of flammable vapors in the vicinity of dip tanks, their drain-boards or associated drying, conveying, or other equipment during operation or shutdown periods. ()

03. General Requirements. ()

a. This section applies to all operations involving the immersion of materials in liquids, or in the vapors of such liquids, for the purpose of cleaning or altering the surface or adding to or imparting a finish thereto or changing the character of the materials and their subsequent removal from the liquid or vapor, draining, and drying. These operations include washing, electroplating, anodizing, pickling, quenching, dyeing, dipping, tanning, dressing, bleaching, degreasing, alkaline cleaning, stripping, rinsing, digesting, and other similar operations. ()

b. Except where specific construction specifications are prescribed in this section, hoods, ducts, elbows, fans, blowers, and all other exhaust system parts, components, and supports thereof shall be so constructed as to meet conditions of service and to facilitate maintenance and shall conform in construction to the specifications contained in American National Standard, Fundamentals Governing the Design and Operation of Local Exhaust Systems, Z9.2. ()

04. Construction of Dip Tanks. ()

a. Dip tanks, including drain-boards if provided, shall be constructed of substantial noncombustible material, and their supports shall be of heavy metal reinforced concrete, or masonry. Where dip tanks extend through a floor to the story below or where the weakening of the tank supports by fire may result in the material having not less than one (1) hour fire resistance. ()

b. Dip tanks of over one-hundred fifty (150) gallons in capacity or ten (10) square feet in liquid surface area shall be equipped with a properly trapped overflow pipe leading to a safe location outside buildings. Smaller dip tanks should also be so equipped, where practical. The discharge of the overflow pipe should be so located and arranged that if the entire combustible contents of the dip tanks is overflowed through overflow pipe by the application of water during fire fighting, property will not be endangered. The size of the overflow pipe should be sufficient to conduct the maximum rate of flow of water expected to be applied to the liquid surface of the dip tank from automatic sprinklers or from other sources in the event of fire. ()

c. Overflow pipes shall be of sufficient capacity to overflow the maximum delivery of dip tank liquid fill pipes but shall not be less than three (3) inches in diameter and shall be increased in size depending upon the area of the liquid surface and the length and pitch of pipe. ()

d. Piping connections on drains and overflow lines shall be designed so as to permit ready access for inspection and cleaning of the interior. ()

e. The bottom of the overflow connection shall be not less than six (6) inches below the top of the tank. See also sub-section 241.04.f. and sub-section 241.04 of this sub-section. ()

f. Dip tanks over five-hundred (500) gallons in liquid capacity shall be equipped with bottom drains automatically and manually arranged to quickly drain the tank in the event of fire, unless the viscosity of the liquid at normal atmospheric temperature makes this impractical. Manual operation shall be from a safely accessible location. Where gravity flow is not practicable, automatic pumps shall be required. ()

g. Bottom drains shall be trapped and discharged to a closed properly vented salvage tank or to a safe location outside which will not endanger property. ()

h. According to tank capacity the diameter of bottom drainpipe shall be not less than the size indicated in Table 241.04-A. ()

TABLE 241.04-A	
Gallons	Inches
500 to 750	3
750 to 1,000	4
1,000 to 2,500	5
2,500 to 4,000	6
over 4,000	8

()

i. The capacity of the salvage tank shall be greater than the capacity of the dip tank or tanks to which they are connected. ()

j. Except as noted in Subsection 241.09. of this section (applying to hardening and tempering tanks), all dip tanks exceeding one-hundred fifty (150) gallons liquid capacity or having a liquid surface area exceeding four (4) square feet shall be protected with at least one (1) of the automatic extinguishing facilities conforming to Subsection 241.08 of this section. ()

k. Dip tanks utilizing a conveyor system shall be so arranged that in the event of fire, the conveyor system shall automatically cease motion and required bottom drains shall open. Conveyor systems shall automatically cease motion unless required ventilation is in full operation. See also Subsection 241.14. ()

l. When dip tank liquids are artificially heated, either by the dipping of heated articles, or by other application of heat to the liquid, provision shall be made to prevent a temperature rise greater than fifty (50) degrees Fahrenheit below the flashpoint of the liquid. See also Subsection 241.09. ()

05. Liquids used in Dip Tanks Storage and Handling. ()

a. The storage of flammable and combustible liquids in connection with dipping operation shall conform to the requirements of Section 220 of this standard, where applicable. Where portable containers are used for the replenishment of flammable and combustible liquids, provision shall be made so that both the container and tank shall be positively grounded and electrically bonded to prevent static electric sparks. ()

06. Electrical and Other Sources of Ignition. ()

a. There shall be no open flames, spark producing devices, or heated surfaces having a temperature sufficient to ignite vapors in any vapor area. Except as specifically permitted in Subsection 241.11.c., relating to electrostatic apparatus, electrical wiring and equipment in any vapor area (as defined in Subsection 241.02.b.) shall be explosion proof type according to the requirements of Section 150 of this Standard and the National Electric Code for Class I, Group D locations and shall otherwise conform to Section 150 of this Standard. ()

b. Unless specifically approved for locations containing both deposits of readily ignitable residues and explosive vapors, there shall be no electrical equipment in the vicinity of dip tanks or associated drain-boards or drying operations which are subject to splashing or dripping of dip tank liquids, except wiring in rigid conduit or in threaded boxes or fittings containing no taps, splices, or terminal connections, and except as specifically permitted in

Subsection 241.11.c. of this section. ()

c. In any floor space outside a vapor area but within twenty (20) feet therefrom, and not separated by tight partitions, there shall be no open flames or spark producing devices except as specifically permitted in NFPA Standard No. 86, Ovens and Furnaces, and electrical wiring and equipment shall conform to the provisions of Section 150 of this standard and the National Electric Code. ()

07. Operations and Maintenance. ()

a. Areas in the vicinity of dip tanks shall be kept as clear of combustible stock as practical and shall be kept entirely free of combustible debris. ()

b. When waste or rags are used in connection with dipping operations, approved self closing metal waste cans shall be provided and all impregnated rags or waste deposited therein immediately after use. The contents of waste cans shall be properly disposed of at least once daily at the end of each shift. ()

c. Periodic inspection or tests of all dip tank facilities shall be made, including covers, overflow pipe inlets and discharge, bottom drains and valves, electrical wiring and equipment and grounding connections, ventilating facilities, and all extinguishing equipment. Any defects found shall be promptly corrected. ()

d. "No Smoking" signs in large letters on contrasting color background shall be conspicuously posted in the vicinity of dip tanks. ()

08. Extinguishment. ()

a. Areas in the vicinity of dip tanks shall be provided with manual fire extinguishers suitable for flammable and combustible liquid fires, conforming to Standard for Portable Fire Extinguishers NFPA No. ten (10). and Section 061 of this Standard. ()

b. Automatic water spray extinguishing systems shall conform to NFPA Standard for Water Spray Systems for Fire Protection NFPA No. fifteen (15) and shall be arranged to protect tanks, drain-boards, and stock over drain-boards. ()

c. Automatic foam extinguishing systems shall conform to NFPA Standard for Foam Extinguishing Systems, NFPA No. eleven (11). Foam producing material selected shall be suitable for the intended use, taking into account characteristics of the dip tank liquid. ()

d. Overflow pipe shall be arranged to prevent the floating away of foam and clogging the overflow pipe. This may be accomplished by either of the following: the overflow pipe may be extended through tank wall and terminated in an "L" pointing downward. The bottom of the overflow pipe at the point it pierces tank wall should not be over two (2) inches above the opening or face of the "L"; or the overflow pipe inlet may be provided with a removable screen of one-quarter (1/4) inch mesh having an area of at least twice the cross-sectional area of overflow pipe. (Screens which may be clogged by dip tank ingredients shall be inspected and cleaned periodically.) ()

e. Automatic Carbon Dioxide Systems. Automatic carbon dioxide systems shall conform to NFPA Standards for Carbon Dioxide Extinguishing Systems NFPA No. twelve (12) and Subsection 063.06. of this Standard and shall be arranged to protect both dip tanks and drain-boards and unless stock over drain-boards is otherwise protected with automatic extinguishing facilities, shall also be arranged to protect such stock. ()

f. Dry chemical extinguishing systems shall conform to NFPA Standard for Dry Chemical Extinguishing Systems NFPA No. seventeen (17) and Subsection 063.05 of this Standard and shall be arranged to protect both dip tanks and drain-boards, and unless stock over drain-boards is otherwise protected with automatic extinguishing facilities, shall also be arranged to protect such stock. ()

g. Dip tank covers arranged to close automatically in the event of fire shall be actuated by approved automatic devices and shall also be arranged for manual operation. ()

- h. Dip tank covers shall be of substantial noncombustible material or of tin-clad type with enclosing metal applied with locked joints. ()
- i. Chains or wire rope shall be used for cover support or operating mechanism where the burning of a cord would interfere with the action of a device. ()
- j. Dip tank covers shall be kept closed when tanks are not in use. ()
09. Hardening and Tempering Tanks. ()
- a. Tanks shall be located as far as practicable from furnaces and shall not be located on or near combustible floors. ()
- b. Tanks shall be provided with a noncombustible hood and vent or other equally effective means of venting to the outside of the building to serve as a vent in case of fire. All such vent ducts shall be treated as flues and be kept well away from combustible roofs or materials. ()
- c. Tanks shall be so designed that the maximum workload is incapable of raising the temperature of the cooling medium to within fifty (50) degrees Fahrenheit below its flash point, or such tanks shall be equipped with circulating cooling systems which will accomplish the same result. ()
- d. Tanks shall be equipped with a high temperature limit switch arranged to sound an alarm when the temperature of the quenching medium reaches within fifty (50) degrees Fahrenheit below the flashpoint. If practical from an operating standpoint, such limit switches shall also shut down conveying equipment supplying work to the tank. ()
- e. The provisions of Subsection 241.08 of this section shall apply to tanks having a liquid surface area of twenty-five (25) square feet or more or a capacity of five-hundred (500) gallons or more. ()
- f. Air under pressure shall not be used to fill or to agitate oil tanks. ()
- g. Drain facilities from the bottom of the tank may be combined with the oil circulating system or arranged independently to drain the oil to a safe location. The drain valve shall be operated automatically with approved heat actuated devices or manually, and if the latter, the valve shall be operated from a safe distance. ()
10. Flow Coat. ()
- a. Except as modified in this subsection, all of the applicable requirements of this section for dip tanks apply. ()
- b. All piping shall be strongly erected and rigidly supported. ()
- c. Paint shall be supplied by direct low-pressure pumping arranged to automatically shut down by means of approved heat actuated devices, in the case of fire, or paint may be supplied by a gravity tank not exceeding ten (10) gallons in capacity. ()
- d. The area of the sump and any areas on which paint flows shall be considered the area of dip tank. ()
11. Electrostatic Apparatus. ()
- a. Installation and use of electrostatic detearing equipment shall conform to all of the applicable requirements of this section. ()
- b. Electrostatic apparatus and devices used in connection with paint detearing operations shall be of approved types. ()

c. Transformers, power-packs, control apparatus, and all other electrical portions of the equipment, with the exception of high voltage grids and their connections, shall be located outside the vapor area or shall conform to the requirements of Subsection 241.06. of this section. ()

d. Electrodes shall be of substantial construction, shall be rigidly supported in permanent locations, and shall be effectively insulated from ground. Insulators shall be nonporous and noncombustible. ()

e. High voltage leads to electrodes shall be effectively and permanently supported on suitable insulators, and shall be effectively guarded against accidental contact or grounding. An automatic means shall be provided for grounding and discharging any accumulated residual charge on the electrode assembly or the secondary circuit of the high voltage transformer when the transformer primary is disconnected from the source of supply. ()

f. A space shall be maintained between goods being deteared and electrodes or conductors of at least twice the sparking distance. A suitable sign stating the sparking distance shall be conspicuously posted near the assembly. ()

g. Goods being deteared using this electrostatic process are to be supported on conveyors. The conveyors shall be so arranged as to maintain safe distance between the goods and the electrodes at all times. All goods shall be so supported as to prevent any swinging or movement which would reduce the clearance to less than specified in Subsection 241.11.f. of this section. ()

h. This electrostatic process is not approved where goods being deteared are manipulated by hand. ()

i. Electrostatic apparatus shall be equipped with automatic controls which will operate without time delay to disconnect the power supply to the high voltage transformer and to signal the operator under any of the following conditions: stoppage of ventilating fans or failure of ventilating equipment from any cause; stoppage of the conveyor carrying goods past the high voltage grid; occurrence of a ground of imminent ground at any point on the high voltage system; or reduction of clearance below that specified in Subsection 241.11.f. of this section. ()

j. Adequate fencing, railings, or guards shall be so placed about the equipment that they, either by their location or character or both assure that a safe isolation of the process is maintained from plant storage or personnel. Such railings, fencing and guards shall be of conducting material, adequately grounded, and should be at least five (5) feet from processing equipment. ()

k. Electrode insulators shall be kept clean and dry. ()

l. The detearing area shall be ventilated by exhausting adequate air from the area as specified in Subsection 243.01 of this section. ()

m. All areas for detearing shall be protected by automatic sprinklers where this protection is available. Where this protection is not available, other approved automatic extinguishing equipment shall be provided. ()

n. Drip plates and screens subject to paint deposits shall be removable and shall be taken to a safe place for cleaning. ()

12. Roll Coating. ()

a. The processes of roll coating, spreading and impregnating, in which fabrics, paper or other materials are passed directly through a tank containing flammable or combustible liquids, or over the surface of a roller that revolves partially submerged in a Class I, or Class II liquids, as these terms are defined in Subsection 220.02 of this Standard, shall conform to the applicable requirements of Subsections 241.03 through 241.08 of this section. ()

b. Adequate arrangements shall be made to prevent sparks from static electricity by bonding and grounding all metallic rotating and other parts of machinery and equipment and by the installation of static collectors

or maintaining a conductive atmosphere such as a high relative humidity. ()

13. Chlorine Used in Chlorinator Systems. ()

a. Ventilation, storage of tanks, and use of tanks shall meet specifications of the Chlorine Manual, The Chlorine Institute, Inc., Third Edition, 1959. ()

14. Ventilation. ()

a. Vapor areas as defined in Subsection 241.02.b. of this section shall be limited to the smallest practical space by maintaining a properly designed system of mechanical ventilation arranged to move air from all directions towards the vapor area origin and thence to a safe outside location. Ventilating systems shall conform to the Standards of Blower and Exhaust Systems NFPA 91. Required ventilating systems shall be so arranged that the failure of any ventilating fan shall automatically stop any dipping conveyor system. See also Subsection 241.04 of this section. ()

b. When a required ventilating system serves associated drying operations utilizing a heating system which may be a source of ignition, means shall be provided for prevention before the heating system can be started; the failure of any ventilating fan shall automatically shut down the heating system; and the installation shall otherwise conform to the Standard for Ovens and Furnaces NFPA 86. ()

c. Open-surface tank operations shall be classified into sixteen (16) classes, numbered A-1 to D-4, inclusive. ()

d. Class is determined by two (2) factors, hazard potential designated by a letter from A to D, inclusive, and rate of gas, vapor, or mist evolution designated by a number from one (1) to four (4), inclusive (for example, B.3). ()

e. Hazard potential is an index, on a scale from A to D, inclusive, of the severity of the hazard associated with the substance contained in the tank because of the toxic, flammable, or explosive nature of the vapor, gas, or mist produced therefrom. The toxic hazard is determined from the concentration, measured in parts by volume of a gas or vapor, per million parts by volume of contaminated air (p.p.m.) or in milligrams of mist per cubic meter of air (mg./m.³), below which ill effects are unlikely to occur to the exposed worker. The concentrations shall be those in Subsection 300.05 of this Standard. ()

f. The relative fire or explosion hazard is measured in degrees Fahrenheit in terms of the closed-cup flash point of the substance in the tank. Detailed information on the prevention of fire hazards in dip tanks may be found in Dip Tanks Containing Flammable or Combustible Liquids, NFPA 34, National Fire Protection Association. Where the tank contains a mixture of liquids, other than organic solvents, whose effects are additive, the hygienic standard of the most toxic component (for example, the one having the lowest p.p.m. or mg./m.³) shall be used, except where such substance constitutes an insignificantly small fraction of the mixture. For mixtures of organic solvents their combined effect, rather than that of either individually, shall determine the hazard potential. In the absence of information to the contrary, the effects shall be considered as additive. If the sum of the ratios of the airborne concentration of each contaminant to the toxic concentration of that contaminant exceeds unity, the toxic concentration shall be considered to have been exceeded. (See NOTE below.) ()

NOTE: $(C_1 \div TLV_1) + (C_2 \div TLV_2) + (C_3 \div TLV_3) + \dots + (C_n \div TLV_n) \leq 1$ where C equals concentration measured at the operation in p.p.m. ()

g. Hazard potential shall be determined from Table 241.14-A with the value indicating greater hazard being used. When the hazardous material may be either a vapor with a threshold limit value (TLV) in p.p.m. or a mist with a TLV in mg./m.³, the TLV indicating the greater hazard shall be used (for example, A takes precedence over B or C; B over C; C over D). ()

TABLE 241.14-A			
DETERMINATION OF HAZARD POTENTIAL			
Hazard Potential	Toxicity Group		
	Gas or vapor (p.p.m.)	Misc. (mg./m ³)	Flash point (in degrees F.)
A	0-10	0-0.1	
B	11-100	0.11-1.0	Under 100
C	101-500	1.1-10	100-200
D	Over 500	Over 10	Over 200

h. Rate of gas, vapor, or mist evolution is a numerical index, on a scale of from one (1) to four (4), inclusive, both of the relative capacity of the tank to produce gas, vapor, or mist and of the relative energy with which it is projected or carried upwards from the tank. Rate is evaluated in terms of: the temperature of the liquid in the tank in degrees Fahrenheit; the number of degrees Fahrenheit that this temperature is below the boiling point of the liquid in degrees Fahrenheit; the relative evaporation of the liquid in still air at room temperature in an arbitrary scale -- fast, medium, slow, or nil; and the extent that the tank gases or produces mist in an arbitrary scale -- high, medium, low, and nil. (See Table 241.14-B, Note 2.) Gassing depends upon electrochemical or mechanical processes, the effects of which have to be individually evaluated for each installation (see Table 241.14-B, Note 3). ()

i. Rate of evolution shall be determined from Table 241.14-B. When evaporation and gassing yield different rates, the lowest numerical value shall be used. ()

TABLE 241.14-B				
DETERMINATION OF RATE OF GAS, VAPOR, OR MIST EVOLUTION¹				
Rate	Liquid temperature, °F	Degrees below boiling point	Relative evaporation ²	Gassing ³
1	Over 200	0-20	Fast	High
2	150-200	21-50	Medium	Medium
3	94-149	51-100	Slow	Low
4	Under 94	Over 100	Nil	Nil

NOTE 1: In certain classes of equipment specifically vapor degreasers, an internal condenser or vapor level thermostat is used to prevent the vapor from leaving the tank during normal operation. In such cases, rate of vapor evolution from the tank into the workroom is not dependent upon the factors listed in the table, but rather upon abnormalities of operating procedure, such as carry-out of vapors from excessively fast parts, contamination of solvent by water and other materials, or improper heat balance. When operating procedure is excellent effective rate of evolution may be taken as 4. When operating procedure is average, the effective rate of evolution may be taken as 3. When the operation is poor, a rate of 2 or 1 is indicated, depending upon observed conditions.

TABLE 241.14-B
DETERMINATION OF RATE OF GAS, VAPOR, OR MIST EVOLUTION¹
NOTE 2: Relative evaporation rate is determined according to the methods described by A.K. Doolittle in Industrial and Engineering Chemistry, Vol. 27, P. 1169, (3) where time for 100 percent evaporation is as follows: Fast: 0-3 hours; Medium: 3-12 hours; Slow: 12-50; Nil: more than 50 hours.
NOTE 3: Gassing means the formation by chemical or electrochemical action of minute bubbles of gas under the surface of the liquid in the tank and is generally limited to aqueous solutions

j. Where ventilation is used to control potential exposures to workers as defined in Subsection 241.14.c. through Subsection 241.14.i of this section, it shall be adequate to reduce the concentration of the air contaminant to the degree that a hazard to the worker does not exist. Methods of ventilation are discussed in American National Standard, Fundamentals Governing the Design and Operation of Local Exhaust Systems, Z9.2. ()

k. Control velocities shall conform to Table 241.14-C in all cases where the flow of air past the breathing or working zone of the operator and into the goods is undisturbed by local environmental conditions, such as open windows, wall fans, unit heaters, or moving machinery. ()

TABLE 241.14-C					
CONTROL VELOCITIES IN FEET PER MINUTE (F.P.M.) FOR UNDISTURBED LOCATIONS					
Class	Enclosing hood		Lateral exhaust ¹	Canopy hood ²	
	One open side	Two open sides		Three open sides	Four open sides
B-1 and A-2	100	150	150	Do not use	Do not use
A-3 (Note 2, B-1, B-2, and C-1)	75	100	100	125	175
A-3, C-2, and D-1 (Note 3)	65	90	75	100	150
B-4 (Note 2), C-3, and D-2 (Note 3)	50	75	50	75	125
A-4, C-4 (Note 3), and D-4	General room ventilation required				
NOTE 1: See Table 241.14-D for computation of ventilation rate.					
NOTE 2: Do not use canopy hood for Hazard Potential A Processes.					
NOTE 3: Where complete control of hot water is desired, design as next highest class.					

k. All tanks exhausted by means of hoods which: project over the entire tank; are fixed in position in such a location that the head of the workman, in all his normal operating positions while working at the tank, is in front of all hood openings; and are completely enclosed on at least two (2) sides, shall be considered to be exhausted through an enclosing hood. The quantity of air in cubic feet per minute necessary to be exhausted through an enclosing hood shall be not less than the product of the control velocity times the net area of all openings in the enclosure through which air can flow into the hood. ()

l. All tanks exhausted by means of hoods which do not project over the entire tank, and in which the

direction of air movement into the hood or hoods is substantially horizontal, shall be considered to be laterally exhausted. The quantity of air in cubic feet per minute necessary to be laterally exhausted per square foot of tank area in order to maintain the required control velocity shall be determined from Table 241.14-D for all variations in ratio of tank width (W) to tank length (L). The total quantity of air in cubic feet per minute required to be exhausted per tank shall be not less than the product of the area of tank surface times the cubic feet per minute per square foot of tank area, determined from Table 241.14-D. ()

TABLE 241.14-D					
MINIMUM VENTILATION RATE IN CUBIC FEET OF AIR PER MINUTE PER SQUARE FOOT OF TANK AREA FOR LATERAL EXHAUST					
Required minimum control velocity, f.p.m.	C.f.m. per sq. ft. to maintain required minimum velocities at following ratios (tank width (W)/tank length (L)). ^{1,2}				
	00-0.09	0.1-0.24	0.25-0.49	0.5-0.99	1.0-2.0
Hood along one side or two parallel sides of tank when one hood is against a wall or baffle ² . Also for a manifold along tank centerline. ²					
50	50	60	75	90	100
75	75	90	110	130	150
100	100	125	150	175	200
150	150	190	225	260	300
Hood along one side or two parallel sides of free standing tank not against wall or baffle.					
50	75	90	100	110	125
75	110	130	150	170	190
100	150	175	200	225	250
150	225	260	300	340	375
Note 1: It is not practicable to ventilate across the long dimension of a tank whose ratio W/L exceeds 2.0. It is undesirable to do so when W/L exceeds 1.0. For circular tanks with lateral exhaust along up to 1/2 the circumference, use W/L = 1.0; for over one-half the circumference use W/L = 0.5.					
Note 2: Baffle is a vertical plate the same length as the tank, and with the top of the plate as high as the tank is wide. If the exhaust hood is on the side of a tank against a building wall or close to it, it is perfectly baffled.					
Note 3: Use W/2 as tank width in computing when manifold is along centerline, or when hoods are used on two parallel sides of a tank. Tank width (W) means the effective width over which the hood must pull air to operate (for example, where the hood face is set back from the edge of the tank, this set back must be added in measuring tank width). The surface area of tanks can frequently be reduced and better control obtained (particularly on conveyORIZED systems) by using covers extending from the upper edges of the slots toward the center of the tank.					

m. For lateral exhaust hoods over forty-two (42) inches wide, or where it is desirable to reduce the amount of air removed from the workroom, air supply slots or orifices shall be provided along the side or the center of the tank opposite from the exhaust slots. The design of such systems shall meet the following criteria: The supply air volume plus the entrained air shall not exceed fifty (50%) percent of the exhaust volume. The velocity of the supply airstream as it reaches the effective control area of the exhaust slot shall be less than the effective velocity over the exhaust slot area. The vertical height of the receiving exhaust hood, including any baffle, shall not be less than one-quarter (1/4) the width of the tank. The supply airstream shall not be allowed to impinge on obstructions between it and the exhaust slot in such a manner as to significantly interfere with the performance of the exhaust hood. Since

most failure of push-pull systems result from excessive supply air volumes and pressures, methods of measuring and adjusting the supply air shall be provided. When satisfactory control has been achieved, the adjustable features of the hood shall be fixed so that they will not be altered. ()

n. All tanks exhausted by means of hoods which project over the entire tank and which do not conform to the definition of enclosing hoods, shall be considered to be overhead canopy hoods. The quantity of air in cubic feet per minute necessary to be exhausted through a canopy hood shall be not less than the product of the control velocity times the net area of all openings between the bottom edges of the hood and the top edges of the tank. ()

o. The rate of vapor evolution (including steam or products of combustion) from the process shall be estimated. If the rate of vapor evolution is equal to or greater than ten (10) percent of the calculated exhaust volume required, the exhaust volume shall be increased in equal amount. ()

p. Wherever spraying or other mechanical means are used to disperse a liquid above an open-surface tank, control must be provided for the airborne spray. Such operations shall be enclosed as completely as possible. The inward air velocity into the enclosure shall be sufficient to prevent the discharge of spray into the workroom. Mechanical baffles may be used to help prevent the discharge of spray. Spray painting operations are covered by Section 240 of this Standard. ()

q. Tank covers, foams, beads, chips or other materials floating on the tank surface so as to confine gases, mists, or vapors to the area under the cover or to the foam, bead, or chip layer; or surface tension depressive agents added to the liquid in the tank to minimize mist formation, or any combination thereof, may all be used as gas, mist, or vapor control means for open-surface tank operations, provided that they effectively reduce the concentrations of hazardous materials in the vicinity of the worker below the limits set in accordance with Subsection 241.14.m. of this section. ()

r. The equipment for exhausting air shall have sufficient capacity to produce the flow of air required in each of the hoods and openings of the system. ()

s. The capacity required in Subsection 241.14.r. of this section shall be obtained when the airflow producing equipment is operating against the following pressure losses, the sum of which is the static pressure: entrance losses into the hood; resistance to air flow in branch pipe including bends and transformations; entrance loss into the main pipe; resistance to airflow in main pipe including bends and transformations; resistance of mechanical equipment; that is, filters, washers, condensers, absorbers, etc., plus their entrance and exit losses; and resistance in outlet duct and discharge stack. ()

t. Two (2) or more operations shall not be connected to the same exhaust system where either one (1) or the combination of the substances removed may constitute a fire, explosion, or chemical reaction hazard in the duct system. Traps or other devices shall be provided to insure that condensate in ducts does not drain back into any tank. ()

u. The exhaust system, consisting of hoods, ducts, air mover, and discharge outlet, shall be designed in accordance with American National Standard, Fundamentals Governing the Design and Operation of Local Exhaust Systems, Z9.2 or the manual, Industrial Ventilation, published by the American Conference of Governmental Industrial Hygienists. Airflow and pressure loss data provided by the manufacturer of any air cleaning device shall be included in the design calculations. ()

v. The required air flow shall be maintained at all times during which gas, mist or vapor is emitted from the tank, and at all times the tank, the draining, or the drying area is in operation or use. When the system is first installed, the airflow from each hood shall be measured by means of a pivot transverse in the exhaust duct and corrective action taken if the flow is less than that required. When the proper flow is obtained, the hood static pressure shall be measured and recorded. At intervals of not more than three (3) months operation, or after a prolonged shutdown period, the hoods and duct system shall be inspected for evidence of corrosion or damage. In any case where the airflow is found to be less than required, it shall be increased to the required value. (Information on airflow and static pressure measurement and calculations may be found in American National Standard Fundamental Governing the Design and Operation of Local Exhaust systems Z9.2, or in the manual, Industrial Ventilation,

published by the American Conference of Governmental Industrial Hygienists. ()

w. The exhaust system shall discharge to the outer air in such a manner that the possibility of its effluent entering any building is at a minimum. Recirculation shall only be through a device for contaminant removal which will prevent the creation of a health hazard in the room or area to which the air is recirculated. ()

x. A volume of outside air in the range of ninety (90%) percent to one-hundred ten (110%) percent of the exhaust volume shall be provided to each room having exhaust hoods. The outside air supply shall enter the workroom in such a manner as not to be detrimental to any exhaust hood. The air-flow of the make-up air system shall be measured on installation. Periodically, thereafter, the airflow should be remeasured, and corrective action shall be taken when the airflow is below that required. The makeup air shall be uncontaminated. ()

15. Personal Protection. ()

a. All employees working in and around open-surface tank operations must be instructed as to the hazards of their respective jobs, and in the personal protection and first aid procedures applicable to these hazards. ()

b. All persons required to work in such a manner that their feet may become wet shall be provided with rubber or other impervious boots or shoes, rubbers, or wooden-soled shoes sufficient to keep feet dry. ()

c. All persons required to handle work wet with a liquid other than water shall be provided with gloves impervious to such a liquid and of a length sufficient to prevent entrance of liquid into the tops of the gloves. The interior of gloves shall be kept free from corrosive or irritating contaminants. ()

d. All persons required to work in such a manner that their clothing may become wet shall be provided with such aprons, coats, jackets, sleeves, or other garments made of rubber or other materials impervious to liquids other than water, as are required to keep their clothing dry. Aprons shall extend well below the top of boots to prevent liquid splashing into the boots. Provisions of dry, clean, cotton clothing along with rubber shoes or short boots and an apron impervious to liquids other than water shall be considered a satisfactory substitute where small parts are cleaned, plated, or acid dipped in open tanks and rapid work is required. ()

e. Whenever there is a danger of splashing, for example, when additions are made manually to the tanks, or when acids and chemicals are removed from the tanks, the employees so engaged shall be required to wear either tight-fitting chemical goggles or an effective face shield. See Subsection 050.04 of this Standard. ()

f. When, during emergencies as described in Subsection 241.16.e. of this section, workers must be in areas where concentrations of air contaminants are greater than the limit set by Subsection 241.14.e. of this section, or oxygen concentrations are less than nineteen point five (19.5%) percent, they shall be required to wear respirators adequate to reduce their exposure to a level below these limits, or to provide adequate oxygen. Such respirators shall also be provided in marked, quickly accessible storage compartments built for the purpose, when there exists the possibility of accidental release of hazardous concentrations of air contaminants. Respirators shall be approved by NIOSH and the U. S. Bureau of Mines, U. S. Department of the Interior and shall be selected by a competent industrial hygienist or other technically qualified source. Respirators shall be used in accordance with Subsection 050.05 of this Standard, and persons who may require them shall be trained in their use. ()

g. Near each tank containing a liquid which may burn, irritate, or otherwise be harmful to the skin if splashed upon the worker's body, there shall be a supply of clean cold water. The water pipe (carrying a pressure not exceeding twenty-five (25) pounds per square inch) shall be provided with a quick opening valve and at least forty-eight (48) inches of hose not smaller than three-quarters (3/4) inch, so that no time may be lost in washing off liquids from the skin or clothing. Alternately, deluge showers and eye flushes shall be provided in cases where harmful chemicals may be splashed on parts of the body. ()

h. Operators with sores, burns, or other skin lesions requiring medical treatment shall not be allowed to work at their regular operations until so authorized by a physician. Any small skin abrasions, cuts, rash, or open sores which are found or reported shall be treated by a properly designated person so that chances of exposures to the

chemicals are removed. Workers exposed to chromic acids shall have a periodic examination made of the nostrils and other parts of the body, to detect incipient ulceration. ()

i. Sufficient washing facilities, including soap, individual towels, and hot water, shall be provided for all persons required to use or handle any liquids which may burn, irritate, or otherwise be harmful to the skin, on the basis of at least one (1) basin (or its equivalent) with a hot water faucet for every ten (10) employees. See Subsection 080.16 of this Standard. ()

j. Locker space or equivalent clothing storage facilities shall be provided to prevent contamination of street clothing. ()

k. First aid facilities specific to the hazards of the operations conducted shall be readily available. ()

l. Dikes or other arrangements shall be provided to prevent the possibility of intermixing of cyanide and acid in the event of tank rupture. ()

16. Inspection, Maintenance and Installation. ()

a. Floors and platforms around tanks shall be prevented from becoming slippery both by original type of construction and by frequent flushing. They shall be firm, sound, and of the design and construction to minimize the possibility of tripping. ()

b. Before cleaning the interior of any tank, the contents shall be drained off, and the clean-out doors shall be opened where provided. All pockets in tanks or pits, where it is possible for hazardous vapors to collect, shall be ventilated and cleared of such vapors. ()

c. Tanks which have been drained to permit employees to enter for the purposes of cleaning, inspection, or maintenance may contain atmospheres which are hazardous to life or health, through the presence of flammable or toxic air contaminants, or through the absence of sufficient oxygen. Before employees shall be permitted to enter any such tank, appropriate tests of the atmosphere shall be made to determine if the limits set by Subsection 241.14.e. of this section are exceeded, or if the oxygen concentration is less than nineteen point five (19.5%) percent and appropriate subsections of Section 043 of this Standard. ()

d. If the tests made in accordance with Subsection 241.16.c. of this section indicate that the atmosphere in the tank is unsafe, before any employee is permitted to enter the tank, the tank shall be ventilated until the hazardous atmosphere is removed, and ventilation shall be continued so as to prevent the occurrence of a hazardous atmosphere as long as an employee is in the tank. ()

e. If, in emergencies, such as rescue work, it is necessary to enter a tank which may contain a hazardous atmosphere, suitable respirators, such as self-contained breathing apparatus; hose mask with blower, if there is a possibility of oxygen deficiency; or a gas mask, selected and operated in accordance with Subsection 241.15.f. of this section shall be used. If a contaminant in the tank can cause dermatitis, or be absorbed through the skin, the employee entering the tank shall also wear protective clothing. At least one (1) trained standby employee, with suitable respirator, shall be present in the nearest uncontaminated area. The standby employee must be able to communicate with the employee in the tank and be able to haul him out of the tank with a lifeline if necessary. Rescue shall be conducted following the requirements of Subsection 043.09 of this Standard. ()

f. Maintenance work requiring welding or open flame, where toxic metal fumes such as cadmium, chromium, or lead may be involved, shall be done only with sufficient local exhaust ventilation to prevent the creation of a health hazard, or be done with respirators selected and used in accordance with Subsection 243.11.f. of this section and Subsection 050.05. of this Standard. Welding, or the use of open flames near any solvent cleaning equipment shall be permitted only after such equipment has first been thoroughly cleaned of solvents and vapors. ()

17. Vapor Degreasing Tanks. ()

a. In any vapor degreasing tank equipped with a condenser or vapor level thermostat, the condenser or thermostat shall keep the level of vapors below the top edge of the tank by a distance of at least equal to one-half (1/2) the tank width, or at least thirty-six (36) inches, whichever is shorter. ()

b. Where gas is used as a fuel for heating vapor degreasing tanks, the combustion chamber shall be of tight construction, except for such openings as the exhaust flue, and those that are necessary for supplying air for combustion. Flues shall be of corrosion-resistant construction and shall extend to the outer air. If mechanical exhaust is used on this flue, a draft diverter shall be used. Special precautions must be taken to prevent solvent fumes from entering the combustion air of this or any other heater when chlorinated or fluorinated hydrocarbon solvents (for example, trichloroethylene, Freon) are used. ()

c. Heating elements shall be so designed and maintained that their surface temperature will not cause the solvent mixture to decompose, break down, or be converted into an excessive quantity of vapor. ()

d. Tanks or machines of more than four (4) square feet of vapor area, used for solvent cleaning or vapor degreasing, shall be equipped with suitable clean-out or sludge doors located near the bottom of each tank or still. These doors shall be so designed and gasketed that there will be no leakage of solvent when they are closed. ()

242. -- 999. (RESERVED).

IDAPA 17 - INDUSTRIAL COMMISSION
17.10.27 - GENERAL SAFETY AND HEALTH STANDARDS- EQUIPMENT SAFETY
DOCKET NO. 17-1027-9601
NOTICE OF PROPOSED RULES

AUTHORITY: In compliance with Section 67-5221(1), Idaho Code, notice is hereby given that this agency has proposed rule-making. The action is authorized pursuant to §72-508 and §§72-720, 721, 722, and 723, Idaho Code.

PUBLIC HEARING SCHEDULE: Public hearing(s) concerning this rule-making will be scheduled if requested in writing by twenty-five (25) persons, a political subdivision, or an agency, not later than August 28, 1996. The hearing site(s) will be accessible to persons with disabilities. Requests for accommodation must be made not later than five (5) days prior to the hearing, to Patricia S. Ramey, Secretary, Industrial Commission, P. O. Box 83720, Boise, ID 83720-0041. Telephone and fax numbers are listed below.

DESCRIPTIVE SUMMARY: The following is a statement in nontechnical language of the substance of the proposed rule:

The Industrial Commission, in cooperation with the Division of Building Safety, proposes the adoption of rules to replace IDAPA 17.04.01, General Safety and Health Standards Code 1, which is being repealed in its entirety. The proposed rules update the state's minimum safety and health standards in the use of hand tools, power tools, machinery, machine guarding, and materials handling for the public sector and bring them into line with generally accepted safety and health standards in the private sector.

ASSISTANCE ON TECHNICAL QUESTIONS, SUBMISSION OF WRITTEN COMMENTS: For assistance on technical questions concerning these proposed rules, contact Mike Poulin, Bureau of Logging and Industrial Safety, at (208) 334-2129.

Anyone may submit written comments regarding this rule. All written comments and data concerning the rule must be directed to the undersigned and must be postmarked or delivered on or before August 28, 1996.

DATED this 3rd day of June, 1996.

Patricia S. Ramey, Commission Secretary
Industrial Commission
P. O. Box 83720
Boise, Idaho 83720-0041
Telephone: (208) 334-6000
Fax: (208) 334-5145

TEXT OF DOCKET NO. 17-1027-9601

IDAPA 17
TITLE 10
Chapter 27

17.10.27 - GENERAL SAFETY AND HEALTH STANDARDS -- EQUIPMENT SAFETY

000. LEGAL AUTHORITY.

These rules presented in IDAPA 17, Title 10, are promulgated pursuant to the authority granted the Industrial Commission by Sections 72-508, 72-720, 72-721, 72-722, and 72-723, Idaho Code. ()

001. TITLE AND SCOPE.

These rules shall be cited as IDAPA 17, Title 10, Chapter 27, General Safety and Health Standards -- Equipment

Safety. For purposes of IDAPA 17, Title 10, these rules shall be applicable to places of public employment, as defined in Sections 72-205 and 72-207, Idaho Code, by the State of Idaho and its political subdivisions i.e. counties, cities, public school districts, and other taxing entities as follows: ()

01. State. Every person in the service of the state or of any political subdivision thereof, under any contract of hire, express or implied, and every official or officer thereof, whether elected or appointed, while performing their official duties. ()

02. County/City. Every person in the service of a county, city, or any political subdivision thereof, or of any municipal corporation. ()

03. National Guard. Members of the Idaho National Guard while on duty. ()

04. Youth Conservation. Participants in Idaho youth conservation project under the supervision of the Idaho State Forester. ()

05. Volunteers. Every person who is a member of volunteer fire, police department, or ambulance service shall be deemed to be in the employment of the political subdivision or municipality where the department is organized. ()

06. Civil Defense. Every person who is a regularly enrolled volunteer member or trainee of the Department of Disaster and Civil Defense, or of a civil defense corps, shall be deemed to be in the employment of the state. ()

07. Public School. Every person who is in the service of a public school or school district shall be deemed to be in the employment of the state. ()

002. WRITTEN INTERPRETATIONS.

For purposes of IDAPA 17, Title 10, there are no written statements which pertain to the interpretation of these rules. ()

003. ADMINISTRATIVE APPEALS.

For purposes of IDAPA 17, Title 10, there are no provisions for administrative appeal of these rules. The procedure for appeals in safety matters is prescribed by Sections 72-722 and 72-714 through 72-718, Idaho Code. ()

004. -- 249. (RESERVED).

250. MACHINERY AND MACHINE GUARDING.

01. Scope. ()

a. Machinery and machine guarding shall conform to all other applicable requirements of this standard, as well as the following provisions. Nothing in this standard shall be construed to prohibit better or otherwise safer conditions than specified herein. ()

02. Definitions Applicable to this Section. ()

a. Abrasive Wheel is a cutting tool consisting of abrasive grains held together by organic or inorganic bonds. Diamond and reinforced wheels are included. ()

b. Adjustable Barrier Guard is a barrier requiring adjustment for each job or die setup. ()

c. Antirepeat is the part of the clutch/brake control system designed to limit the press to a single stroke if the tripping means is hand operated. Antirepeat requires release of all tripping mechanisms before another stroke can be initiated. Antirepeat is also called single stroke reset or reset circuit. ()

d. Automatic Feeding is feeding wherein the material or part being processed is placed within or

removed from the point of operation by a method or means not requiring action by an operator on each stroke of the press. ()

e. Block is a short block of wood, provided with a handle similar to that of a plane and a shoulder at the rear end, which is used for pushing short stock over revolving cutters. ()

f. Bolster Plate is the plate attached to the top of the bed of the press having drilled holes or t-slots for attaching the lower die or die shoe. ()

g. Brake is the mechanism used on a mechanical power press to stop and/or hold the crankshaft, either directly or through a gear train, when the clutch is disengaged. ()

h. Brake Monitor is a sensor designed, constructed, and arranged to monitor the effectiveness of the press braking system. ()

i. Clutch is the coupling mechanism used on a mechanical power press to couple the flywheel to the crankshaft, either directly or through a gear train. ()

j. Concurrent is acting in conjunction, and is used to describe a situation wherein two (2) or more controls exist in an operated condition at the same time. ()

k. Continuous is uninterrupted multiple strokes of the slide without intervening stops (or other clutch control action) at the end of individual strokes. ()

l. Control System is sensors, manual input and mode selection elements, interlocking and decision-making circuitry, and output elements to the press operating mechanism. ()

m. Counterbalance is the mechanism that is used to balance or support the weight of the connecting rods, slide, and slide attachments. ()

n. Cutting Off Wheels are wheels having diameter, thickness and hole size dimensions and are subject to all limitations of mounting and use listed for Type 1 wheels. They may be steel centered, diamond abrasive or organic bonded abrasive of the plain or reinforced type. Limitation: Cutting off wheels are recommended only for use on specially designed and fully guarded machines. Maximum hole size for cutting-off wheels should not be larger than one-fourth (1/4) wheel diameter and are subject to the following maximum thickness and hole size limitations (see Table 250.02-A.) ()

TABLE 250.02-A	
Wheel Diameter:	Maximum Thickness (inch)
0 to 6 inches	3/16
6 to 12 inches	1/4
12 to 23 inches	3/8
23 and over inches	1/2

()

o. Device means a press control or attachment that: restrains the operator from inadvertently reaching into the point of operation; prevents normal press operation if the operator's hands are inadvertently within the point of operation; or automatically withdraws the operator's hands if the operator's hands are inadvertently within the point of operation as the dies close. ()

p. Die is the tooling used in a press for cutting or forming material. An upper and a lower die make a

- complete set. ()
- q. Die Builder is any person who builds die for power presses. ()
- r. Die Enclosure Guard is an enclosure attached to the die shoe or stipper, or both, in a fixed position. ()
- s. Die Set is a tool holder held in alignment by guide posts and bushings and consisting of a lower shoe, an upper shoe or punch holder, and guide posts and bushings. ()
- t. Die Setter is an individual who places or removes dies in or from mechanical power presses, and who, as a part of his duties, makes the necessary adjustments to cause the tooling to function properly and safely. ()
- u. Die Setting is the process of placing or removing dies in or from a mechanical power press, and the process of adjusting the dies, other tooling and safeguarding means to cause them to function properly and safely. ()
- v. Die Shoe is a plate or block upon which a die holder is mounted. A die shoe functions primarily as a base for the complete die assembly, and, when used, is bolted or clamped to the bolster plate or the face of slide. ()
- w. Direct Drive is the type of driving arrangement wherein no clutch is used; coupling and decoupling of the driving torque is accomplished by energization and deenergization of a motor. Even though not employing a clutch, direct drives match the operational characteristics of part revolution clutches because the driving power may be disengaged during the stroke of the press. ()
- x. Ejector is a mechanism for removing work or material from between the dies. ()
- y. Face of Slide is the bottom surface of the slide to which the punch or upper die is generally attached. ()
- z. Feeding is the process of placing or removing material within or from the point of operation.()
- aa. Fixed Barrier Guard is a die space barrier attached to the press frame. ()
- bb. Flanges are collars, discs, or plates between which wheels are mounted and are referred to as adaptor, sleeve, or back up type. See Subsection 250.21 of this section for full description. ()
- cc. Foot Control is the foot operated control mechanism designed to be used with a clutch or clutch/brake control system. ()
- dd. Foot Pedal is the foot operated lever designed to operate the mechanical linkage that trips a full revolution clutch. ()
- ee. Full Revolution Clutch is a type of clutch that, when tripped, cannot be disengaged until the crankshaft has completed a full revolution and the press slide a full stroke.()
- ff. Gate or Movable Barrier Device is a movable barrier arranged to enclose the point of operation before the press stroke can be started. ()
- gg. Guard is a barrier that prevents entry of the operator's hands or fingers into the point of operation. ()
- hh. Guide Post is the pin attached to the upper or lower die shoe, operating within the bushing on the opposing die shoe, to maintain the alignment of the upper and lower dies. ()

- ii. Hand Feeding Tool is any hand held tool designed for placing or removing material or parts to be processed within or from the point of operation. ()
- jj. Holdout or Restraint Device is a mechanism, including attachments for operator's hands, that when anchored and adjusted prevent the operators hands from entering the point of operation. ()
- kk. Inch is an intermittent motion imparted to the slide (on machines using part revolution clutches) by momentary operation of the Inch operating means. Operation of the Inch operating means engages the driving clutch so that a small portion of one (1) stroke or indefinite stroking can occur, depending upon the length of time the Inch operating means is held operated. Inch is a function used by the die setter for setup of dies and tooling, but is not intended for use during production operations by the operator. ()
- ll. Inorganic Wheels are wheels which are bonded by means of inorganic material such as clay, glass, porcelain, sodium silicate, magnesium oxychloride, or metal. Wheels bonded with clay, glass, porcelain, or related ceramic materials are characterized as "vitrified bonded wheels". ()
- mm. Interlocked Press Barrier Guard is a barrier attached to the press frame and interlocked so that the press stroke cannot be started normally unless the guard itself, or its hinged or movable sections, enclose the point of operation. ()
- nn. Job is an intermittent motion imparted to the slide by momentary operation of the drive motor, after the clutch is engaged with the flywheel at rest. ()
- oo. Knockout is a mechanism for releasing material from either die. ()
- pp. Liftout is the mechanism also known as knockout. ()
- qq. Manual Feeding is feeding wherein the material or part being processed is handled by the operator on each stroke of the press. ()
- rr. Off-Hand Grinding is the grinding of any material or part which is held in the operator's hand. ()
- ss. Operator's Station is the complete complement of controls used by or available to an operator on a given operation for stroking the press. ()
- tt. Organic Wheels are wheels which are bonded by means of an organic material such as resin, rubber, shellac, or other similar bonding agent. ()
- uu. Part Revolution Clutch is a type of clutch that can be disengaged at any point before the crankshaft has completed a full revolution and the press slide a full stroke. ()
- vv. Point of Operation is the area on a machine where material is actually positioned and work is performed such as shearing, punching, forming, or assembly. ()
- ww. Presence Sensing Device is a device designed, constructed and arranged to create a sensing field or area and deactivate the clutch control of the press when an operator's hand and/or other parts of his body is within such field or area. ()
- xx. Press is a mechanically powered machine that shears, punches, forms, or assembles metal or other material by means of cutting, shaping, or combination dies attached to slides. A press consists of a stationary bed or anvil, and a slide (or slides) having a controlled reciprocating motion toward and away from the bed surface, the slide being guided by a definite path by the frame of the press. ()
- yy. Pull-Out Device is a mechanism attached to the operator's hands and connected to the upper die or slide of the press, that is designed, when properly adjusted, to withdraw the operators hands as the dies closes, if the operator's hands are inadvertently within the point of operation. ()

zz. Push Stock is a narrow strip of wood or other soft material with a notch cut into one (1) end and which is used to push short pieces of material through saws. ()

aaa. Repeat is an unintended or unexpected successive stroke of the press resulting from a malfunction. ()

bbb. Safety block is a prop that, when inserted between the upper and lower dies or between the bolster plate and the face of the slide prevents the slide from falling off by its own deadweight. ()

ccc. Safety Guard is an enclosure designed to restrain the pieces of the grinding wheel and furnish all possible protection in the event that the wheel is broken while in operation. See Subsection 250.21 of this section. ()

ddd. Semiautomatic Feeding is feeding wherein the material or part being processed is placed within or removed from the point of operation by an auxiliary means controlled by operator on each stroke of the press. ()

eee. Single Stroke is one (1) complete stroke of the slide, usually initiated from a full open (or up) position, followed by closing, (or down), and then a return to the full open position. ()

fff. Slide is the main reciprocating press member. A slide is also called a ram, plunger, or platen. ()

ggg. Snagging is grinding which removes relatively large amounts of material without regard to close tolerances or surface finish requirements. ()

hhh. Stop Control is an operator control designed to immediately deactivate the clutch control and activate the brake to stop slide motion. ()

iii. Stripper is a mechanism or die part for removing the parts or material from the punch. ()

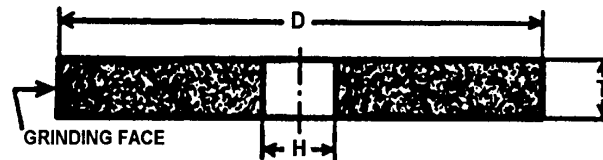
jjj. Stroking Selector is the part of the clutch/brake that determines the type of stroking when the operating means is actuated. The stroking selector generally includes positions for "OFF" ("clutch control", "inch", "single stroke", and "continuous" (when continuous is furnished)). ()

kkk. Surface Feet per Minute (s.f.p.m.) is the distance in feet any one (1) abrasive grain on the peripheral surface of a grinding wheel travels in one (1) minute. EXAMPLES:twenty-four (24) - inch diameter wheel, one thousand (1,000) revolutions per minute. Surface feet per minute $.262 \times 24 \times 1,000 = 6,288$ s.f.p.m. twelve (12) - inch diameter wheel, one thousand (1,000) revolutions per minute. Surface feet per minute $.262 \times 12 \times 1,000 = 3,144$ s.f.p.m. ()

lll. Sweep Device is a single or double arm (rod) attached to the upper die or slide of the press and designed to move the operator's hands to a safe position as the dies close, if the operator's hands are inadvertently within the point of operation. ()

mmm. Terrazzo, Modified Types 6 and 11 Wheels are some type 6 and 11 cup wheels used in the terrazzo trade having tapered (K) dimensions to match a special tapered flange furnished by the machine builder. See Figure 250.02-A. Limitation: These wheels shall be mounted only with a special tapered flange. ()

FIGURE 250.02-A

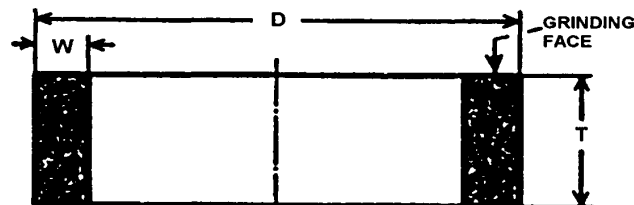


Straight Wheel

Typical examples of modified types 6 and 11 wheels (terrazzo) showing tapered (K) dimensions.

- nnn. Trip or Tripping is the activation of the clutch to run a press. ()
- ooo. Turnover bar is a bar used in die setting to manually turn the crankshaft of the press. ()
- ppp. Two (2) Hand Control Device is a two (2) hand trip that further requires concurrent pressure from both hands of the operator during a substantial part of the die-closing portion of the stroke of the press. ()
- qqq. Two (2) Hand Trip is a clutch actuating means, requiring the concurrent use of both hands of the operator to trip the press. ()
- rrr. Type 1 Straight Wheels are wheels having diameter, thickness, and hole size dimensions, and shall be used only on the periphery. Type 1 wheels shall be mounted between flanges. See Figure 250.02-B Limitation: Hole dimension (H) should not be greater than two-thirds (2/3) of wheel diameter dimension (D) for precision, cylindrical, centerless, or surface grinding applications. Maximum hole size for all other applications should not exceed one-half (1/2) wheel diameter. ()

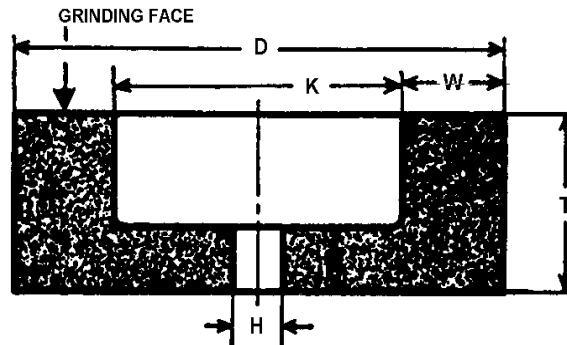
FIGURE 250.02-B



Cylinder Wheel

- sss. Type 2 Cylinder Wheels are wheels having diameter, wheel thickness, and rim thickness dimensions. Grinding is performed on the rim face only, dimension (W). Cylinder wheels may be plain, plate mounted, inserted nut, or of the projecting stud type. See Figure 250.02-C. Limitation: Rim height, (T) dimension, is generally equal to or greater than rim thickness, (W) dimension. ()

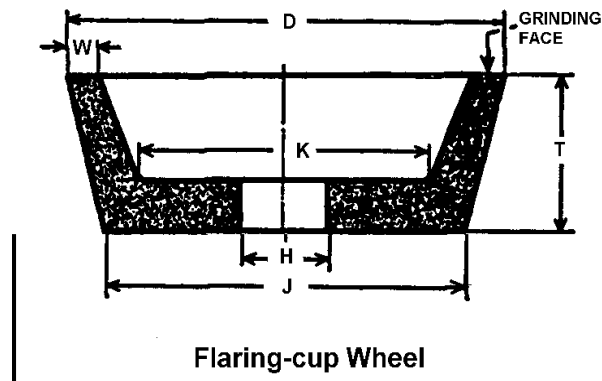
FIGURE 250.02-C



Straight-cup Wheel

ttt. Type 6 Straight Cup Wheels are wheels having diameter, thickness, hole size, rim thickness, and back thickness dimensions. Grinding is always performed on rim face, (W) dimension. See Figure 250.02-D. Limitation: Minimum back thickness, (E) dimension, should not be less than one-fourth (1/4) (T) dimension. In addition, when unthreaded hole wheels are specified, the inside flat, (K) dimension, must be large enough to accommodate a suitable flange. ()

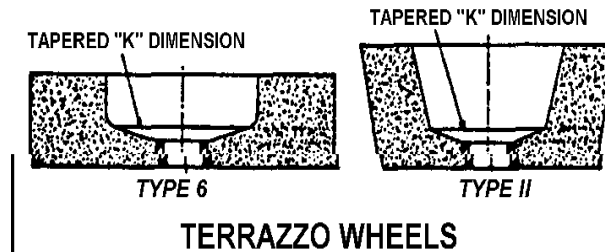
FIGURE 250.02-D



Flaring-cup Wheel

uuu. Type 11 Flaring Cup Wheels means wheels having double diameter dimensions (D) and (J) and in addition, have thickness, hole size, rim and back thickness dimensions. Grinding is always performed on rim face, (W) dimension Type 11 wheels are subject to all limitation of use and mounting listed for type 6 straight sided cup wheels. See Figure 250.02-E. Limitation: Minimum back thickness, (E) dimension, should not be less than threaded hole wheels are specified the inside flat, (K) dimension, shall be large enough to accommodate a suitable flange. ()

FIGURE 250.02-E



vvv. Types 27 and 28 Depressed Center Wheels are wheels having diameter, thickness, and hole size dimensions. Both types are reinforced, organic bonded wheels having offset hubs which permit side and peripheral grinding operations without interference with the mounting. Type 27 wheels are manufactured with flat grinding rims permitting notching and cutting operations. Type 28 wheels have saucer shaped grinding rims. Limitations: Special supporting, back adapter and inside flange nuts are required for the proper mounting of these types of wheels subject to limitations of Subsection 250.21.x through Subsection 250.21.cc. of this section. Mounts which are affixed to the wheel by the manufacturer may not require an inside nut and shall not be reused. ()

www. Type 27A Depressed Center Cutting Off Wheels are wheels having diameter, thickness, and hole size dimensions. They are reinforced, organic bonded, offset hub type wheels, usually sixteen (16) inches diameter and larger, specially designed for use on cutting-off machines where mounting nut or outer flange interference cannot be tolerated. Limitations: See Subsection 250.21.x. through Subsection 250.21.cc. of this section. ()

xxx. Unitized Tooling is a type of die in which the upper and lower members are incorporated into a self-contained unit so arranged as to hold the die members in alignment. ()

03. General Requirements. ()

a. One (1) or more methods of machine guarding shall be provided to protect the operator and other employees in the machine area from hazards such as those created by point of operation, ingoing nip points, rotating parts, flying chips, shears, and sparks. Example of guarding methods are: Barrier guards, two (2) hand tripping devices, electronic safety devices, etc. ()

b. Guards shall be affixed to the machine where possible and secured elsewhere if for any reason attachment to the machine is not possible. The guard shall be such that it does not offer an accident hazard in itself. ()

04. Guarding. ()

a. Point of operation is the area on a machine where work is actually performed upon the material being processed. ()

b. The point of operation of machines whose operation exposes an employee to injury shall be guarded. The guarding device shall be in conformity with any appropriate standards thereof, or, in the absence of applicable specific standards, shall be so designed and constructed as to prevent the operator from having any part of his body in the danger zone during the operating cycle. ()

c. Special handtools for placing and removing material shall be such as to permit easy handling of material without the operator placing a hand in the danger zone. Such tools shall not be in lieu of the regarding required by this section, but can only be used to supplement protection provided. ()

d. The following are some of the machines which usually require point of operation guarding: guillotine cutters, paper cutters (manual and power), shears, alligator shears, power presses, milling machines, power saws, jointers, portable power tools, forming tools and calendars. ()

e. Revolving drums, barrels, and containers shall be guarded by an enclosure which is interlocked with the drive mechanism, so that the barrel, drum, or container cannot revolve unless the guard enclosure is in place. ()

f. When the periphery of the blades of a fan is less than seven (7) feet above the floor or working level, the blades shall be guarded. The guard shall have openings no larger than one-half (1/2) inch. Safeguards shall be so constructed that rods, pipes, or like material being handled by workmen will not enter same, and come in contact with moving machinery. ()

g. Cams and other machine parts which move in such a manner as to create shearing or crushing hazards shall, if exposed to contact, be guarded with a standard safeguard. ()

h. All counterweights exposed to contact shall be guarded with standard safeguards. ()

i. All belts, pulleys, gears, shafts, and moving parts shall be guarded in accordance with the specific requirements of this standard. ()

05. Anchoring Fixed Machinery. ()

a. Machines designed for a fixed location shall be securely anchored to prevent walking or moving. ()

06. Means to Prevent Slipping. ()

a. Operators of dangerous machinery, such as shapers, jointers, and circular saws, shall be safeguarded against slipping on smooth, oily or otherwise slippery floor, where he stands while at the point of operation of such dangerous machinery, by covering such portion of the floor with a rubber mat, cork, non-slip composition flooring, or some other effective means of preventing slipping. ()

07. Repairs. ()

a. The workman making the repairs or adjustments shall tag and/or lock out the main disconnecting device, warning that the machine shall not be started. The said tag and/or lock shall not be removed by any other person than the one who attached it, unless authorized by a department head, i.e., superintendent or foreman, after proper investigation and notification to the person applying the tag and/or lock. These tags and/or locks shall carry the name of the person applying, and the time and date of application. ()

b. All power-driven machinery shall be stopped and brought to a complete standstill before any repairs or adjustments are made, or pieces of material or refuse removed, except where motion is necessary to make adjustment. ()

08. Machine Construction. ()

a. Each machine shall be so constructed as to be free from sensible vibration when the largest size tool is mounted and run idle at full speed. ()

b. Arbors and mandrels shall be constructed so as to have firm and secure bearing and be free from play. ()

c. The use of wooden band saw wheels other than those of commercial manufacture is prohibited. ()

d. Any automatic cutoff saw that strokes continuously without the operator being able to control each stroke shall not be used. ()

e. Saw frames or tables shall be constructed with lugs cast on the frame or with an equivalent means

to limit the size of the saw blade that can be mounted, so as to avoid overspeed caused by mounting a saw larger than intended. ()

f. Circular saw fences shall be so constructed that they can be firmly secured to the table or table assembly without changing their alignment with the saw. For saws with tilting tables or tilting arbors the fence shall be so constructed that it will remain in a line parallel with the saw, regardless of the angle of the saw with the table. ()

g. Circular saw gages shall be so constructed as to slide in grooves or tracks that are accurately machined, to insure exact alignment with the saw for all positions of the guide. ()

h. Hinged saw tables shall be so constructed that the table can be firmly secured in any position and in true alignment of the saw. ()

i. Each power-driven woodworking machine shall be provided with a disconnect switch that can be locked in the off position. ()

j. The frames and all exposed, noncurrent-carrying metal parts of portable electric woodworking machinery operated at more than fifty (50) volts to ground shall be grounded and other portable motors driving electric tools which are held in the hand while being operated shall be grounded if they operate at more than fifty (50) volts to ground. The ground shall be provided through use of a separate ground wire and polarized plug and receptacle. EXCEPTION: Double insulated hand held power tools. ()

k. For all circular saws where conditions are such that there is a possibility of contact with the portion of the saw either beneath or behind the table, that portion of the saw shall be covered with an exhaust hood, or, if no exhaust system is required, with a guard that shall be so arranged as to prevent accidental contact with the saw. ()

l. Revolving double arbor saws shall be fully guarded in accordance with all the requirements for circular crosscut saws or with all the requirements for circular rip saws, according to the kind of saws mounted on the arbors. ()

m. No saw, cutter head, or tool collar shall be placed or mounted on a machine arbor unless the tool has been accurately machined to size and shape to fit the arbor. ()

n. Combs (featherboards) or suitable jigs shall be provided at the workplace for use when a standard guard cannot be used, as in dadoing, grooving, jointing, molding, and rabbeting. ()

09. Machine Controls. ()

a. A mechanical or electrical power control shall be provided on each machine to make it possible for the operator to cut off the power from each machine without leaving his position at the point of operation. ()

b. On applications where injury to the operator might result if motors were to restart after power failures, provision shall be made to prevent machines from automatically restarting upon restoration of power. ()

c. Power controls and operating controls should be located within easy reach of the operator while he is at his regular work location, making it unnecessary for him to reach over the cutter to make adjustments. This does not apply to constant pressure controls used only for setup purposes. ()

d. On each machine operated by electric motors, positive means shall be provided for rendering such controls or devices inoperative while repairs or adjustments are being made to the machines they control. ()

e. Each operating treadle shall be protected against unexpected or accidental tripping. ()

f. Feeder attachments shall have the feed rolls or other moving parts so covered or guarded as to protect the operator from hazardous points. ()

10. Hand-Fed Ripsaws and Crosscut Table Saws. ()

a. Each circular hand-fed rip saw and crosscut table saw shall be guarded by a hood which shall completely enclose that portion of the saw above the table and that portion of the saw above the material being cut. The hood and mounting shall be arranged so that the hood will automatically adjust itself to the thickness of and remain in contact with the material being cut but it shall not offer any considerable resistance to insertion of material to saw or to passage of the material being sawed. The hood shall be made of adequate strength to resist blows and shall be so designed as to protect the operator from flying splinters and broken saw teeth. It shall be made of material that is soft enough so that it will be unlikely to cause tooth breakage. The material shall not shatter when broken, should be nonexplosive, and should be no more flammable than wood. The hood shall be so mounted as to insure that its operation will be positive, reliable and in true alignment with the saw; and the mounting shall be adequate in strength to resist any reasonable side thrust or other force tending to throw it out of line. ()

b. Each hand-fed circular rip saw and crosscut table saw shall be furnished with a spreader to prevent material from squeezing the saw or being thrown back on the operator. The spreader shall be made of hard tempered steel, or its equivalent, and shall be thinner than the saw kerf. It shall be of sufficient width to provide adequate stiffness or rigidity to resist any reasonable side thrust or blow tending to bend or throw it out of position. The spreader shall be attached so that it will remain in true alignment with the saw even when either the saw or table is tilted, and should be placed so that there is not more than one-half (1/2) inch space between the spreader and the back of the saw when the largest saw is mounted in the machine. The provision of a spreader in connection with grooving, dadoing, or rabbeting is not required. On the completion of such operations, the spreader shall be immediately replaced. ()

c. Each hand-fed circular rip saw and crosscut table saw shall be provided with non-kickback fingers on dogs so located as to oppose the thrust or tendency of the saw to pick up the material or to throw it back toward the operator. They shall be designed to provide adequate holding power for all the thicknesses of materials being cut. ()

11. Swing Cutoff Saws. ()

a. The requirements of this section are also applicable to sliding cutoff saws mounted above the table. ()

b. Each swing cutoff saw shall be provided with a hood that will completely enclose the upper half of the saw, the arbor end, and the point of operation at all positions of the saw. The hood shall be constructed in such a manner and of such material that it will protect the operator from flying splinters and broken saw teeth. Its hood shall be so designed that it will automatically cover the lower portion of the blade, so that when the saw is returned to the back of the table the hood will rise on top of the fence, and when the saw is moved forward the hood will drop on top of and remain in contact with the table or material being cut. ()

c. Each swing cutoff saw shall be provided with an effective device to return the saw automatically to the back of the table when released at any point of its travel. Such a device shall not depend for its proper functioning upon any rope, cord, or swing. If there is a counterweight, the bolts supporting the bar and counterweight shall be provided with cotter pins; and the counterweight shall be prevented from dropping by either a bolt passing through both the bar and counterweight, or a bolt put through the extreme end of the bar, or, where the counterweight does not encircle the bar, a safety chain attached to it. ()

d. Limit chains or other equally effective devices shall be provided to prevent the saw from swinging beyond the front or back edges of the table, or beyond a forward position where the gullets of the lowest saw teeth will rise above the table top. ()

e. Inverted swing cutoff saws shall be provided with a hood that will cover the part of the saw that protrudes above the top of the table or above the material being cut. It shall automatically adjust itself to the thickness of and remain in contact with the material being cut. ()

12. Radial Saws. ()

a. The upper hood shall completely enclose the upper portion of the blade down to a point that will include the end of the saw arbor. The upper hood shall be constructed in such a manner and of such material that it will protect the operator from flying splinters, broken saw teeth, etc., and will deflect sawdust away from the operator. The sides of the lower exposed portion of the blade shall be guarded to the full diameter of the blade by a device that will automatically adjust itself to the thickness of the stock and remain in contact with stock being cut to give maximum protection possible for the operation being performed. ()

b. Each radial saw used for ripping shall be provided with non-kickback fingers or dogs located on both sides of the saw so as to oppose the thrust or tendency of the saw to pick up the material or to throw it back toward the operator. They shall be designed to provide adequate holding power for all the thickness of material being cut. ()

c. An adjustable stop shall be provided to prevent the forward travel of the blade beyond the position necessary to complete the cut in repetitive operations. ()

d. Installation shall be in such a manner that the front end of the unit will be slightly higher than the rear, so as to cause the cutting head to return gently to the starting position when released by the operator. ()

e. Ripping and ploughing shall be against the direction in which the saw turns. The direction of the saw rotation shall be conspicuously marked on the hood. In addition, a permanent label not less than one and one-half (1 1/2) inches by three-fourths (3/4) inch shall be affixed to the rear of the guard at approximately the level of the arbor, reading as follows: "Danger: Do Not Rip or Plough From This End". Such a label should be colored standard danger red. ()

13. Band Saws. ()

a. All portions of the saw blade shall be enclosed or guarded except for the working portion of the blade between the bottom of the guide rolls and the table. Band saw wheels shall be fully encased. The outside periphery of the enclosure shall be solid. The front and back of the band wheels shall be either enclosed by solid material or by wire mesh or perforated metal. Such mesh or perforated metal shall be not less than point zero three seven (.037) inch (U.S. Gage No. 20), and the openings shall be not greater than three-eighths (3/8) inch. Solid material used for this purpose shall be of an equivalent strength and firmness. The guard for the portion of the blade between the sliding guide and the upper-saw-wheel guard shall protect the saw blade at the front and outer side. This portion of the guard shall be self-adjusting to raise and lower with the guide. The upper-wheel guard shall be made to conform to the travel of the saw on the wheel, and the top member of the guard should have at least a two (2) inch clearance outside the saw and be lined with smooth material, preferably metal. Effective brakes should be provided to stop the wheel in case of blade breakage. ()

b. Each band saw machine shall be provided with a tension control device to indicate a proper tension for the standard saws used on the machine, in order to assist in the elimination of saw breakage due to improper tension. ()

14. Jointers. ()

a. Each hand-fed planer and jointer with horizontal head shall be equipped with a cylindrical cutting head, the knife projection of which shall not exceed one-eighth (1/8) inch beyond the cylindrical body of the head. ()

b. The opening in the table shall be kept as small as possible. The clearance between the edge of the rear table and the cutter head shall be not more than one-eighth (1/8) inch. The table throat opening shall be not more than two and one-half (2 1/2) inches when tables are set or aligned with each other for zero (0) cut. ()

c. Each hand-fed jointer with a horizontal cutting head shall have an automatic guard which will cover all the section of the head on the working side of the fence or gage. The guard shall effectively keep the operator's hand from coming in contact with the revolving knives. The guard shall automatically adjust itself to cover the unused portion of the head and shall remain in contact with the material at all times. ()

d. Each hand-fed jointer with horizontal cutting head shall have a guard which will cover the section of the head back of the gage or fence. ()

e. Each wood jointer with vertical head shall have either an exhaust hood or other guard so arranged as to enclose completely the revolving head, except for a slot of such width as may be necessary and convenient for the application of the material to be jointed. ()

15. Boring and Mortising Machines. ()

a. Safety-bit chucks with no projecting set screws shall be used. ()

b. Boring bits should be provided with a guard that will enclose all portions of the bit and chuck above the material being worked. ()

c. The top of the cutting chain and driving mechanism shall be enclosed. ()

d. If there is a counterweight, one (1) of the following or equivalent means shall be used to prevent its dropping: it shall be bolted to the bar by means of a bolt passing through both bar and counterweight; a bolt shall be put through the extreme end of the bar; where the counterweight does not encircle the bar, a safety chain shall be attached to it. Other types of counterweights shall be suspended by chain or wire rope and shall travel in a pipe or other suitable enclosure wherever they might fall and cause injury. ()

e. Universal joints on spindles of boring machines shall be completely enclosed in such a way as to prevent accidental contact by the operator. ()

f. Each operating treadle shall be covered by an inverted U-shaped metal guard, fastened to the floor, and of adequate size to prevent accidental tripping. ()

16. Wood Shapers and Similar Equipment. ()

a. The cutting heads of each wood shaper, hand-fed panel raiser, or other similar machine not automatically fed, shall be enclosed with a cage or adjustable guard so designed as to keep the operator's hand away from the cutting edge. The diameter of circular shaper guards shall be not less than the greatest diameter of the cutter. In no case shall a warning device of leather or other material attached to the spindle be acceptable. ()

b. Cylindrical heads should be used whenever the nature of the work will permit. Single cutter knives in shaper heads shall not be used unless properly balanced. ()

c. All double-spindle shapers shall be provided with a spindle starting and stopping device for each spindle. ()

17. Planing and Molding Machines. ()

a. Each planing and molding machines shall have all cutting heads, and saws if used, covered by a metal guard. If such guard is constructed of sheet metal, the material used shall be not less than one sixteenth (1/16) inch in thickness, and if cast iron is used, it shall be not less than three-sixteenths (3/16) inch in thickness. ()

b. Where an exhaust system is used, the guards shall form part or all of the exhaust hood and shall be constructed of metal of a thickness not less than that specified in Subsection 250.15.a. of this section. ()

c. Feed rolls shall be guarded by a hood or suitable guard to prevent the hands of the operator from coming in contact with the in-running rolls at any point. The guard shall be fastened to the frame carrying the rolls so as to remain in adjustment for any thickness of stock. ()

d. Surfacer or planers used in thicknessing multiple pieces of material simultaneously shall be provided with sectional infeed rolls having sufficient yield in the construction of the sections to provide feeding

contact pressure on the stock, over the permissible range of variation in stock thickness specified or for such yielding sectional rolls, suitable section kickback finger devices shall be provided at the infeed end. ()

18. Profile and Swing-Head Lathes and Wood Heel Turning Machine. ()

a. Cutting heads on wood-turning lathes, whether rotating or not, shall be covered as completely as possible by hoods or shields, which shall be hinged to the machines so that they can be thrown back for making adjustments. ()

b. Lathes used for turning long pieces of wood stock held only between the two (2) centers shall be equipped with long curved guards extending over the tops of the lathes in order to prevent the work pieces from being thrown out of the machines if they should become loose. ()

c. Where an exhaust system is used, the guard shall form part or all of the exhaust hood and shall be constructed of metal of a thickness not less than that specified in 250.21.a of this subsection. ()

19. Sanding Machines. ()

a. Feed rolls of self-feed sanding machines shall be protected with a semi-cylindrical guard to prevent the hands of the operator from coming in contact with the in-running rolls at any point. The guard shall be constructed of heavy material, preferably metal, and firmly secured to the frame carrying rolls so as the remain in adjustment for any thickness of stock. The bottom of the guard should come down to within three-eighths (3/8) inch of a plane formed by the bottom or contact face of the feed roll where it touches the stock. ()

b. Each drum sanding machine shall have an exhaust hood, or other guard if no exhaust system is required, so arranged as to enclose the revolving drum, except for that portion of the drum above the table, if a table is used which may be necessary and convenient for the application of the material to be finished. ()

c. Each disk sanding machine shall have the exhaust hood, or other guard if no exhaust system is required, so arranged as to enclose the revolving disk, except for that portion of the disk above the table, if a table is used, which may be necessary for the application of the material to be finished. ()

d. Belt sanding machines shall be provided with guards at each nip point where the sanding belt runs on to a pulley. These guards shall effectively prevent the hands or fingers of the operator from coming in contact with the nip points. The unused run of the sanding belt shall be guarded against accidental contact. ()

20. Inspection and Maintenance of Woodworking Machinery. ()

a. Dull, badly set, improperly filed, or improperly tensioned saws shall be immediately removed from service before they begin to cause the material to stock, jam, or kickback when it is fed to the saw at normal speed. Saws to which gum has adhered on the sides shall be immediately cleaned. ()

b. All knives and cutting heads of woodworking machines shall be kept sharp, properly adjusted, and firmly secured. Where two (2) or more knives are used in one (1) head, they shall be properly balanced. ()

c. Bearings shall be kept free from lost motion and shall be well lubricated. ()

d. Arbors of all circular saws shall be free from play. ()

e. Sharpening or tensioning of saw blades or cutters shall be done only by persons of demonstrated skill in this kind of work. ()

f. Emphasis is placed upon the importance of maintaining cleanliness around woodworking machinery, particularly as regards the effective functioning of guards and the prevention of fire hazards in switch enclosures, bearings, and motors. ()

g. All cracked saws shall be removed from service. ()

- h. The practice of inserting wedges between the saw disk and the collar to form what is commonly known as a "wobble saw" shall not be permitted. ()
- i. Push sticks or push blocks shall be provided at the work place in several sizes and types suitable for the work to be done. ()
- j. Twists or kinks in bandsaws shall be promptly removed with a hammer. ()
- k. To avoid vibration, brazed joints in bandsaws shall be the same thickness as the saw blades. ()
- l. The knife blade of jointers shall be so installed and adjusted that it does not protrude more than one-eighth (1/8) inch beyond the cylindrical body of the head. Push sticks or push blocks shall be provided at the work place in several sizes and types suitable for the work to be done. ()
21. Abrasive Wheel Machinery. ()
- a. Abrasive wheels shall be used only on machines provided with safety guards. EXCEPTIONS: Wheels used for internal work while within the work being ground; mounted wheels used in portable operations two (2) inches and smaller in diameter; and types 16, 17, 18, 18R, and 19 cones, plugs, and threaded hole pit balls where the work offers protection. ()
- b. The safety guard shall cover the spindle end, nut, and flange projections. The safety guard shall be mounted so as to maintain proper alignment with the wheel, and the strength of the fastenings shall exceed the strength of the guard. EXCEPTIONS: Safety guards on all operations where the work provides a suitable measure of protection to the operator, may be so constructed that the spindle end, nut, and outer flange are exposed; and where the nature of the work is such as to entirely cover the side of the wheel, the side covers of the guard may be omitted; and the spindle end, nut, and outer flange may be exposed on machines designed like portable saws. ()
- c. Grinding machines shall be equipped with flanges in accordance with Subsection 250.21.x. through Subsection 250.21.cc. of this section. ()
- d. On off-hand grinding machines, work rests shall be used to support the work. They shall be of rigid construction and designed to be adjustable to compensate for wheel wear. Work rests shall be kept adjusted closely to the wheel with a maximum opening of one-eighth (1/8) inch to prevent the work from being jammed between the wheel and the rest, which may cause wheel breakage. The work rest shall be securely clamped after each adjustment. The adjustment shall not be made with the wheel in motion. ()
- e. Natural sandstone wheels and metal, wooden, cloth, or paper discs, having a layer of abrasive on the surface are not covered by Section 250.21 of this section. ()
- f. Cup wheels (Types 6 and 11) shall be protected by: safety guards as specified in Subsection 250.21.f. through Subsection 250.23.w. this section; band type guards as specified in Subsection 250.21.v. of this section; and special revolving cup guards which mount behind the wheel and turn with it. They shall be made of steel or other material with adequate strength and shall enclose the wheel sides upward from the back for one-third (1/3) of the wheel thickness. The mounting features shall conform with all requirements of this section. It is necessary to maintain clearance between the wheel side and the guard. This clearance shall not exceed one-sixteenth (1/16) inch. ()
- g. The maximum exposure angles specified in Subsection 250.21.g. through Subsection 250.21.l. of this section shall not be exceeded. Visors or other accessory equipment shall not be included as a part of the guard when measuring the guard opening, unless such equipment has strength equal to that of the guard. ()
- h. The angular exposure of the grinding wheel periphery and sides for safety guards used on machines known as bench and floor stands should not exceed ninety (90) degrees or one-fourth (1/4) of the periphery. This exposure shall begin at a point not more than sixty-five (65) degrees above the horizontal plane of the wheel spindle. (See Figure 250.21-A). Wherever the nature of the work requires contact with the wheel below the horizontal plane of

the spindle, the exposure shall not exceed one hundred twenty-five (125) degrees. (See Figure 250.21-B) ()

FIGURE 250.21-A

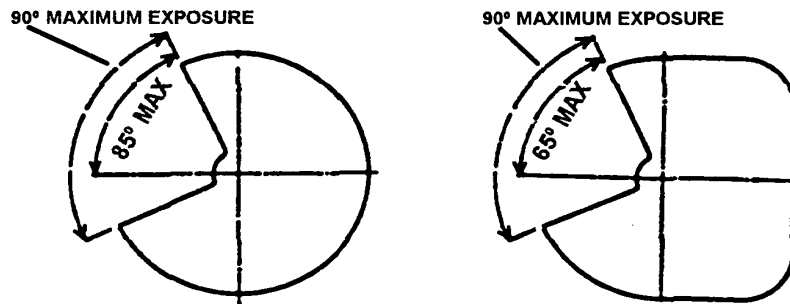
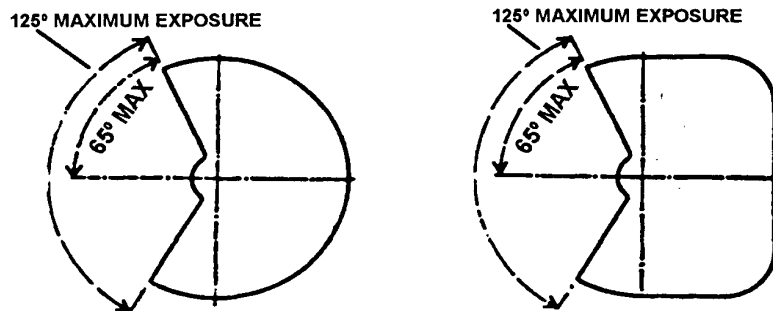
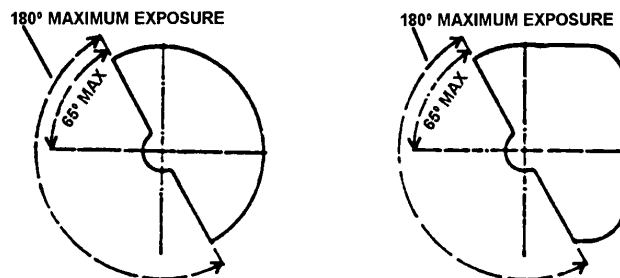


FIGURE 250.21-B



i. The maximum angular exposure of the grinding wheel periphery and sides for safety guards used on cylindrical grinding machines shall not exceed one hundred eighty (180) degrees. This exposure shall begin at a point not more than sixty-five (65) degrees above the horizontal plane of the wheel spindle. (See Figure 250.21-C). ()

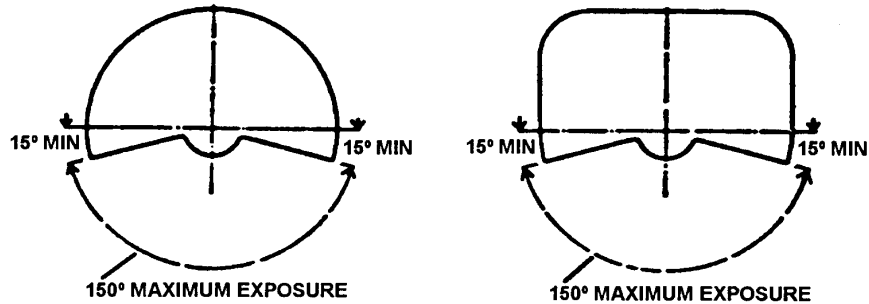
FIGURE 250.21-C



j. The maximum angular exposure of the grinding wheels periphery and sides for safety guards used

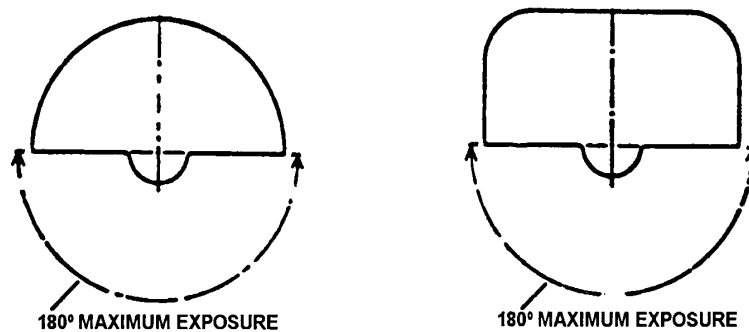
on cutting-off machines and on surface grinding machines which employ the wheel periphery shall not exceed one hundred fifty (150) degrees. This exposure shall begin at a point not less than fifteen (15) degrees below the horizontal plane of the wheel spindle. (See Figure 250.21-D). ()

FIGURE 250.21-D



k. The maximum angular exposure of the grinding wheel periphery and sides for safety guards used on machines shall not exceed one hundred eighty (180) degrees, and the top half of the wheel shall be enclosed at all times. (See Figure 250.21-E). ()

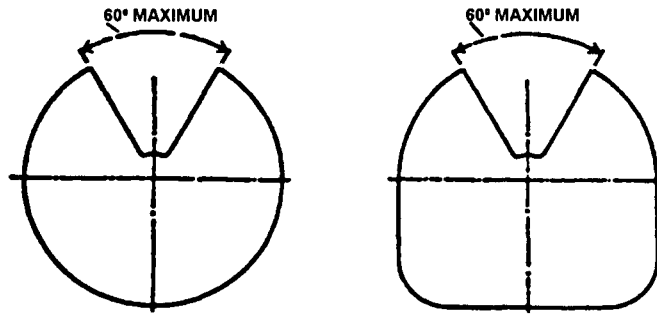
FIGURE 250.21-E



l. The maximum angular exposure of the grinding wheel periphery and sides known as automatic snagging machines shall not exceed one hundred eighty (180) degrees and the top half of the wheel shall be enclosed at all times. (See Figure 250.21-E). ()

m. Where the work is applied to the wheel above the horizontal center line, the exposure of the grinding wheel periphery shall be as small as possible and shall not exceed sixty (60) degrees. (See Figure 250.21-F). ()

FIGURE 250.21-F



n. Safety guards of the types described in Subsection 250.21.h. and Subsection 250.23.i. of this section, where the operator stands in front of the opening shall be constructed so that the peripheral protecting member can be adjusted to the constantly decreasing diameter of the wheel. The maximum angular exposure above the horizontal plane of the wheel spindle as specified in Subsection 250.21.h. and Subsection 250.23.i. of this section, shall never be exceeded, and the distance between the wheel periphery and the adjustable tongue or the end of the peripheral member at the top shall never exceed one-fourth (1/4) inch. See Figure 250.21-G and Table 250.21-A for minimum basic thickness of peripheral and side members for various types of safety guards and classes of service.

()

FIGURE 250.21-G

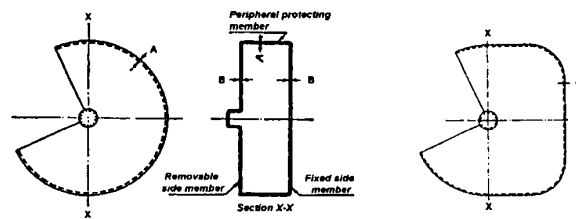
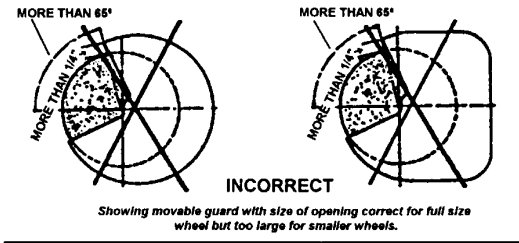
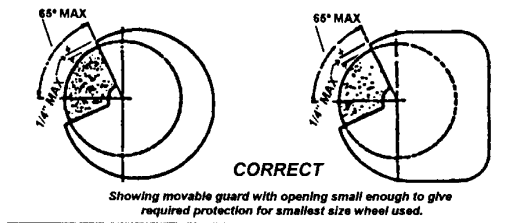
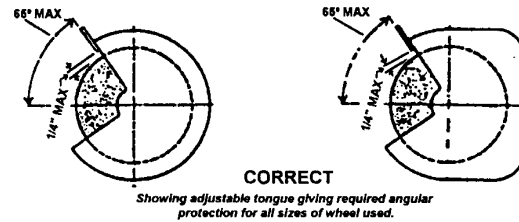


TABLE 250.21-A					
Diameters 3" to 12"					
Material used in construction of guard	Maximum thickness of grinding wheel	Grinding wheel diameters			
		3 to 6 inches		Over 6 to 12 inches	
		A	B	A	B
	Inches	Inches		Inches	
Structural steel (min. tensile strength 60,000 p.s.i.)	2	1/8	1/16	5/16	1/4
	4	1/8	1/16	3/8	5/16
	6	3/16	1/16	1/2	3/8
	8			1/2	3/8
	10			9/16	7/16
	16				
	20				

TABLE 250.21-A					
Diameters 12" to 20"					
Material used in construction of guard	Maximum thickness of grinding wheel	Grinding wheel diameters			
		Over 12 to 16 inches		Over 16 to 20 inches	
		A	B	A	B
	Inches	Inches		Inches	
Material satisfactory ¹ for speeds up to 8,000 SFPM. Cast iron (min. tensile strength 20,000 p.s.i.) Class 20.	2	1/2	3/8	5/8	1/2
	4	1/2	3/8	3/4	5/8
	6	5/8	1/2	1	5/8
	8	7/8	3/4	1	3/4
	10	7/8	3/4	1	3/4
	16	1 1/8	1	1 1/4	1
	20			1 3/8	1 1/8

TABLE 250.21-A					
Diameters 12" to 20"					
Material used in construction of guard	Maximum thickness of grinding wheel	Grinding wheel diameters			
		Over 12 to 16 inches		Over 16 to 20 inches	
		A	B	A	B
	Inches	Inches		Inches	
Material satisfactory ¹ for speeds up to 9,000 SFPM. Malleable iron (min. tensile strength 50,000 p.s.i.) Grade 32510.	2	1/2	3/8	5/8	1/2
	4	1/2	3/8	5/8	1/2
	6	5/8	1/2	3/4	5/8
	8	5/8	1/2	3/4	5/8
	10	5/8	1/2	3/4	5/8
	16	13/16	11/16	13/16	11/16
	20			7/8	3/4

¹The recommendations listed in the above table are guides for the conditions stated. Other material, designs or dimensions affording equal or superior protection are also acceptable.

TABLE 250.21-A					
Diameters 12" to 20"					
Material used in construction of guard	Maximum thickness of grinding wheel	Grinding wheel diameters			
		Over 12 to 16 inches		Over 16 to 20 inches	
		A	B	A	B
	Inches	Inches		Inches	
Material satisfactory ¹ for speeds up to 16,000 SFPM. Steel castings (min. tensile strength 60,000 p.s.i.) Grade V60-30.	2	3/8	3/8	1/2	7/16
	4	1/2	1/2	9/16	1/2
	6	3/4	5/8	3/4	5/8
	8	7/8	3/4	7/8	3/4
	10	1	7/8	1	7/8
	16	1 1/4	1 1/8	1 1/4	1 1/8
	20			1 3/8	1 1/4

TABLE 250.21-A					
Diameters 12" to 20"					
Material used in construction of guard	Maximum thickness of grinding wheel	Grinding wheel diameters			
		Over 12 to 16 inches		Over 16 to 20 inches	
		A	B	A	B
	Inches	Inches		Inches	
Structural steel (min. tensile strength 60,000 p.s.i.)	2	5/16	1/4	5/16	1/4
	4	3/8	5/16	3/8	5/16
	6	7/16	3/8	7/16	3/8
	8	9/16	7/16	9/16	7/16
	10	5/8	1/2	5/8	1/2
	16	5/8	9/16	3/4	5/8
	20			13/16	11/16

¹The recommendations listed in the above table are guides for the conditions stated. Other material, designs or dimensions affording equal or superior protection are also acceptable.

TABLE 250.21-A					
Diameters Over 20" to 40"					
Material used in construction of guard	Maximum thickness of grinding wheel	Grinding wheel diameters			
		Over 20 to 24 inches		Over 20 to 24 inches	
		A	B	A	B
	Inches	Inches		Inches	
Material satisfactory ¹ for speeds up to 8,000 SFPM. Cast iron (min. tensile strength 20,000 p.s.i.) Class 20	2	7/8	5/8	1	3/4
	4	1	5/8	1 1/8	3/4
	6	1 1/8	3/4	1 1/4	7/8
	8	1 1/8	3/4	1 1/4	7/8
	10	1 1/8	3/4	1 1/4	7/8
	16	1 5/16	1	1 7/16	1 1/16
	20	1 3/8	1 1/8	1 1/2	1 3/8

TABLE 250.21-A					
Diameters Over 20" to 40"					
Material used in construction of guard	Maximum thickness of grinding wheel	Grinding wheel diameters			
		Over 20 to 24 inches		Over 20 to 24 inches	
		A	B	A	B
	Inches	Inches		Inches	
Material satisfactory ¹ for speeds up to 9,000 SFPM. Malleable iron (min. tensile strength 50,000 p.s.i.) Grade 32510.	2	3/4	5/8	7/8	3/4
	4	3/4	5/8	7/8	3/4
	6	7/8	5/8	1	3/4
	8	7/8	5/8	1	3/4
	10	7/8	5/8	1	3/4
	16	1	3/4	1 1/8	7/8
	20	1	3/4	1 1/8	7/8
Material satisfactory ¹ for speeds up to 16,000 SFPM. Steel castings (min. tensile strength 60,000 p.s.i.) Grade V60-30.	2	5/8	1/2	3/4	5/8
	4	5/8	1/2	3/4	5/8
	6	13/16	11/16	13/16	11/16
	8	7/8	3/4	15/16	13/16
	10	1 1/8	15/16	1 1/8	1
	16	1 1/4	1 1/8	1 1/4	1 1/8
	20	1 3/8	1 1/4	1 7/16	1 5/16
Structural steel (min. tensile strength 60,000 p.s.i.)	2	5/16	1/4	3/8	5/16
	4	3/8	5/16	3/8	5/16
	6	7/16	3/8	7/16	3/8
	8	9/16	7/16	5/8	1/2
	10	5/8	1/2	5/8	1/2
	16	3/4	5/8	13/16	11/16
	20	13/16	11/16	7/8	3/4

¹The recommendations listed in the above table are guides for the conditions stated. Other material, designs or dimensions affording equal or superior protection are also acceptable

TABLE 250.21-A			
Diameters Over 40" to 48"			
Material used in construction of guard	Material used in construction of guard	Grinding wheel diameters	
		Over 40 to 48 inches	
		A	B
		Inches	Inches
Material satisfactory ¹ for speeds up to 8,000 SFPM. Cast iron (min. tensile strength 20,000 p.s.i.) Class 20	2	1 1/4	1
	4	1 3/8	1
	6	1 1/2	1 1/8
	8	1 1/2	1 1/8
	10	1 1/2	1 1/8
	16	1 3/4	1 3/8
	20	2	1 5/8
Material satisfactory ¹ for speeds up to 9,000 SFPM. Malleable iron (min. tensile strength 50,000 p.s.i.) Grade 32510.	2	1	7/8
	4	1 1/8	7/8
	6	1 1/4	7/8
	8	1 1/4	7/8
	10	1 1/4	7/8
	16	1 3/8	1
	20	1 1/2	1 1/8
Material satisfactory ¹ for speeds up to 16,000 SFPM. Steel castings (min. tensile strength 60,000 p.s.i.) Grade V60-30.	2	7/8	3/4
	4	1	3/4
	6	1 1/8	3/4
	8	1 3/8	1
	10	1 7/16	1 1/16
	16	1 13/16	1 7/16
	20	2 1/16	1 11/16

TABLE 250.21-A			
Diameters Over 40" to 48"			
Material used in construction of guard	Material used in construction of guard	Grinding wheel diameters	
		Over 40 to 48 inches	
		A	B
		Inches	Inches
Structural steel (min. tensile strength 60,000 p.s.i.)	2	1/2	3/8
	4	1/2	3/8
	6	3/4	1/2
	8	3/4	1/2
	10	7/8	5/8
	16	1 1/16	13/16
	20	1 3/16	15/16
¹ The recommendations listed in the above table are guides for the conditions stated. Other material, designs or dimensions affording equal or superior protection are also acceptable.			

o. If operating speed does not exceed eight thousand (8,000) surface feet per minute cast iron safety guards, malleable iron guards, or other guards as described in Subsection 250.21.p. of this section. ()

p. Cast steel, or structural steel, safety guards as specified in Figure 250.21-G and Table 250.21-A shall be used where operating speeds of wheels are faster than eight thousand (8,000) surface feet per minute up to a maximum of sixteen thousand (16,000) surface feet per minute. ()

q. For cutting-off wheels sixteen (16) inches diameter and smaller and where speed does not exceed sixteen thousand (16,000) surface feet per minute, cast iron or malleable iron safety guards as specified in Figure 250.21-G and in Table 250.21-A shall be used. ()

r. For cutting-off wheels larger than sixteen (16) inches diameter and where speed does not exceed fourteen thousand two hundred (14,200) surface feet per minute, safety guards as specified in Figures 250.21-H and in Table 250.21-B shall be used. ()

FIGURE 250.21-H

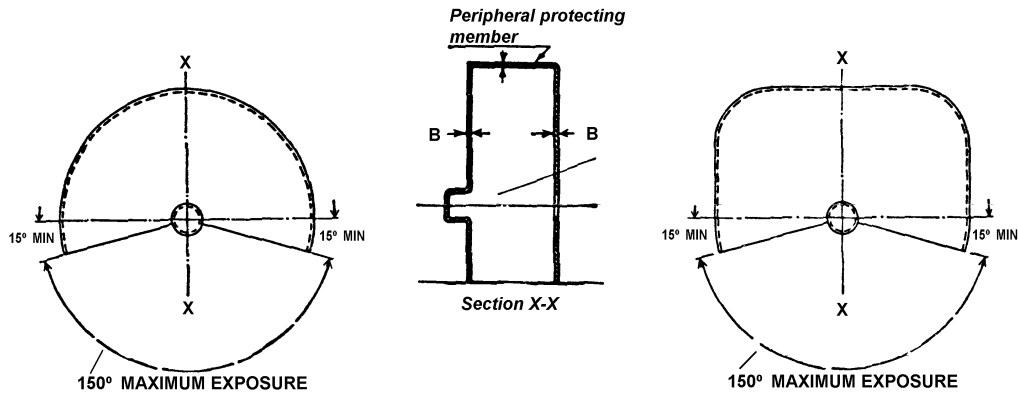


TABLE 250.21-B (Part 2)

MINIMUM BASIC THICKNESS FOR PERIPHERAL AND SIDE MEMBERS FOR SAFETY GUARDS USED WITH CUTTING - OFF WHEELS Part 2 -- 30" Through 72"						
Material used in construction of guard	Maximum thickness of cutting off wheel	Speed not to exceed	Cutting off wheel diameters			
			Over 30 to 48 in.		Over 48 to 72 in.	
			A	B	A	B
Structural steel min. tensile strength 60,000 p.s.i.	1/2 inch or less	14,200 SFPM	3/16	3/16	1/4	1/4
	1/2 inch or less	16,000 SFPM	1/4	3/16	5/16	1/4

s. For threaded grinding wheels not exceeding one (1) inch in thickness cast iron or malleable iron safety guards as specified in Figure 250.21-G and in Table 250.21-A shall be used. ()

t. Band type guards shall be of steel plate or other material of equal or greater strength. They shall be continuous, the ends being either riveted, bolted, or welded together in such a manner as to leave the inside free from projections. ()

u. The inside diameter of band type guards shall not be more than one (1) inch larger than the outside diameter of the wheel, and shall be mounted as nearly concentric with the wheel as practicable. ()

v. Band type guards shall be of sufficient width and its position and kept so adjusted that at no time will the wheel protrude beyond the edge of the band a distance greater than that indicated in Figure 250.21-I and in Table 250.21-C or the wall thickness (W), whichever is smaller. ()

TABLE 250.21-C (Part 1)	
EXPOSURE VERSUS WHEEL THICKNESS	
Overall thickness of wheel (T) (inches)	Maximum exposure of wheel (C) (inches)
1/2	1/4
1	1/2
2	3/4
3	1
4	1 1/2
5 and over	2

TABLE 250.21-C (Part 2)				
GUIDE FOR CONSTRUCTION OF BAND TYPE (Maximum Wheel Speed 7,000 SFPM)				
Minimum material specifications	Diameter of wheel	Minimum thickness of band A	Minimum diameter of rivets	Maximum distance between centers of rivets
	Inches	Inches	Inches	Inches
Hot rolled steel SAE 1008	Inches	Inches	Inches	Inches
	Under 8	1/16	3/16	3/4
	8 to 24	1/8	1/4	1
	Over 24 to 30	1/4	3/8	1 1/4

w. Abrasive wheel machinery guards shall meet the design specifications of the American National Standard Safety Code for the use, care, and protection of abrasive wheels, ANSI B7.1. These requirements shall not apply to natural sandstone wheels or metal, wooden, cloth, or paper discs, having a layer of abrasive on the surface. ()

x. All abrasive wheels shall be mounted between flanges which shall not be less than one third (1/3) of the diameter of the wheel. Type 1 cutting-off wheels are to be mounted between properly relieved flanges which have matching bearing surfaces. Such flanges shall be at least one-fourth (1/4) the wheel diameter. Type 27A cutting-off wheels are designed to be mounted by means of flat, not relieved, flanges having matching bearing surfaces and which may be less than one-third (1/3) but shall not be less than one-fourth (1/4) the wheel diameter. (See Figure 250.21-J for one (1) such type of mounting). There are three (3) general types of flanges: straight relieved flanges (see Figure 250.21-K); straight unrelieved flanges (see Figure 250.21-L); adaptor flanges (see Figure 250.21-M). Regardless of flange type used, the wheel shall always be guarded. Blotters shall be used in accordance with Subsection 250.21.z. of this section. EXCEPTIONS: Mounted wheels; portable wheels with threaded inserts or projecting studs; abrasive discs (inserted nut, inserted washer and projecting stud type); plate mounted wheels; cylinders, cup or segmental wheels that are mounted in chucks; types 27 and 28 wheels; certain internal wheels;

modified types 6 and 11 wheels (terrazzo); and cutting-off wheels types 1 and 27A. ()

FIGURE 250.21-J

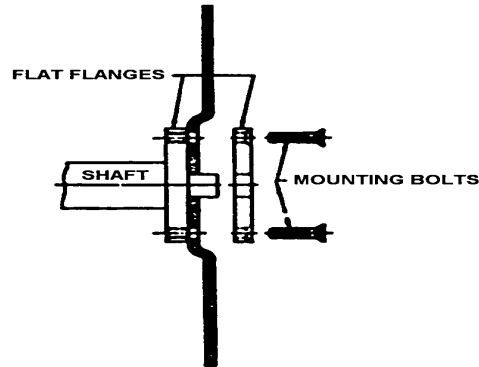


FIGURE 250.21-K

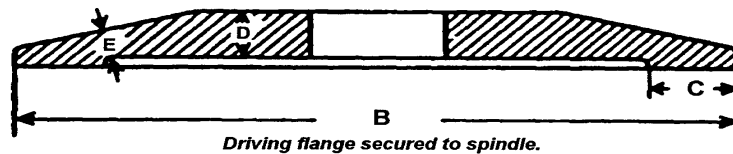


FIGURE 250.21-L

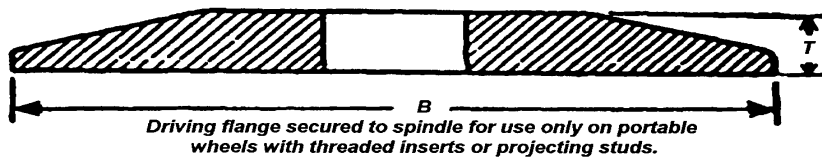
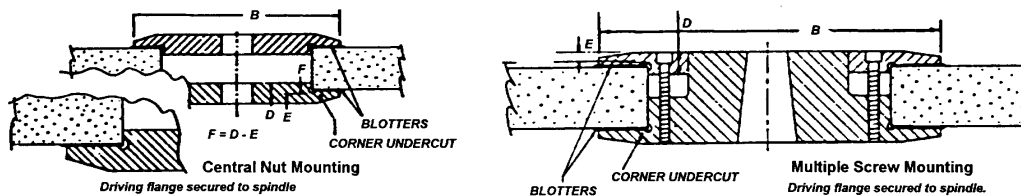


FIGURE 250.21-M



y. Flanges shall be of such design as to satisfactorily transmit the driving torque from the spindle to the grinding wheel. Flanges may be made of steel, cast iron, or other material of equal or greater strength and rigidity. Flanges shall be designed with respect to rigidity so that when tightened, the radial width of bearing surface of contact on the wheel is maintained. (See Table 250.21-D and Figure 250.21-K.) Flanges shall be dimensionally accurate and in good balance. There shall be no rough surfaces or sharp edges. Both flanges, of any type, between which a wheel is mounted, shall be of the same diameter and have equal bearing surface. Straight relieved flanges made according to Table 250.21-D and Figure 250.21-K shall be recessed at least one sixteenth (1/16) inch on the side next to the wheel for a distance as specified in Table 250.21-D. Straight flanges of the adaptor or sleeve type (Table 250.21-E and Figure 250.21-M) shall be undercut so that there will be no bearing on the sides of the wheel

within one-eighth (1/8) inch of the arbor hole. EXCEPTIONS: Type 27 and 28 wheels because of their shape and usage, require specially designed adaptors. The back flange shall extend beyond the central hub or raised portion and contact the wheel to counteract the side pressure on the wheel in use. The adapter nut which is less than the minimum one-third (1/3) diameter of the wheel fits in the depressed side of wheel to prevent interference in side grinding and serves to drive the wheel by its clamping force against the depressed portion of the back flange. The variance in flange diameters, the adaptor nut being less than one-third (1/3) wheel diameter, and the use of side pressure in wheel operation limit the use to reinforced organic bonded wheels. Mounts which are affixed to the wheel by the manufacturer shall not be reused. Type 27 and Type 28 wheels shall be used only with a safety guard located between wheel and operator during use. (See Figure 250.21-N). Modified Types 6 and 11 wheels (terrazzo) with tapered K. dimension. ()

TABLE 250.21-D					
MINIMUM DIMENSIONS FOR STRAIGHT RELIEVED FLANGES					
A¹ Diameter of wheel	B Minimum outside diameter of flanges	C Radial width of bearing surface		D Minimum thickness of flange at bore	E Minimum thickness of flange at edge of recess
		Minimum	Maximum		
Inches	Inches	Inches	Inches	Inches	Inches
1	3/6	1/16	1/8	1/16	1/16
2	3/4	1/8	3/16	1/8	3/32
3	1	1/8	3/16	3/16	3/32
4	1 3/8	1/8	3/16	3/16	1/8
5	1 3/4	3/16	1/4	1/4	1/8
6	2	1/4	1/2	3/8	3/16
7	2 1/2	1/4	1/2	3/8	3/16
8	3	1/4	1/2	3/8	3/16
10	3 1/2	5/16	5/8	3/8	1/4
12	4	5/16	5/8	1/2	5/16
14	4 1/2	3/8	3/4	1/2	5/16
16	5 1/2	1/2	1	1/2	5/16
18	6	1/2	1	5/8	3/8
20	7	5/8	1 1/4	5/8	3/8
22	7 1/2	5/8	1 1/4	5/8	7/16
24	8	3/4	1 1/4	5/8	7/16
26	8 1/2	3/4	1 1/4	5/8	1/2
28	10	7/8	1 1/2	3/4	1/2
30	10	7/8	1 1/2	3/4	5/8

TABLE 250.21-D					
MINIMUM DIMENSIONS FOR STRAIGHT RELIEVED FLANGES					
A ¹ Diameter of wheel	B Minimum outside diameter of flanges	C Radial width of bearing surface		D Minimum thickness of flange at bore	E Minimum thickness of flange at edge of recess
		Minimum	Maximum		
Inches	Inches	Inches	Inches	Inches	Inches
36	12	1	2	7/8	3/4
42	14	1	2	7/8	3/4
48	16	1 1/4	2	1 1/8	1
60	20	1 1/4	2	1 1/4	1 1/8
72	24	1 1/2	2 1/2	1 3/8	1 1/4

¹Flanges for wheels under 2 inches diameter may be unrelieved and shall be maintained flat and true.

()

FIGURE 250.21-N

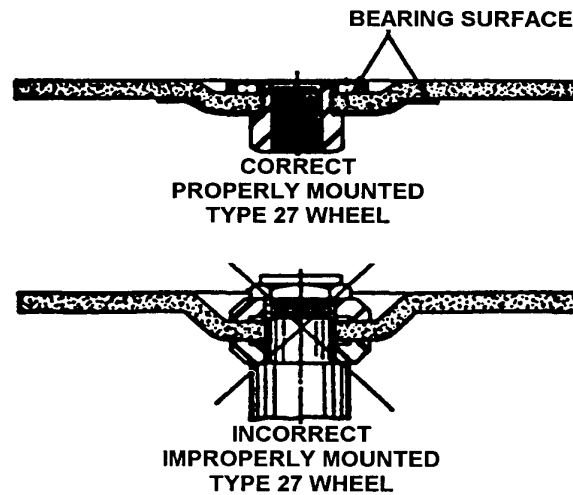


TABLE 250.21-E (Part 1)		
MINIMUM DIMENSIONS FOR STRAIGHT UNRELIEVED FLANGES FOR WHEELS WITH THREADED INSERTS OR PROJECTING STUDS		
A Diameter of wheel	B¹ Minimum outside diameter of flange	T Minimum thickness of flange
Inches	Inches	Inches
1	5/8	1/8
2	1	1/8
3	1	3/16
4	1 3/8	3/16
5	1 3/4	1/4
6	2	3/8

¹Note: Must be large enough to extend beyond the bushing. Where prong anchor or cupback bushing are used, this footnote does not apply.

TABLE 250.21-E (Part 2)					
MINIMUM DIMENSIONS FOR STRAIGHT ADAPTOR FLANGE FOR ORGANIC BONDED WHEELS OVER 1 1/4 INCHES THICK¹					
Wheel diameter	Wheel hole diameter	B Minimum flange diameter	D Minimum thickness of flange at bore	E Minimum thickness of flange at edge of undercut	F¹ (D-E) Minimum thickness
Inches	Inches	Inches	Inches	Inches	Inches
12 to 14	4	6	7/8	3/8	1/2
	5	7	7/8	3/8	1/2
	6	8	7/8	3/8	1/2
Larger than 14 to 18	4	6	7/8	3/8	1/2
	5	7	7/8	3/8	1/2
	6	8	7/8	3/8	1/2
	7	9	7/8	3/8	1/2
	8	10	7/8	3/8	1/2

TABLE 250.21-E (Part 2)					
MINIMUM DIMENSIONS FOR STRAIGHT ADAPTOR FLANGE FOR ORGANIC BONDED WHEELS OVER 1 1/4 INCHES THICK ¹					
Wheel diameter	Wheel hole diameter	B Minimum flange diameter	D Minimum thickness of flange at bore	E Minimum thickness of flange at edge of undercut	F ¹ (D-E) Minimum thickness
Inches	Inches	Inches	Inches	Inches	Inches
Larger than 18 to 24	6	8	1	1/2	1/2
	7	9	1	1/2	1/2
	8	10	1	1/2	1/2
	10	12	1	1/2	1/2
	12	14	1	1/2	1/2
Larger than 24 to 30	12	15	1	1/2	1/2
Larger than 30 to 36	12	15	1 3/8	7/8	1/2

¹For wheels under 1/4 inches thick F dimension shall not exceed 40 percent of wheel thickness.

z. Blotters (compressible washers) shall always be used between flanges and abrasive wheel surfaces to insure uniform distribution of flange pressure. EXCEPTIONS: mounted wheels; abrasive discs (inserted nut, inserted washer, and projecting stud type); plate mounted wheels; cylinders, cups or segmental wheels that are mounted in chucks; type 27 and 28 wheels; certain Type 1 and Type 27A cutting-off wheels; certain internal wheels; type 4 tapered wheels; diamond wheels, except certain vitrified diamond wheels; and modified types 6 and 11 wheels (terrazzo) -(blotters shall be applied flat side of wheel only). ()

aa. The driving flange shall be securely fastened to the spindle and the bearing surface shall run true. When more than one (1) wheel is mounted between a single set of flanges, wheels may be cemented together or separated by specially designed spacers. Spacers shall be equal in faces. (See Subsection 250.21.z. of this section.) ()

bb. Table 250.21-D and 250.21-F, and Figures 250.21-L, 250.21-K show minimum dimensions for straight relieved and unrelieved flanges for use with wheels with small holes that fit directly on the machine spindle. Dimensions of such flanges shall never be less than indicated and shall be greater where practicable. Tables 250.21-E, 250.21-F, and 250.21-G minimum dimensions for straight adaptor flanges for use with wheels having holes larger than the spindle. Dimensions of such adaptor flanges shall never be less than indicated and should be greater where practicable. Table 250.21-F and Figure 250.21-M show minimum dimensions for straight flanges that are an integral part of wheel sleeves which are frequently used on precision grinding machines. Dimensions of such flanges shall never be less than indicated and should be greater where practicable. ()

TABLE 250.21-F					
MINIMUM DIMENSIONS FOR STRAIGHT FLANGES FOR MECHANICAL GRINDERS 12,500 S.F.P.M. TO 16,500 S.F.P.M.¹					
Wheel diameter	Wheel hole diameter	B Minimum flange diameter	D Minimum thickness of flange at bore	E Minimum thickness of flange at edge of undercut	F² (D-E) minimum thickness
20	6	8	1	1/2	1/2
20	8	10	1 1/2	3/4	3/4
24	12	15	2	1	1
30	12	15	2	1	1
36	12	15	2	1	1

¹Flange shall be of steel, quality SAE 1040 or equivalent, annealed plate, heat treated to R_c 25-30.

²For wheels under 1 1/4-inch thick F dimension shall not exceed 40-percent of wheel thickness.

TABLE 250.21-G				
MINIMUM DIMENSIONS FOR STRAIGHT FLANGES USED AS WHEEL SLEEVES FOR PRECISSION GRINGING ONLY				
Steel diameter	Wheel hole diameter	B Minimum outside diameter of flange	D Minimum thickness of flange at bore	E Minimum thickness of flange at edge of undercut
Inches	Inches	Inches	Inches	Inches
12 to 14	5	7	1/2	7/16
	5	7	5/8	7/16
	6	8	5/8	7/16
Larger than 14 to 20	8	10	5/8	7/16
	10	11 1/2	5/8	7/16
	12	13 1/2	5/8	7/16

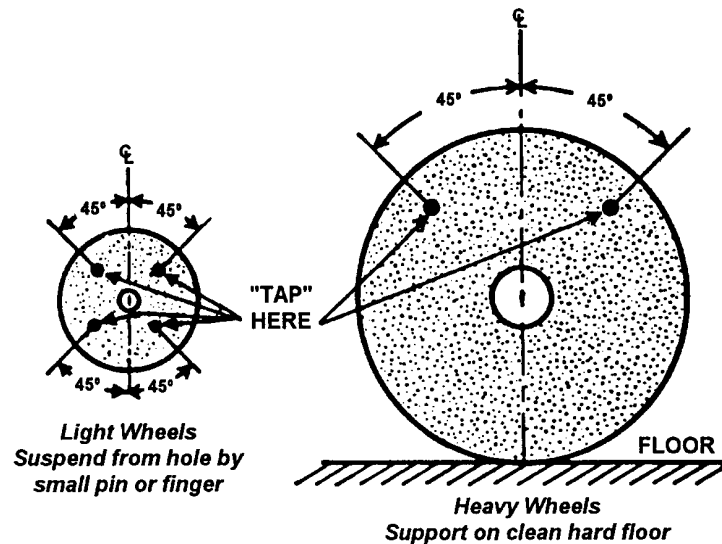
TABLE 250.21-G				
MINIMUM DIMENSIONS FOR STRAIGHT FLANGES USED AS WHEEL SLEEVES FOR PRECISION GRINDING ONLY				
Steel diameter	Wheel hole diameter	B Minimum outside diameter of flange	D Minimum thickness of flange at bore	E Minimum thickness of flange at edge of undercut
Inches	Inches	Inches	Inches	Inches
Larger than 20 to 30	8	10	3/4	1/2
	10	11 1/2	3/4	1/2
	12	13 1/2	3/4	1/2
	16	17 1/2	3/4	1/2
Larger than 30 to 42	12	13 1/2	3/4	1/2
	16	17 1/2	3/4	1/2
	18	19 1/2	3/4	1/2
	20	21 1/2	3/4	1/2
Larger than 42 to 60	16	20	1	3/4
	20	24	1	3/4
	24	29	1 1/8	7/8

Note: These flanges may be clamped together by means of central nut, or by a series of bolts or some other equivalent means of fastening.

cc. All flanges shall be maintained in good condition. When the bearing surfaces become worn, warped, sprung, or damaged, they should be trued or refaced. When refacing or truing care shall be exercised to make sure that proper relief and rigidity is maintained as specified Subsection 250.21.y. of this section and they shall be replaced when they do not conform to these requirements. Failure to observe these rules might cause excessive flange pressure around the hole of the wheel. This is especially true of wheel-sleeve or adaptor flanges. ()

dd. Immediately before mounting, all wheels shall be closely inspected and sounded by the user (ring test) to make sure they have not been damaged in transit, storage, or otherwise. The spindle speed of the machine shall be checked before mounting of the wheel to be certain that it does not exceed the maximum operating speed marked on the wheel. Wheels should be tapped gently with a light nonmetallic implement, such as the handle of a screwdriver for light wheels, or a wooden mallet for heavier wheels. If they sound cracked (dead), they shall not be used. This is known as the "Ring Test". Wheels must be dry and free from sawdust when applying the ring test, otherwise the sound will be deadened. It should also be noted that organic bonded wheels do not emit the same clear metallic ring as do citrified and silicate wheels. Tap wheels about forty-five (45) degrees each side of the vertical centerline and about one (1) or two (2) inches from the periphery as indicated by the spots in Figure 250.21-O. Then rotate the wheel forty-five (45) degrees and repeat the test. A sound and undamaged wheel will give a clear metallic tone. If cracked there will be a dead sound and not a clear ring. ()

FIGURE 250.21-O



ee. Grinding wheels shall fit freely on the spindle and remain free under all grinding conditions. A controlled clearance between the wheel and the machine spindle (or wheel sleeves or adaptors) is essential to avoid excessive pressure from mounting and spindle expansion. To accomplish this, the machine spindle shall be made to nominal (standard) size plus zero (0) minus point zero zero two (.002) inch, and the wheel hole shall be made suitably oversize to assure safety clearance under the conditions of operating heat and pressure. ()

ff. All contact surfaces of wheels, blotters, and flanges shall be flat and free of foreign matter. ()

gg. When a bushing is used in the wheel hole it shall not exceed the width of the wheel and shall not contact the flanges. ()

hh. When blotters or flange facings of compressible material are required, they shall cover the entire contact area of wheel flanges. Highly compressible material such as blotting paper as normally used shall not exceed point zero two five (.025) inch in thickness. If material of lower compressibility is used, greater thickness may be necessary. Blotters need not be used with the following types of wheels: mounted wheels; abrasive discs (inserted nut, inserted washer, and projecting stud type); plate mounted wheels; cylinders, cups, or segmental wheels that are mounted in chucks; types 27 and 28 wheels; certain type 1 and type 27A cutting-off wheels; certain internal wheels; type 4 tapered wheels; and diamond wheels, except certain vitrified diamond wheels. ()

ii. When more than one (1) wheel is mounted between a single set of flanges, wheels may be cemented together or separated by specially designed spacers. Spacers shall be equal in diameter to the mounting flanges and have equal bearing surfaces. When mounting wheels which have not been cemented together, or ones which do not utilize separating spacers, care must be exercised to use wheels specially manufactured for that purpose. ()

jj. After mounting a wheel, care should be taken to see that the safety guard is properly positioned before starting the wheel. ()

22. Mechanical Power Presses. ()

a. Machine components shall be designed, secured, or covered to minimize hazards caused by breakage, loosening and falling, or release of mechanical energy (i.e. broken springs). ()

b. Friction brakes provided for stopping or holding a slide movement shall be inherently self-engaging by requiring power or force from an external source to cause disengagement; brake capacity shall be sufficient to stop the motion of the slide quickly and capable of holding the slide and its attachments at any point in its travel. ()

c. Machines using full revolution clutches shall incorporate a single-stroke mechanism. If the single-stroke mechanism is dependent upon spring action, the spring(s) shall be of the compression type, operating on a rod or guided within a hold or tube, and designed to prevent interleaving of the spring coils in event of breakage. ()

d. The treadle pedal mechanism shall be protected to prevent unintended operation from falling or moving objects or by accidental stepping onto the pedal. A pad with a non-slip contact area shall be firmly attached to the pedal. The pedal return spring(s) shall be of the compression type, operating on a rod or guided within a hole or tube, or designed to prevent interleaving of spring coils in the event of breakage. If pedal counterweights are provided, the path of the travel of the weight shall be enclosed. ()

e. Hand-lever-operated power presses shall be equipped with a spring latch on the operating lever to prevent premature or accidental tripping. The operating levers on hand-tripped presses having more than one (1) operating station shall be interlocked to prevent the tripping of the press except by the concurrent use of all levers. ()

f. A two (2) hand trip shall have the individual operator's hand controls protected against unintentional operation and have the individual operator's hand controls arranged by design and construction and/or separation to require the use of both hands to trip the press and use a control arrangement requiring concurrent operation of the individual operator's hand controls. Two (2) hand trip systems on full revolutions clutch machines shall incorporate an antirepeat feature. If two (2) hand trip systems are used on multiple operator presses, each operator shall have a separate set of controls. ()

g. For machines using part revolution clutches, the clutch shall release and the brake shall be applied when the external clutch engaging means is removed, deactivated, or deenergized. A red color stop control shall be provided with the clutch/brake control system. Momentary operation of the stop control shall immediately deactivate the clutch and apply the brake. The stop control shall override any other control, and reactivation of the clutch shall require use of the operating (tripping) means which has been selected. A means of selecting "OFF", "INCH", "SINGLE STROKE", and "CONTINUOUS" (when the continuous function is furnished) shall be supplied with the clutch/brake control to select type of operation of the press. Fixing of selection shall be by means capable of supervision by the employer. The "INCH" operating means shall be designed to prevent exposure of the worker's hands within the point of operation by: requiring the concurrent use of both hands to actuate the clutch; or being a single control protected against accidental actuation and so located that the worker cannot reach into the point of operation while operating the single control. ()

h. Two (2) hand controls for single stroke shall conform to the following requirements: each hand control shall be protected against unintended operation and arranged by design, construction, and/or separation so that the concurrent use of both hands is required to trip the press; the control system shall be designed to permit an adjustment which will require concurrent pressure from both hands during the die closing portion of the stroke; the control system shall incorporate an antirepeat feature; the control system shall be designed to require release of all operator's hand controls before an interrupted stroke can be resumed. ()

i. Controls for more than one (1) operating station shall be designed to be activated and deactivated in complete sets of two (2) operator's hand controls per operating station by means capable of being supervised by the employer. The clutch/brake control system shall be designed and constructed to prevent actuation of the clutch if all operating stations are bypassed. ()

j. Those clutch/brake control systems which contain both single and continuous functions shall be designed so that completion of continuous circuits may be supervised by the employer. The initiation of continuous run shall require a prior action or decision by the operator in addition to the selection of "Continuous" on the stroking selector, before actuation of the operating means will result in continuous stroking. ()

- k. If foot control is provided, the selection method between hand and foot stroking selector and shall be designed so that the selection may be supervised by the employer. ()
- l. Foot operated tripping controls, if used, shall be protected so as to prevent operation from falling or moving objects, or from unintended operation by accidental stepping onto the foot control. ()
- m. The control of air-clutch machines shall be designed to prevent a significant increase in the normal stopping time due to failure within the operating valve mechanism, and to inhibit further operation if such failure does occur. ()
- n. The clutch/brake control shall incorporate an automatic means to prevent initiation or continued activation of the Single Stroke or Continuous functions unless the press drive motor is energized and in the forward direction. ()
- o. The clutch/brake control shall automatically deactivate in the event of failure of the power or pressure supply for the clutch engaging means. Reactivation of clutch shall require restoration of normal supply and the use of the tripping mechanism(s). ()
- p. The clutch/brake control shall automatically deactivate in the event of failure of the counterbalance(s) air supply. Reactivation of the clutch shall require restoration of normal air supply and use of the tripping mechanism(s). ()
- q. Selection of bar operation shall be by means capable of being supervised by the employer. A separate push-button shall be employed to activate the clutch, and the clutch shall be activated only if the driver motor is deenergized. ()
- r. A main power disconnect switch capable of being locked only in the "OFF" position shall be provided with every power press control system. ()
- s. The motor start button shall be protected against accidental operation. ()
- t. All mechanical power press controls shall incorporate a type of drive motor starter that will disconnect the drive motor from the power source in event of control voltage or power source failure, and require operation of the motor start button to restart the motor when voltage conditions are restored to normal. ()
- u. All AC control circuits and solenoid valve coils shall be powered by not more than a nominal one hundred twenty (120) volt AC supply obtained from a transformer with an isolated secondary. Higher voltages that may be necessary for operation of machine or control mechanism shall be isolated from any control mechanism handled by the operator, but motor starters with integral Start-Stop buttons may utilize line voltage controls. All DC control circuits shall be powered by not more than nominal two hundred forty (240) volt DC supply isolated from any higher voltages. ()
- v. All clutch/brake control electrical circuits shall be protected against the possibility of an accidental ground in the control circuit causing false operation of the press. ()
- w. Electrical clutch/brake control circuits shall incorporate features to minimize the possibility of an unintended stroke in event of the failure of a control component to function properly, including relays, limit switches, and static output circuits. ()
- x. Spring counterbalance systems when used shall incorporate means to retain system parts in event of breakage. Spring counterbalances when used shall have the capability to hold the slide and its attachments at midstroke, without brake applied. ()
- y. Air counterbalance cylinders shall incorporate means to retain the piston and rod in case of breakage or loosening. Air counterbalance cylinders shall have adequate capability to hold the slide and its attachments at any point in stroke, without brake applied. Air counterbalance cylinders shall incorporate means to

prevent failure of capability (sudden loss of pressure) in event of air supply failure. ()

z. Air controlling equipment shall be protected against foreign material and water entering the pneumatic system of the press. A means of air lubrication shall be provided when needed. ()

aa. The maximum anticipated working pressures in any hydraulic system on a mechanical power press shall not exceed the safe working pressure rating of any component used in that system. ()

bb. All pressure vessels used in conjunction with power presses shall conform to the American Society of Mechanical Engineers Code for Pressure Vessels and IDAPA 17.04.06. ()

cc. When required by Subsection 250.22.h. of this section, the control system shall be constructed so that a failure within the system does not prevent the normal stopping action from being applied to the press when required, but does prevent initiation of a successive stroke until the failure is corrected. The failure shall be detectable by a simple test, or indicated by the control system. This requirement does not apply to those elements of the control system which have no effect on the protection against point of operation injuries. ()

dd. When required by Subsection 250.22.uu. of this section, the brake monitor shall meet the following requirements: Be so constructed as to automatically prevent the activation of a successive stroke if the stopping time or braking distance deteriorates to a point where the safety distance being utilized does not meet the requirements set forth in Subsection 250.22.oo. or Subsection 250.22.ss. of this section. The brake monitor used with the type B gate or movable barrier device shall be installed in a manner to detect slide top-stop overrun beyond the normal limit reasonably established by the employer. Be installed on a press such that it indicates when the performance of the braking system has deteriorated to the extent described in Subsection 250.22.x. of this section; and be constructed and installed in a manner to monitor brake system performance on each stroke. ()

ee. It shall be the responsibility of the employer to provide and insure the usage of point of operation guards or properly applied and adjusted point of operation devices on every operation performed on a mechanical power press. The requirement above, shall not apply when the point of operation opening is one-fourth (1/4) inch or less. See Table 250.22-A. ()

TABLE 250.22-A		
MAXIMUM OPENINGS UNDER GUARDS		
Distance of Opening From Point of Operation Hazard (Inches)	Maximum Openings Under Guard (Inches)	
1/2 to 1/2	1/4	
1 1/2 to 2 1/2	3/8	
2 1/2 to 3 1/2	1/2	
3 1/2 to 5 1/2	5/8	
5 1/2 to 6 1/2	3/4	
6 1/2 to 7 1/2	7/8	
7 1/2 to 12 1/2	1 1/4	
12 1/2 to 15 1/2	1 1/2	
15 1/2 to 17 1/2	1 7/8	
17 1/2 to 31 1/2	2 1/8	
MAXIMUM OPENINGS THROUGH GUARDS		

TABLE 250.22-A		
MAXIMUM OPENINGS UNDER GUARDS		
Distance of Opening From Point of Operation Hazard (Inches)	Maximum Openings Under Guard (Inches)	
Material	Guard Clearance From Hazard Point	Largest Mesh or Opening (Inches)
Woven Wire,	From 2 to 4	1/2
Wood or Metal	From 2 to 4	3/8
Strips (Crossed)	From 4 to 15	2
Wood or metal	From 2 to 4	1/2 width of strip
Strips (Not Crossed)	From 4 to 15	1 width of strip

Note: The specifications for the materials used for filling barrier, point of operation guards is contained in Table 257.16-A in section 257.16 of this standard. When plastic is used as filling, it shall be 1/4-inch thick (minimum).

ff. Every point of operation guard shall meet the following design, construction, application and adjustment requirements: it shall prevent entry of hands or fingers into the point of operation by reaching through, over, under, or around the guard; it shall conform to the maximum permissible openings of Table 250.22-A; it shall, in itself, create no pinch point between the guard and moving machine parts; it shall utilize fasteners not readily removable by operator, so as to minimize the possibility of misuse or removal of essential parts; it shall facilitate its inspection; and it shall offer maximum visibility of the point of operation consistent with other requirements. ()

gg. A die enclosure guard shall be attached to the die shoe or stripper in a fixed position. ()

hh. A fixed barrier guard shall be attached securely to the frame of the press or to the bolster plate. ()

ii. An interlocked press barrier guard shall be attached to the press from or bolster and shall be interlocked with the press clutch control so that the clutch cannot be activated unless the guard itself, or the hinges or movable sections of the guard are in position to conform to the requirements of Table 250.22-A. ()

jj. The hinged or movable sections of an interlocked press barrier guard shall not be used for manual feeding. The guard shall prevent opening of the interlocked section and reaching into the point of operation prior to die closure or prior to the cessation of slide motion. See Subsection 250.22.nn. of this section regarding manual feeding through interlocked press barrier devices. ()

kk. The adjustable barrier guard shall be securely attached to the press bed, bolster plate, or die shoe, and shall be adjusted and operated in conformity with Table 250.22-A and the requirements of this subsection. Adjustments shall be made only by authorized personnel whose qualifications include a knowledge of the provisions of Table 250.22-A and this subsection. ()

ll. A point of operation enclosure which does not meet the requirements of this subsection and Table 250.22-A shall be used only in conjunction with point of operation devices. ()

mm. Point of operation devices shall protect the operator by: preventing and/or stopping normal stroking of the press if the operator's hands are inadvertently placed in the point of operation; preventing the operator from inadvertently reaching into the point of operation or withdrawing his hands if they are inadvertently located in the point of operation as the dies close; preventing the operator from inadvertently reaching into the point of operation at all times; requiring application of both of the operator's hands to machine operating controls and locating such controls at such a safety distance from the point of operation that the slide completes the downward travel or stops

before the operator can reach into the point of operation with his hands; enclosing the point of operation before a press stroke can be initiated and maintaining this closed condition until the motion of the slide had ceased; or enclosing the point of operation before a press stroke can be initiated, so as to prevent an operator from reaching into the point of operation prior to die closure or prior to cessation of slide motion during the downward stroke. ()

nn. The gate or movable barrier device shall protect the operator as follows: a Type A gate or movable barrier device shall protect the operator in the manner specified in Subsection 250.22.mm. section; or a Type B gate or movable barrier device shall protect the operator in the manner specified in Subsection 250.22.mm. of this section. ()

oo. A presence sensing point of operation device shall protect the operator as provided in Subsection 250.22.mm. of this section, and shall be interlocked into the control circuit to prevent or stop slide motion if the operator's hand or other part of his body is within the sensing field of the device during the downstroke of the press slide. The device may not be used on machine using full revolution clutches; the device may not be used as a tripping means to initiate slide motion; the device shall be constructed so that a failure within the system does not prevent the normal stopping action from being applied to the press when required, but does prevent the initiation of a successive stroke until the failure is corrected. The failure shall be indicated by the system, muting (bypassing of the protective function) of such device, during the upstroke of the press slide, is permitted for the purpose of parts ejection, circuit checking, and feeding. ()

pp. The pull-out device shall protect the operator as specified in Subsection 250.22.mm. of this section and shall include attachments for each of the operator's hands. Attachments shall be connected to and operated only by the press slide or upper die; attachments shall be adjusted to prevent the operator from reaching into the point of operation or to withdraw the operator's hands from the point of operation before the dies close; a separate pull-out device shall be provided for each operator if more than one (1) operator is used on a press; each pull-out device that is used shall be visually inspected and checked for proper adjustment at the start of each operator shift, following a new die set-up, and when operators are changed. Necessary maintenance or repair or both shall be performed and completed before the press is operated. Records of inspections and maintenance shall be kept in accordance with Subsection 250.06.iii. through Subsection 250.22.jjj. of this section. ()

qq. The sweep device shall protect the operator as specified in Subsection 250.22.mm. of this section, by removing his hands safely to a safe position if they are inadvertently located in the point of operation, as the dies close or prior to tripping the clutch. Devices operating in this manner shall have a barrier, attached to the sweep arm in such a manner as to prevent the operator from reaching into the point of operation, past the trailing edge of the sweep arm on the downward stroke of the press. The sweep device must be activated by the slide or by motion of a foot pedal trip rod; the sweep device must be designed, installed and operated so as to prevent the operator from reaching into the point of operation before the dies close; the sweep device must be installed so that it will not itself create an impact or shear hazard between the sweep arm and the press tie rods, dies, or any other part of the press or barrier; partial enclosure conforming with Subsection 250.22.qq. of this section as to the area of entry which they protect, must be provided on both sides of the point of operation to prevent the operator from reaching around or behind the sweep device and into the point of operation after the dies start to close. Partial enclosures shall not themselves create a pinch point or shear hazard. ()

rr. A holdout or a restraint device shall protect the operator as specified in Subsection 250.22.mm. of this section and shall include attachments for each of the operator's hands. Such attachments shall be securely anchored and adjusted in such a way that the operator is restrained from reaching into the point of operation. A separate set of restraints shall be provided for each operator if more than one (1) operator is required on a press. ()

ss. The two (2) hand control device shall protect the operator as specified in Subsection 250.22.qq. of this section. When used in press operations requiring more than one (1) operator, separate two (2) hand controls shall be provided for each operator, and shall be designed to require concurrent application of all operators' controls to activate the slide. The removal of a hand from any control button shall cause the slide to stop. Two (2) hand control safety shall be fixed in position so that only a supervisor or safety engineer is capable of relocating the controls. The two (2) hand trip device shall protect the operator as specified in Subsection 250.22.qq. of this section. When used in press operations requiring more than one (1) operator, separate two (2) hand trips shall be provided for each operator, and shall be designed to require concurrent application of all operators' controls to activate the slide. Two (2) hand

trips shall be fixed in position so that only a supervisor or safety engineer is capable of relocating the controls. Each two (2) hand trip shall meet the construction requirements of Subsection 250.22.e. of this section. (See Figure 250.22-A). ()

tt. Hand feeding tools are intended for placing and removing materials in and from the press. Hand feeding tools are not a point of operation guard or protection device and shall not be used in lieu of the "Guards" or devices required in this section. ()

uu. Where the operator feeds or removes parts by placing one (1) or both hands in the point of operation, and a two (2) hand control, presence sensing device gate or movable barrier (on a part revolution clutch) is used for safeguarding. The employer shall use a control system and a brake monitor which comply with Subsection 250.22.cc. and Subsection 250.22.dd. of this section. ()

vv. The control of air clutch machines shall be designed to prevent a significant increase in the normal stopping time due to a failure within the operating valve mechanism, and to inhibit further operation if such failure does occur, where a part revolution clutch is employed. ()

ww. The employer shall use dies and operating methods designed to control or eliminate hazards to operating personnel, and furnish and enforce the use of hand tools for freeing and removing stuck work or scrap pieces from the die, so that no employee need reach into the point of operation for such purposes. ()

xx. The employer shall provide means for handling scrap from roll feed or random length stock operations. Scrap cutters used in conjunction with scrap handling systems shall be safeguarded in accordance with Subsection 250.22.a. through 250.22.dd of this section. ()

yy. The hazard created by a guide post (when it is located in the immediate vicinity of the operator) when separated from its bushing by more than one-fourth (1/4) inch shall be considered as a point of operation hazard and be protected in accordance with Subsection 250.22.ee. through Subsection 250.22.vv. of this section. ()

zz. If unitized tooling is used, the opening between the top of the punch holder and the face of the slide, or striking pad, shall be safeguarded in accordance with the requirements of Subsections 250.22.a. through 250.22.dd. of this section. ()

aaa. Tonnage, Stroke, and Weight Designation. All dies shall be: stamped with the tonnage and stroke requirements, or have these characteristics recorded if these records are readily available to the die setter; stamped to indicate upper die weight when necessary for air counterbalance pressure adjustment; and stamped to indicate complete die weight when handling equipment may become overloaded. ()

bbb. Provision shall be made in both the upper and lower shoes for securely mounting the die to the bolster and slide. Where clamp caps or setscrews are used in conjunction with punch stems, additional means of securing the upper shoe to the slide shall be used. ()

ccc. Die Handling equipment attach points shall be provided on all dies requiring mechanical handling. ()

ddd. The employer shall establish a diesetting procedure that will insure compliance with Subsection 250.22.a. through 250.22.dd. of this section. ()

eee. The employer shall provide spring loaded turnover bars, for presses designed to accept such turnover bars. ()

fff. The employer shall provide die stops or other means to prevent losing control of the die while setting or removing dies in presses which are inclined. ()

ggg. The employer shall provide and enforce the use of safety blocks whenever dies are being adjusted or repaired in the press. ()

hhh. The employer shall provide brushes, swabs, lubricating rolls, and automatic or manual pressure guns so that operators and diesetters shall not be required to reach into the point of operation or other hazard areas to lubricate material, punches, or dies. ()

iii. It shall be the responsibility of the employer to establish and follow a program of periodic and regular inspections of his power presses to insure that all their parts, auxiliary equipment and safeguards are in a safe operating condition and adjustment. The employer shall maintain records of these inspections and the maintenance work performed. ()

jjj. Each press shall be inspected and tested no less than weekly to determine the condition of the clutch/brake mechanism, anti-repeat feature and single stroke mechanism. Necessary maintenance or repair or both shall be performed and completed before the press is operated. The employer shall maintain records of these inspections and the maintenance work performed. These requirements do not apply to those presses which comply with Subsections 250.22.cc. and 250.22.dd. of this section. ()

kkk. It shall be the responsibility of any person modifying a power press to furnish instructions with the modification to establish new or changed guidelines for use and care of the power press so modified. ()

lll. It shall be the responsibility of the employer to ensure the original and continuing competence of personnel caring for, inspecting and maintaining power presses. ()

mmm. The employer shall permit noone under eighteen (18) years of age to operate or assist in the operation of machinery covered in this section, except that this section shall not be deemed to prohibit the employment of persons who are sixteen (16) or seventeen (17) years of age in an apprenticeship training or student-learner program which meets the requirements of Child Labor Requirements in Non-Agricultural Occupations under the Fair Labor Standards Act. ()

nnn. The employer shall train and instruct the operator in the safe method of work before starting work on any operation covered by this section. The employer shall insure by adequate supervision that correct operating procedures are being followed. ()

ooo. The employer shall provide clearance between machines so that movement of one (1) operator will not interfere with the work of another. Ample room for cleaning machines, handling material, work pieces, and scrap shall also be provided. All surrounding floors shall be kept in good condition and free from obstructions, grease, oil and water. ()

ppp. The employer shall operate his presses within the tonnage and attachment weight ratings specified by the manufacturer. ()

23. Compactors. ()

a. An antirepeat device shall be installed on compactors which will prohibit the compacting of material while the gate or door is raised or open. When adjustments or clearing of jams are necessary, means shall be provided for locking out the control energy. ()

24. Laundry Machinery. ()

a. This Subsection applies to moving parts of equipment used in laundries and to conditions peculiar to this industry, with special reference to the point of operation of laundry machines. This section does not apply to dry-cleaning operations. ()

b. Each washing machine shall be provided with means for holding open the doors or covers of inner and outer cylinders or shells while being loaded or unloaded. ()

c. Each drying tumbler shall be provided with means for holding open the doors or covers of inner and outer cylinders or shells while being loaded or unloaded. ()

d. Each shaker or clothes tumbler of the double-cylinder type shall be provided with means for holding open the doors or covers of inner and outer cylinders or shells while being loaded or unloaded. EXCEPTION: Provisions of Subsection 250.24.c. and 250.24.d. this section shall not apply to shakeout or conditioning tumblers where the clothes are loaded into the open end of the revolving cylinder and are automatically discharged out of the opposite end. ()

e. All steam pipes that are within seven (7) feet of the floor or working platform, and with which the worker may come into contact, shall be insulated or covered with a heat resistive material or shall be otherwise properly guarded. ()

f. Where pressure reducing valves are used, one (1) or more relief or safety valves shall be provided on the low-pressure side of the reducing valve, in case the piping or equipment on the low-pressure side does not meet the requirements for full initial pressure. The relief or safety valve shall be located adjacent to, or as close as possible to, the reducing valve. Proper protection shall be provided to prevent injury or damage caused by fluid escaping from relief or safety valves if vented to the atmosphere. The vents shall be of ample size and as short and direct as possible. The combined discharge capacity of the relief valves shall be such that the pressure piping and equipment will not be exceeded if the reducing valve stocks fail to open. ()

g. Markers and other persons handling soiled clothes shall be warned against touching the eyes, mouth, or any part of the body on which the skin has been broken by a scratch or abrasion; and they shall be cautioned not to touch or eat food until their hands have been thoroughly washed. They shall also be instructed on the provisions of Section 330 of this Standard dealing with blood borne pathogens. ()

h. Employees shall be properly instructed as to the hazards of their work and be instructed in safe practices, by bulletins, printed rules, and verbal instructions. ()

i. No safeguard, safety appliance, or device attached to, or forming an integral part of any machinery shall be removed or made ineffective except for the purpose of making immediate repairs or adjustments. Any such safeguard, safety appliance, or device removed or made ineffective during the repair or adjustment of such machinery shall be replaced immediately upon the completion of such repairs or adjustments. ()

251. -- 269. (RESERVED).

270. HAND AND PORTABLE POWERED TOOLS AND EQUIPMENT.

01. Scope. ()

a. Hand and portable powered tools and equipment shall conform to all other applicable requirements of this standard, as well as the following provisions. Nothing in this standard shall be construed to prohibit better or otherwise safer conditions than specified herein. ()

b. The purpose of this section is to provide reasonable safety for life, limb, and property, by establishing requirements for design, construction, operation, service, and storage of powder actuated fastening tools, fasteners, and power loads. ()

02. Definitions Applicable to this Section. ()

a. Angle Control is a safety feature designed to prevent a tool from operating when tilted beyond a predetermined angle. ()

b. Blade Tip Circle is the path described by the outermost point of the blade as it is rotated about its shaft axis. ()

c. Cased Powder Load is a powder load with the propellant contained in a closed case. ()

d. Caseless Powder Load is a powder load with the propellant in solid form not requiring containment. ()

- e. Catcher Assemblies are parts or combinations of parts which provide a means for collecting grass clippings or debris. ()
- f. Chamber (noun) is the location in the tool into which the powder load is placed and in which it is actuated. ()
- g. Chamber (verb) is to fit the chamber according to the manufacturer's specifications. ()
- h. Deadman Control is a control designed so that it will automatically interrupt power to a drive when the operator's actuating force is removed. ()
- i. Direct-Acting Tool is a tool in which the expanding gas of the powder load acts directly on the fastener to be driven. ()
- j. Fasteners are any pins (unthreaded heads) or studs (threaded heads) driven by powder actuated tools. ()
- k. Fixture is a special shield that provides equivalent protection where the standard shield cannot be used. ()
- l. Guards are a part or an assembly provided for shielding a hazardous area of a machine. ()
- m. Head is that portion of a fastener that extends above the work surface after being properly driven. ()
- n. High-Velocity Tool - a tool whose test velocity has been measured ten (10) times while utilizing the combination of: the lightest commercially available fastener designed for the tool; the strongest commercially available powder load which will properly chamber in the tool; and that will produce an average velocity from the ten (10) tests in excess of four hundred ninety-two (492) feet per second. ()
- o. Indirect-Acting Tool is a tool in which the expanding gas of the powder load acts on a captive piston, which in turn drives the fastener. ()
- p. Jack is an appliance for lifting and lowering or moving horizontally a load by application of a pushing force. NOTE: Jacks may be of the following types: lever and ratchet, screw and hydraulic. ()
- q. Lowest Blade Position is the lowest blade position under static conditions. ()
- r. Low Velocity Tool is a tool whose test velocity has been measured ten (10) times while utilizing the highest velocity combination of: the lightest commercially available fastener designed for that specific tool; the strongest commercially available powder load that will properly chamber in the tool; and the piston designed for that tool and appropriate for that fastener; that will produce an average test velocity from the ten (10) tests not in excess of three hundred twenty-eight (328) feet per second but not in excess of four hundred ninety-two (492) feet per second with no single test having a velocity of over three hundred fifty-four (354) feet per second. ()
- s. Medium-Velocity Tool is a tool whose velocity has been measured ten (10) times while utilizing the highest velocity combination of: the lightest commercially available fastener designed for the tool; the strongest commercially available powder load that will properly chamber in the tool; and the piston designed for that tool and appropriate for that fastener; that will produce an average test velocity from ten (10) tests in excess of three hundred twenty-eight (328) feet per second but not in excess of four hundred ninety-two (492) feet per second with no single test having a velocity of five hundred twenty-five (525) feet per second. ()
- t. Misfire is a condition in which the powder load fails to ignite after the tool has been operated. ()
- u. Mounted Wheels usually two (2) inch diameter or smaller, and of various shapes, may be either

organic or inorganic bonded abrasive wheels. They are secured to plain or threaded steel mandrels. ()

v. Operator Area for discharge interference purposes, that area confined within a circle no smaller than thirty (30) inches in diameter, the center of which is located to the rear of the mower on its longitudinal centerline thirty (30) inches behind the nearest blade tip circle. ()

w. Organic Bonded Wheels are wheels which are bonded by means of an organic material such as resin, rubber, shellac, or other similar bonding agent. ()

x. Portable Grinding is a grinding operation where the grinding machine is designed to be hand held and may be easily moved from one location to another. ()

y. Powder Actuated Fastening System is a method comprising the use of a powder actuated tool, a powder load, and a fastener. ()

z. Powder Actuated Tool is a tool that utilizes the expanding gases from a powder load to drive a fastener. ()

aa. Powder Load is the energy source used in powder actuated tools. ()

bb. Power Reel Mower is a lawn cutting machine utilizing a power source to rotate one (1) or more helically formed blades about a horizontal axis to provide a shearing action with a stationary cutter bar or bed knife. ()

cc. Power Rotary Mower is a lawn cutting machine utilizing a power source to rotate one (1) or more cutting blades about a vertical axis. ()

dd. Qualified Operator is a person who meets the requirements of Subsection 270.12.fff. through Subsection 270.12.hhh. of this section. ()

ee. Rating of a jack is the maximum working load for which it is designed to lift safely that load throughout its specified amount of travel. NOTE: To raise the rated load of a jack, the point of application of the load, the applied force, and the length of the lever arm should be those designated by the manufacturer for the particular jack considered. ()

ff. Reinforced Wheels as applied to grinding wheels shall define a class of organic wheels which contain strengthening fabric or filament. The term reinforced does not cover wheels using such mechanical additions as steel rings, steel cup backs, or wire or tape winding. ()

gg. Riding Mower is a powered, self-propelled lawn cutting vehicle on which the operator rides and controls the machine. ()

hh. Safety Guard is a safety guard is an enclosure designed to restrain the pieces of the grinding wheel and furnish all possible protection in the event that the wheel is broken in operation. ()

ii. Shield is a device, attached to the muzzle end of a powder actuated tool, which is designed to confine flying particles. ()

jj. Spalled area is a damaged and non-uniform concrete or masonry surface. ()

kk. Sulky Type Mower is normally a walk-behind mower which has been converted to a riding mower by the addition of a sulky. ()

ll. Test Velocity is the measurement of fastener velocity performed in accordance with Subsection 270.12.p. of this section. ()

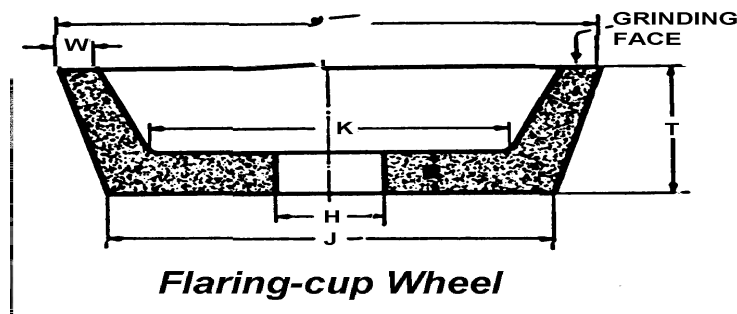
mm. Tuck Pointing is removal, by grinding, of cement, mortar, or other nonmetallic jointing material.

()

nn. Tuck Pointing Wheels are usually Type-1, reinforced organic bonded wheels have diameter thickness and hole size dimension. They are subject to the same limitations of use and mounting as Type 1 wheels defined in Subsection 270.12.qq. of this section. LIMITATION: Wheels used for tuck pointing shall be reinforced, organic bonded. ()

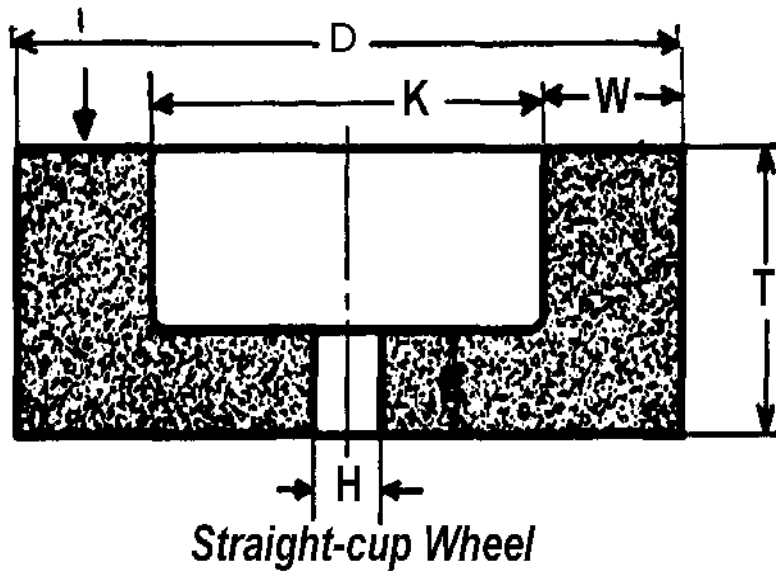
oo. Type-II Flaring Cup Wheels are wheels that have double diameter dimensions (D). and (J)., and in addition have thickness, hole size, rim and back thickness dimensions. Grinding is always performed on rim face, W dimension. Type II wheels are subject to all limitations of use and mounting listed for Type-6 straight sided cup wheels definition in i. of this subsection. See Figure 270.02-A. Type- II - Flaring-cup Wheel Side grinding wheel having a wall flared or tapered outward from the back. Wall thickness at the back is normally greater than at the grinding face (W). ()

FIGURE 270.02-A



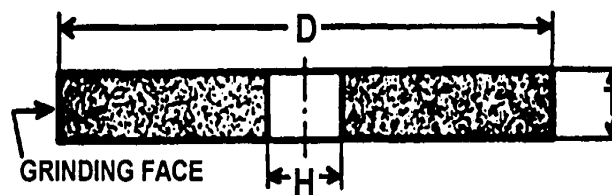
pp. Type-6 Cup Wheels have diameter, thickness, hole size, rim thickness, and back thickness dimensions. Grinding is always performed on rim face, W dimension. LIMITATION: Minimum back thickness, E dimension, should not be less than one-fourth (1/4) T dimension. In addition, when unthreaded hole wheels are specified, the inside flat, K dimension, must be large enough to accommodate a suitable flange. Side grinding wheel having a diameter, thickness and hole with one (1) side straight or flat and the opposite side recessed. This type, however, differs from Type-5 in that the grinding is performed on the wall of the abrasive created by difference between the diameter of the recess and the outside diameter of the wheel. Therefore, the wall dimension "W" takes precedence over the diameter of the wheel D. (See Figure 270.02-B) ()

FIGURE 270.02-B



qq. Type-I Straight Wheels have a diameter, thickness, and hole size dimensions and should be used only on the periphery. Type-1 wheels shall be mounted between flanges. LIMITATION: Hole dimension (H) should not be greater than two thirds ($2/3$) of wheel diameter dimension (D) for precision, cylindrical, centerless, or surface grinding applications. Maximum hole size for all other application should not exceed one-half ($1/2$) wheel diameter. See Figure 270.02-C. ()

FIGURE 270.02-C



rr. Walk-Behind Mower is a mower either pushed or self-propelled and normally guided by the operator walking behind the unit. ()

03. General Requirements. ()

a. Each employer shall be responsible for the safe condition of tools and equipment used by employees, including tools and equipment which may be furnished by employees. ()

b. All cracked saws shall be removed from service. ()

c. Portable electric powered tools shall meet the electrical requirements of Section 150 of this Standard and the National Electrical Code. ()

04. Compressed Air. ()

a. Compressed air shall not be used for cleaning purposes except where reduced to less than thirty (30) psi and then only with effective chip guarding and personal protective equipment. ()

b. Air hose and hose connections used for conducting compressed air to equipment shall be designed for the pressure and service to which they are subjected. ()

05. Compressed Air Tools. ()

a. The operating trigger on portable hand-operated equipment shall be so located as to minimize the possibility of its accidental operation and shall be arranged to close the air inlet valve automatically when the pressure of the operator's hand is removed. ()

b. When momentarily out of use the gun should be laid in such position that the tool cannot fly out if the pressure is accidentally released. When not in use, all tools should be removed from the gun. ()

c. In disconnecting a compressed air tool from the air line, care shall be exercised first to shut off the pressure and then to operate the tool to exhaust the pressure remaining in the hose. ()

d. Compressed air hose or guns shall not be pointed at or brought into contact with the body of any person. ()

e. In the use of compressed air tools, care should be used to prevent the tool from being shot from the gun. ()

f. A tool retainer shall be installed on each piece of equipment which, without such a retainer, may eject the tool. ()

06. Air Hammer. ()

a. Before laying down an air hammer, remove tool from hammer unless it is held in place by safety catch. ()

07. Portable Circular Saws. ()

a. All portable power-driven circular saws having a blade diameter greater than two (2) inches shall be equipped with guards above and below the base plate or shoe. The upper guard shall cover the saw to the depth of the teeth, except for the minimum arc required to permit the base to be tilted for bevel cuts. The lower guard shall cover the saw to the depth of the teeth, except for the minimum arc required to allow proper retraction and contact with the work, the lower guard shall automatically and instantly return to covering position. This section does not apply to circular saws used in the meat industry for meat cutting purposes. ()

08. Saber, Scroll, and Jig Saws. ()

a. Saber, scroll, and jig saws, with nonstandard blade holders, may use blades with shanks which are nonuniform in width, provided the narrowest portion of the blade shank is an integral part in the mounting of the blade. ()

b. Blade shank width shall be measured at the narrowest portion of the blade shank when saber, scroll, and jig saws have non-standard blade holders. ()

09. Portable Belt Sanding Machines. ()

a. Belt sanding machines shall be provided with guards at each nip point where the sanding belt runs onto a pulley. These guards shall effectively prevent the hands or fingers of the operator from coming in contact with the nip points. The unused run of the sanding belt shall be guarded against accidental contact. ()

10. Switches and Controls. ()

a. All hand held powered circular saws having a blade diameter greater than two (2) inches, electric, hydraulic, or pneumatic chain saws, and percussion tools without positive accessory holding means shall be equipped with a constant pressure switch or control that will shut off the power when the pressure is released. All hand held gasoline powered chain saws shall be equipped with a constant pressure throttle control that will shut off the power to the saw chain when the pressure is released. ()

b. All hand-held powered drills, tappers, fastener drivers, horizontal, vertical, and angle grinders with wheels greater than two (2) inches in diameter, disc sanders with discs greater than two (2) inches in diameter, belt sanders, reciprocating saws, saber, scroll, and jig saws with blade shanks greater than a nominal one-fourth (1/4) inch, and other similarly operating powered tools shall be equipped with a constant pressure switch or control and may have a lock-on control provided that turnoff can be accomplished by a single motion of the same finger or fingers that turn it on. ()

c. All other hand-held powered tools such as, but not limited to, platen sanders, grinders with wheels two (2) inches in diameter or less, disc sanders with discs two (2) inches in diameter or less, routers, planers, laminate trimmers, nibblers, shears, saber, scroll, and jig saws with blade shanks a nominal one-fourth (1/4) inch wide or less, may be equipped with either a positive on-off control, or other controls as described in Subsection 270.08.a. and b. of this section. ()

d. The operating control on hand-held power tools shall be so located as to minimize the possibility of its accidental operation, if such accidental operation would constitute a hazard to employees. ()

e. This subsection does not apply to concrete vibrators, concrete breakers, powered tampers, jack hammers, rock drills, garden appliances, household and kitchen appliances, personal car appliances, medical or dental equipment, or to fixed machinery. ()

11. Portable Abrasive Wheel Grinders. ()

a. All abrasive wheels shall be used only on machines provided with safety guards as defined in this subsection. EXCEPTIONS: This requirement shall not apply to the following classes of wheels and conditions: wheels used for internal work while within the work being ground; mounted wheels used in portable grinders two (2) inches and smaller in diameter; and types 16, 17, 18, 18R, and 19 cones and plugs and threaded hole pot balls as illustrated and described in 1.4.11 of ANSI B7.1-1970 Safety Code for the Use, Care and Protection of Abrasive Wheels, where the work offers protection. ()

b. The safety guard shall cover the spindle end, nut, and flange projections. The safety guard shall be mounted so as to maintain proper alignment with the wheel, and the strength of the fastenings shall exceed the strength of the guard. EXCEPTIONS: Safety guards on all operations where the work provides a suitable measure of protection to the operator, may be so constructed that the spindle end, nut, and outer flange are exposed; the spindle end, nut and outer flange may be exposed on portable machines designed for, and used with, type 6, 11, 27, and 28 abrasive wheels, cutting off wheels, and tuck pointing wheels; and the spindle end, nut, and outer flange may be exposed on machines designed as portable saws. ()

c. Cup wheels (type 6 and 11) shall be guarded by safety guards as specified in this subsection.()

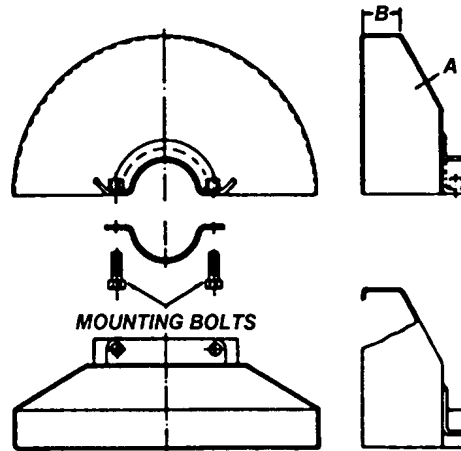
d. Special revolving cup guards which mount behind the wheel and turn with it. They shall be made of steel or other material with adequate strength and shall enclose the wheel sides upward from the back for one-third (1/3) of the wheel thickness. The mounting features shall conform with all regulations. (See Subsection 270.11.g. through Subsection 270.11.k. of this section). It is necessary to maintain clearance between the wheel side and the guard. The clearance shall not exceed one-sixteenth (1/16) inch; or, some other form of guard that will insure as good protection as that which would be provided by the guards specified in Subsection 270.11.b. of this section. ()

e. Safety guards used on machines known as right angle head or vertical portable grinders shall have a maximum exposure angle of one hundred eighty (180) degrees, and the guard shall be located so as to be between the operator and the wheel during use. Adjustment of guard shall be such that pieces of an accidentally broken wheel will

be deflected away from the operator. (See Figure 270.11-A).

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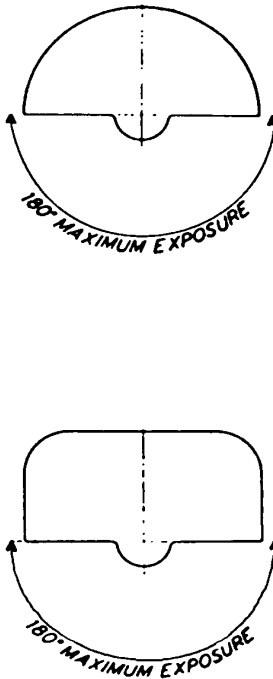
FIGURE 270.11-A



f. The maximum angular exposure of the grinding wheel periphery and sides for safety guards used on other portable grinding machines shall not exceed one hundred eighty (180) degrees and the top half of the wheel shall be enclosed at all times. (See Figures 270.11-B).

()

FIGURE 270.11-B



g. Immediately before mounting, all wheels shall be closely inspected and sounded by the user (ring test) to make sure they have not been damaged in transit, storage, or otherwise. The spindle speed of the machine shall be checked before mounting of the wheel to be certain that it does not exceed the maximum operating speed marked on the wheel. Wheels should be tapped gently; if they sound cracked (dead), they shall not be used. NOTE: Wheels shall be tapped gently with a light nonmetallic implement, such as the handle of a screwdriver for light wheels, or a wooden mallet for heavier wheels. This is known as the Ring Test. ()

h. Grinding wheels shall fit freely on the spindle and remain free under all grinding conditions. The machine spindle shall be made to nominal (standard) size plus zero (0) minus point zero zero two (.002) inch, and the wheel hole shall be made suitably oversize to assure safety clearance under the conditions of operating heat and pressure. NOTE: A controlled clearance between the wheel hole and the machine spindle (or wheel sleeves or adaptors) is essential to avoid excessive pressure from mounting and spindle expansion. ()

i. All contact surfaces of wheels, blotters, and flanges shall be flat and free of foreign matter. ()

j. When a bushing is used in the wheel hole, it shall not exceed the width of the wheel and shall not contract the flanges. ()

k. For requirements for the use of flanges and blotters see Subsection 250.20.x. through Subsection 250.20.z. of this standard. NOTE: Excluded machinery. Natural sandstone wheels and metal, wooden, cloth, or paper discs, having a layer of abrasive on the surface are not covered by this subsection. ()

12. Powder Actuated Fastening Systems. ()

a. This Section provides safety requirements for a powder actuated fastening tool or machine which propels a stud, pin, fastener, or other object for the purpose of affixing it by penetration to another object. ()

b. This subsection does not apply to devices designed for attaching objects to soft construction materials, such as wood, plaster, tar, dry wallboard, and the like, or to stud welding equipment. ()

c. Powder actuated tools can be divided into two (2) types: direct acting and indirect acting; and three (3) classes: low velocity, medium velocity, and high velocity. ()

d. The tool shall be designed to prevent inadvertent actuation. ()

e. The tool shall be designed to prevent actuation when dropped in any attitude from a height of ten (10) feet onto a smooth, hard surface such as concrete or steel, if such actuation can propel a fastener or any part thereof in free flight. ()

f. Actuation of the tool shall be dependent upon at least two (2) separate and distinct operations by the operator, with at least one (1) operation being separate from the operation of holding the tool against the work surface. ()

g. The tool shall be designed not to be operable other than against a work surface with a force on the work surface equal to five (5) pounds greater than the weight of the tool or a minimum impact energy of three (3) foot-pounds. ()

h. All tools shall be designed so that compatible protective shields or fixtures, designed, built, and supplied by the manufacturer of the tool can be used (see Subsection 270.12.q. of this section). ()

i. The tool shall be designed so that a determinable means of varying the power levels is available for selecting a power level adequate to perform the desired work (See Subsection 270.12.x. of this section). ()

j. The tool shall be designed so that all principal functional parts can be checked for foreign matter that may affect operation. ()

k. The tool shall be designed so that all parts will be of adequate strength to resist maximum stresses imposed on actuation when the tool is used in accordance with the manufacturer's instructions and is powered by any commercially available powder load which will properly chamber in the tool. ()

l. Each tool shall bear a legible permanent model designation, which shall serve as a means of identification. Each tool shall also bear a legible, permanent manufacturer's unique serial number. ()

m. A lockable container shall be provided for each tool. The words POWDER ACTUATED TOOL shall appear in plain sight on the outside of the container. The following notice shall be attached on the inside cover of the container: WARNING, POWDER ACTUATED TOOL TO BE USED ONLY BY A QUALIFIED OPERATOR AND KEPT UNDER LOCK AND KEY WHEN NOT IN USE. ()

n. Each tool shall bear a durable warning label with the following statement, or the equivalent: WARNING, FOR USE ONLY BY QUALIFIED OPERATORS ACCORDING TO MANUFACTURER'S INSTRUCTION MANUAL. ()

o. Each tool shall be supplied with the following: operator's instruction and service manual; power load chart; tool inspection record; service tools and accessories. ()

p. In determining tool test velocities the velocity of the fastener shall be measured in free flight at a distance of six and one-half (6 1/2) feet from the muzzle end of the tool, using accepted ballistic test methods.()

q. Low-velocity tools shall be supplied with a shield. Medium-velocity tools shall have a shield at least two and one-half (2 1/2) inches in diameter mounted perpendicular to, and concentric with the muzzle end, when it is indexed to the center position. High-velocity tools shall have a shield at least three and one-half (3 1/2) inches in diameter mounted perpendicular to, and concentric with, the muzzle end, when it is indexed to the center position. A special shield or fixture may be used when it provides equivalent protection. ()

r. The powder actuated tools shall be designed so that it cannot be actuated unless it is equipped with a shield or fixture. ()

s. The medium-velocity tools shall be designed with angle control so that it will not actuate when equipped with the standard shield indexed to the center position if the bearing surface of the shield is tilted more than twelve (12) degrees from a flat surface. ()

t. The high-velocity tool shall be designed with angle control so that it will not actuate when equipped with the standard shield indexed to the center position, if the bearing surface of the shield is tilted more than eight (8) degrees from a flat surface. ()

u. Cased powder loads shall be coded to identify powder load levels by case color and powder load color as specified in Table 270.12-A. Caseless powder loads shall be coded to identify powder load levels by powder load color as specified in Table 270.12-A and by configuration. ()

TABLE 270.12-A				
Power Load Identification				
Power Level	Color Identification		Nominal Velocity	
	Case Color	Load Color	Meters per Second (± 13.5)	Feet per Second (± 45)
1	Brass	Gray	91	300
2	Brass	Brown	119	390

TABLE 270.12-A				
Power Load Identification				
Power Level	Color Identification		Nominal Velocity	
	Case Color	Load Color	Meters per Second (± 13.5)	Feet per Second (± 45)
3	Brass	Green	146	480
4	Brass	Yellow	174	570
5	Brass	Red	201	660
6	Brass	Purple	229	750
7	Nickel	Gray	256	840
8	Nickel	Brown	283	930
9	Nickel	Green	311	1020
10	Nickel	Yellow	338	1110
11	Nickel	Red	366	1200
12	Nickel	Purple	393	1290

NOTE: The nominal velocity applies to a 3/8-inch diameter 350-grain ballistic slug fired in a test device and has no reference to actual fastener velocity developed in any specific tool.

()

v. No powder load (cased or caseless) shall be used if it will not properly chamber in any existing commercially available tool and will cause a fastener to have a test velocity in excess of the maximum test velocities specified for the said tool. ()

w. Powder load packages shall provide a visual number-color indication of the power level of the powder load as specified in Table 270.12-A. ()

x. Optional power load variation where means other than powder loads of varying power levels are to be used to control penetration, such means shall provide an equivalent power level variation. ()

y. Fasteners for use in powder actuated tools shall be designed and manufactured to function compatibly with these tools and, when used in masonry, concrete, or steel, to effect properly the application for which they are recommended. ()

z. Only tools meeting the requirements of this standard shall be used. ()

aa. Only qualified operators shall operate tools. ()

bb. The lowest velocity class of tool that will properly set the fastener shall be used. ()

cc. Tools shall be operated in strict accordance with the manufacturer's instructions. ()

dd. Eye or face protection, or both, shall be worn by operators, assistants, and adjacent personnel when tool is in use. Hearing protection shall be used when making fastenings in confined areas. ()

- ee. Each day, prior to use, the operator shall inspect the tool to determine that it is in proper working condition in accordance with the testing methods recommended by the manufacturer of the tool. ()
- ff. Any tool found not to be in proper working condition shall be immediately removed from service and tagged DEFECTIVE; it shall not be used until it has been properly repaired in accordance with the manufacturer's instructions. ()
- gg. The proper shield, fixture, adaptor, or accessory, suited for the application, as recommended and supplied by the manufacturer, shall be used. ()
- hh. Only those types of fasteners and powder loads recommended by the tool manufacturer shall be used. ()
- ii. Before fastening into any questionable material, the operator shall determine its suitability by using a fastener as a center punch. If the fastener point does not easily penetrate, is not blunted, and does not fracture the material, initial test fastenings shall then be made in accordance with the tool manufacturer's recommendations. (See Subsection 270.12.rr. of this section). ()
- jj. No tool shall be loaded unless it is being prepared for immediate use. If the work is interrupted after loading, the tool shall be unloaded at once. ()
- kk. Tools shall not be loaded until just prior to the intended firing time. Neither loaded nor empty tools are to be pointed at any person; hands shall be kept clear of the open barrel end. ()
- ll. The tool shall always be held perpendicular to the work surface when fastening into any material, except for specific applications recommended by the tool manufacturer. ()
- mm. In the event of a misfire, the operator shall hold the tool firmly against the work surface for a period of thirty (30) seconds and then follow the explicit instructions set forth in the manufacturer's instructions. ()
- nn. Powder loads of different power levels and types shall be kept in separate compartments or containers. ()
- oo. A sign, at least eight by ten (8 x 10) inches, using boldface type no less than one (1) inch in height, shall be posted in plain sight on all construction projects where tools are used. The sign shall bear wording similar to the following: POWDER ACTUATED TOOL IN USE. ()
- pp. The tool shall not be used in an explosive or flammable atmosphere. ()
- qq. A tool shall never be left unattended in a place where it would be available to unauthorized persons. ()
- rr. Fasteners shall not be driven into very hard or brittle materials including, but not limited to, cast iron, glazed tile, hardened steel, glass block, natural rock, hollow tile, or most brick. (See Subsection 270.12.ii. of this section.) ()
- ss. Fasteners shall not be driven into easily penetrated or thin materials or materials of questionable resistance, unless backed by a material that will prevent the fastener from passing completely through the other side. ()
- tt. Fasteners shall not be driven closer than three (3) inches from the unsupported edge of masonry materials except for specific applications recommended by the tool manufacturer. ()
- uu. Fasteners shall not be driven closer than one-half (1/2) inch from the edge of steel except for specific applications recommended by the tool manufacturer. ()
- vv. Fasteners shall not be driven into concrete unless material thickness is at least three (3) times the

- fastener shank penetration. ()
- ww. Fasteners shall not be driven into any spalled area. ()
- xx. Fasteners shall not be driven through existing holes unless a specific guide means, as recommended and supplied by the tool manufacturer, is used to ensure positive alignment. ()
- yy. The tool shall be serviced and inspected for worn or damaged parts at regular intervals as recommended by the tool manufacturer. Prior to the tool being put back into use, all worn or damaged parts shall be replaced by a qualified person using only parts supplied by the tool manufacturer. A record of this inspection shall be noted and dated on the tool inspection record. ()
- zz. Instruction manuals, maintenance tools, and accessories supplied with the tool shall be stored in the tool container when not in use. ()
- aaa. Powder actuated tools and powder loads shall be locked in a container and stored in a safe place when not in use and shall be accessible only to authorized personnel. ()
- bbb. Only persons trained and authorized by the tool manufacturer or by an authorized representative of the tool manufacturer shall be qualified to instruct and qualify operators for the manufacturer's powder actuated tools. ()
- ccc. All authorized instructors shall have read and be familiar with this standard, and shall be capable of: disassembling, servicing, and re-assembling the tool; recognizing any worn or damaged parts or defective operation; recognizing and clearly identifying the colors used to identify power load levels; using the tool correctly within the limitations of its use; and training and testing operators prior to issuing a qualified operators card. ()
- ddd. All authorized instructors shall have in their possession a valid authorized instructor's card issued and signed by an authorized representative of the manufacturer. The card shall be wallet size of approximately two and one-half (2 1/2) x three and one-half (3 1/2) inches and the face of the card shall bear text similar to that shown in Figure 270.12-A. ()

FIGURE 270.12-A

AUTHORIZED INSTRUCTOR	
_____ Powder Actuated Tools (MAKE)	Date _____
Card No. _____	Social Security No. _____
This certifies that _____ (NAME OF INSTRUCTOR)	
has received the prescribed training in the operation and maintenance of powder actuated tools manufactured by _____ and is qualified to train and (NAME OF MANUFACTURER)	
certify operators of _____ power actuated tools. (MAKE)	
Model(s) _____	
Authorized by _____	
I have received instruction by the manufacturer's authorized representative in the training of operators of the above tools and agree to conform to all rules and regulations governing the instruction of tool operators.	
Date of Birth _____	
_____ (SIGNATURE)	

eee. A list of all instructors authorized by the manufacturer to instruct and qualify operators shall be maintained by the tool manufacturer and be made available to the Department upon request. An instructor's card may be revoked by the authorizing agent or the Department upon request. An instructor's card may be revoked by the authorizing agent or the Department, if the instructor is known to have issued a qualified operator's card in violation of any regulation contained in this standard. When an instructor is no longer authorized to issue qualified operator's cards, he shall surrender his card to the authorizing agent or to the Department. ()

fff. The operator shall be trained by an authorized instructor to be familiar with the provisions of this standard and the instructions provided by the manufacturer for operation and maintenance. The operator shall also be capable of: reading and understanding the manufacturer's instruction manual; cleaning the tool correctly; recognizing any worn or damaged parts or defective operation; recognizing the number color code system used in this standard to identify powder load levels. In the event the operator is unable to distinguish the colors used, he shall be given special instruction to enable him to avoid error; and using the tool correctly within the limitations of its use and demonstrating his competence by operating the tool in the presence of the instructor. ()

ggg. After training, the operator shall, to substantiate his competency, satisfactorily complete a written examination provided by the manufacturer of the tool. The operator's written examination shall consist of questions to establish the operator's competence with respect to: the requirements of this standard; the powder actuated fastening system; and the specific details of operation and maintenance of the tool(s) involved. The examination shall provide a statement, attested to by the instructor, that the applicant can (or cannot) readily distinguish the colors used to identify powder load levels. (See Subsection 274.05.u. through Subsection 270.12.w. of this section.) ()

hhh. Each applicant who meets the requirements as set forth in Subsection 270.12.fff. and ggg. of this section shall receive a qualified operator's card, issued and signed by both the instructor and applicant. While using the tool, the operator shall have this card in his possession. The qualified operator's card supplied by the manufacturer shall be wallet size of approximately two and one-half (2 1/2) x three and one-half (3 1/2) inches and the face of the card shall bear text similar to that shown in Figure 270.12-B. There shall be printed on the card a notation reading: Revocation of card - Failure to comply with any of the rules and regulation for safe operation of powder actuated fastening tools shall be cause for the immediate revocation of this card. ()

FIGURE 270.12-B

QUALIFIED OPERATOR	
_____ Powder Actuated Tools (MAKE)	Date _____
Card No. _____	Social Security No. _____
This certifies that _____ (NAME OF OPERATOR)	
has received the prescribed training in the operation of powder actuated tools manufactured by: _____ and is qualified to	
train and	(NAME OF MANUFACTURER)
certify operators of _____ power actuated tools. (MAKE)	
Model(s) _____	
Authorized by _____ (SIGNATURE OF AUTHORIZED INSTRUCTOR)	
I have received instruction by the manufacturer's authorized representative in the training of operators of the above tools and agree to conform to all rules and regulations governing the instruction of tool operators.	
Date of Birth _____	
	_____ (SIGNATURE)

13. Power Lawn Mowers. ()
- a. Power lawnmowers of the walk-behind, riding-rotary types, and reel power lawn mowers designed for use by employees shall meet the design specifications in "American National Standard Safety Specifications for Power Lawnmowers" ANSI B71.1. These specifications do not apply to sulky-type mowers, flail mowers, sickle-bar mowers, or mowers designed for commercial use. ()
- b. All power-drive chains, belts and gears shall be so positioned or otherwise guarded to prevent the operator's accidental contact therewith, during normal starting, mounting, and operation of the machine. ()
- c. A shut-off device shall be provided to stop operation of the motor or engine. This device shall require manual and intentional reactivation to restart the motor or engine. ()
- d. All positions of the operating controls shall be clearly identified. ()
- e. The words, Caution. Be Sure The Operating Control(s) Is In Neutral Before Starting The Engine, or similar wording shall be clearly visible at an engine starting control point on self-propelled mowers. ()
- f. The walk-behind and riding rotary mower blade shall be enclosed except on the bottom and the enclosure shall extend to or below the lowest cutting point of the blade in the lowest blade position. ()
- g. Guards which must be removed to install a catcher assembly shall comply with the following: Warning instructions shall be affixed to the mower near the opening stating that the mower shall not be used without either the catcher assembly or the guard in place. The catcher assembly or the guard shall be shipped and sold as part of the mower. The instruction manual shall state that the mower shall not be used without either the catcher assembly or the guard in place. The catcher assembly, when properly and completely installed, shall not create a condition which violates the limits given for the guarded opening. ()
- h. Openings in the blade enclosure, intended for the discharge of grass, shall be limited to a maximum vertical angle of the opening of thirty (30) degrees. Measurements shall be taken from the lowest blade position.

()

i. The total effective opening area of the grass discharge opening(s) shall not exceed one hundred (100) square inches on units having a width of cut less than twenty-seven and one-half (27 1/2) inches, or two hundred (200) square inches on units having a width of cut twenty-seven and one-half (27 1/2) inches or over. ()

j. The word Caution or stronger wording, shall be placed on the mower at or near each discharge opening. ()

k. Blade(s) shall stop rotating from the manufacturer's specified maximum speed within fifteen (15) seconds after declutching, or shutting off power. ()

l. In a multi piece blade, the means of fastening the cutting members to the body of the blade or disc shall be so designed that they will not become worn to a hazardous condition before the cutting members themselves are worn beyond use. ()

m. The maximum tip speed of any blade shall be nineteen thousand (19,000) feet per minute. ()

n. The horizontal angle of the opening(s) in the blade enclosure, intended for the discharge of grass, shall not contact the operator area. ()

o. There shall be one (1) of the following at all openings in the blade enclosure intended for the discharge of grass: A minimum unobstructed horizontal distance of three (3) inches from the end of the discharge chute to the blade tip circle. A rigid bar fastened across the discharge opening, secured to prevent removal without the use of tools. The bottom of the bar shall be no higher than the bottom edge of the blade enclosure. ()

p. The highest point(s) on the front of the blade enclosure for walk behind rotary mowers, except discharge openings, shall be such that any line extending a maximum of fifteen (15) degrees downward from the horizontal toward the blade shaft axis shall not intersect the horizontal plane within the blade tip circle. The highest point(s) on the blade enclosure front, except discharge-openings, shall not exceed one and one-fourth (1 1/4) inches above the lowest cutting point of the blade in the lowest blade position. Mowers with a swing-over handle are to be considered as having no front in the blade enclosure and therefore shall comply with Subsection 270.13.a. of this section. ()

q. The mower handle for walk behind rotary mowers shall be fastened to the mower so as to prevent loss of control by unintentional uncoupling while in operation. ()

r. A positive up-stop or latch shall be provided for walk behind rotary mowers the mower handle in the normal operating position(s). The up-stop shall not be subject to unintentional disengagement during normal operation of the mower. The up-stop or latch shall not allow the center or the handle grips to come closer than seventeen (17) inches horizontally behind the closest path of the mower blade(s) unless manually disengaged. ()

s. A swing-over handle for walk behind rotary mowers, which complies with the above requirements will be permitted. ()

t. Wheel drive disengaging controls, except deadman controls, shall move opposite to the direction of the vehicle motion in order to disengage the drive. Deadman controls shall comply with Subsection 270.02.h. of this section and may operate in any direction to disengage the drive. ()

u. The highest point(s) of all openings in the blade enclosure front for riding rotary mowers shall be limited by a vertical angle of opening of fifteen (15) degrees and a maximum distance of one and one-fourth (1 1/4) inches above the lowest cutting point of the blade position. ()

v. Opening(s) shall be placed so that grass or debris from riding rotary mowers will not discharge directly toward any part of an operator seated in a normal operator position. ()

w. There shall be one (1) of the following at all openings in the blade enclosure intended for the

discharge of grass for riding rotary mowers: A minimum unobstructed horizontal distance of six (6) inches from the end of the discharge chute to the blade tip circle. A rigid bar fastened across the discharge opening, secured to prevent removal without the use of tools. The bottom of the bar shall be no higher than the bottom edge of the blade enclosure. ()

x. Riding rotary mowers shall be provided with stops to prevent jackknifing or locking of the steering mechanism. ()

y. Riding rotary mower stopping means shall be provided. ()

z. Hand-operated wheel drive disengaging controls for riding rotary mowers shall move opposite to the direction of vehicle motion in order to disengage the drive. Foot-operated wheel drive disengaging controls shall be depressed to disengage the drive. Deadman controls, both hand and foot operated, shall comply with Subsection 270.02.h. of this section, and may operate in any direction to disengage the drive. ()

14. Jacks. ()

a. The operator shall make sure that the jack used has a rating sufficient to lift and sustain the load. ()

b. The rated load shall be legibly and permanently marked in a prominent location on the jack by casting, stamping, or other suitable means. ()

c. In the absence of a firm foundation the base of the jack shall be blocked. If there is a possibility of slippage of the cap, a block shall be placed in between the cap and the load. ()

d. The operator shall watch the stop indicator, which shall be kept clean, in order to determine the limit of travel. The indicated limit shall not be overrun. ()

e. After the load has been raised it shall immediately be cribbed, blocked, or otherwise secured. ()

f. Hydraulic jacks exposed to freezing temperatures shall be supplied with an adequate antifreeze liquid. ()

g. All jacks shall be properly lubricated at regular intervals. The lubricating instructions of the manufacturer should be followed, and only lubricants recommended by him should be used. ()

h. Each jack shall be thoroughly inspected at times which depend upon the service conditions. Inspections shall be not less frequent than the following: for constant or intermittent use at one (1) locality, once every six (6) months; for jacks sent out of shop for special work, when sent out and when returned; and for a jack subjected to abnormal load or shock, immediately before and immediately thereafter. ()

i. Repair or replacement parts shall be examined for possible defects. ()

j. Jacks which are out of order shall be tagged accordingly, and shall not be used until repairs are made. ()

271. -- 279. (RESERVED).

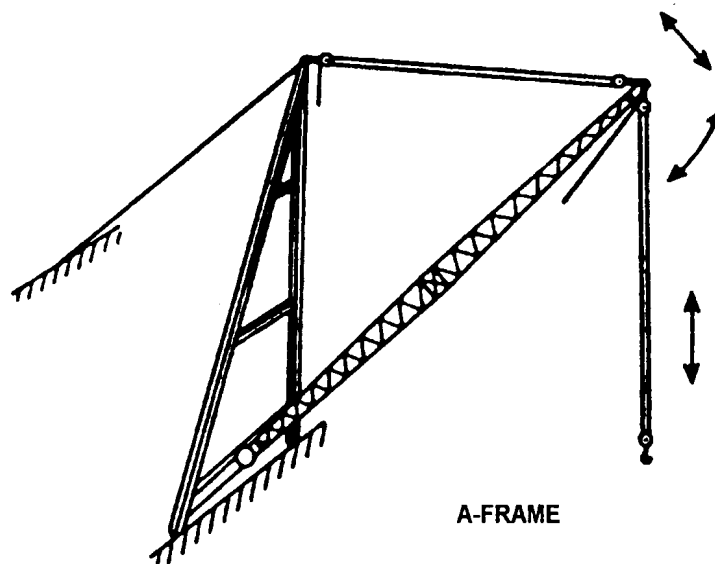
280. VEHICLE OPERATIONS AND MATERIAL HANDLING.

01. Scope. ()

a. Vehicle operations and material handling shall conform to all other applicable requirements of this standard, as well as the following provisions. Nothing in this standard shall be construed to prohibit better or otherwise safer conditions than specified herein. ()

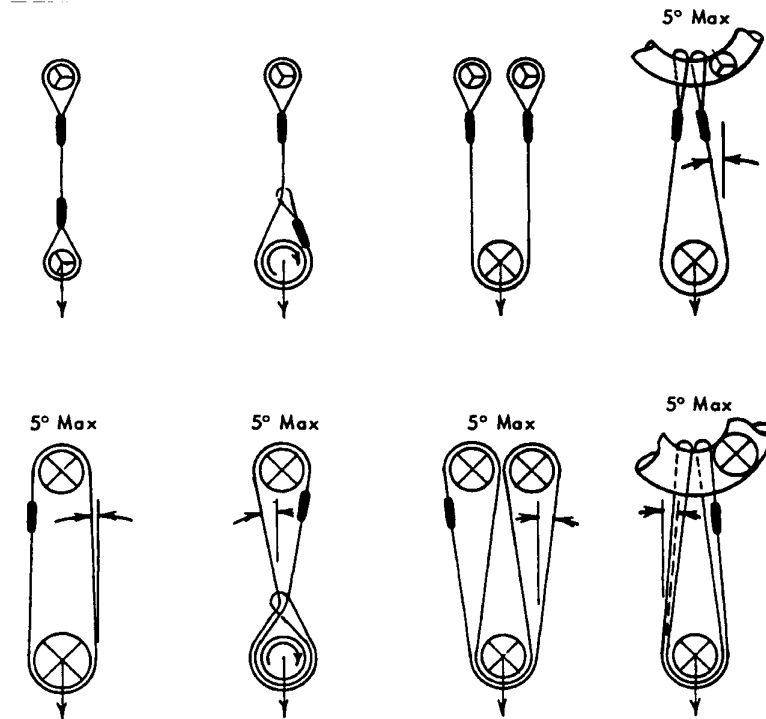
02. Definitions Applicable to this Section. ()
- a. Accessory is a secondary part or assembly of parts which contributes to the overall function and usefulness of a machine. ()
- b. A-Frame Derrick is a derrick in which the boom is hinged from a cross member between the bottom ends of two (2) upright members spread apart at the lower ends and joined at the top; the boom point secured to the junction of the side members, and the side members are braced or guyed from this junction point. (See Figure 280.02-A.) ()

FIGURE 280.02-A



- c. Angle Indicator (boom) is an accessory which measures the angle of the crane boom to the horizontal. ()
- d. Angle of Loading is the inclination of a leg or branch of a sling measured from the horizontal or vertical plane as shown in Figure 280.02-B, provided that an angle of loading of five (5) degrees or less from the vertical may be considered a vertical angle of loading. ()

FIGURE 280.02-B



- e. Automatic Crane is a crane which when activated operates through a preset cycle or cycles. ()
- f. Auxiliary Hoist is a supplemental hoisting unit of lighter capacity and usually of a higher speed than provided for the main hoist. ()
- g. Axis of Rotation is the vertical axis around which the crane superstructure rotates. ()
- h. Axle is 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. ()
- i. Axle (Bogie) is two (2) 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. ()
- j. Base (mounting) is the traveling base or carrier on which the rotating superstructure is mounted such as a car, truck, crawlers, or wheel platform. ()
- k. Basket Hitch is a sling configuration whereby the sling is passed under the load and has both ends, end attachments, eyes or handles on the hook or a single master link. ()
- l. Boom (crane) is a member hinged to the front of the rotating superstructure with the outer end supported by ropes leading to a gantry of A frame and used for supporting the hoisting tackle. ()
- m. Boom (derrick) is a timber or metal section or strut, pivoted or hinged at the heel (lower end) at a

location fixed in height on a frame or mast or vertical member, and with its point (upper end) supported by chains, ropes, or rods to the upper end of the frame mast, or vertical member. A rope for raising and lowering the load is reeved through sheaves or a block at the boom point. The length of the boom shall be taken as the straight line distance between the axis of the foot pin and the axis of the boom point sheave pin, or where used, the axis of the upper load block attachment pin. ()

n. 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. ()

o. Boom Harness is the block and sheave arrangement on the boom point to which the topping lift cable is reeved for lowering and raising the boom. ()

p. 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. ()

q. Boom Point is the outward end of the top section of the boom. ()

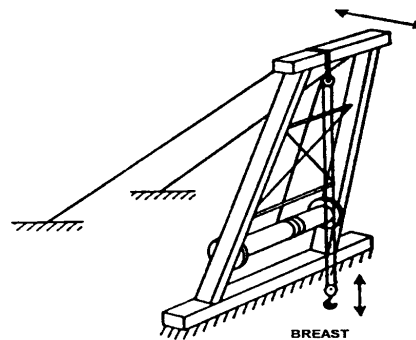
r. Boom Stop is a device used to limit the angle of the boom at the highest position. ()

s. Brake is a device used for retarding or stopping motion by friction or power means. ()

t. Braided Wire Rope is a wire rope formed by plaiting component wire ropes. ()

u. Breast Derrick is a derrick without boom. The mast consists of two (2) side members spread farther apart at the base than at the top and tied together at top and bottom by rigid members. The mast is prevented from tipping forward by guys connected to its top. The load is raised and lowered by ropes through a sheave or block secured to the top crosspiece. (See Figure 280.02-C. ()

FIGURE 280.02-C



v. Bridge is that part of a crane consisting of girders, trucks, end ties, footwalks, and drive mechanism which carries the trolley or trollies. ()

w. Bridge Travel is the crane movement in a direction parallel to the crane runway. ()

x. Bridle Wire Rope Sling is a sling composed of multiple wire rope legs with the top ends gathered in a fitting that goes over the lifting hook. ()

y. 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 (2) moving cranes or trollies come in contact. ()

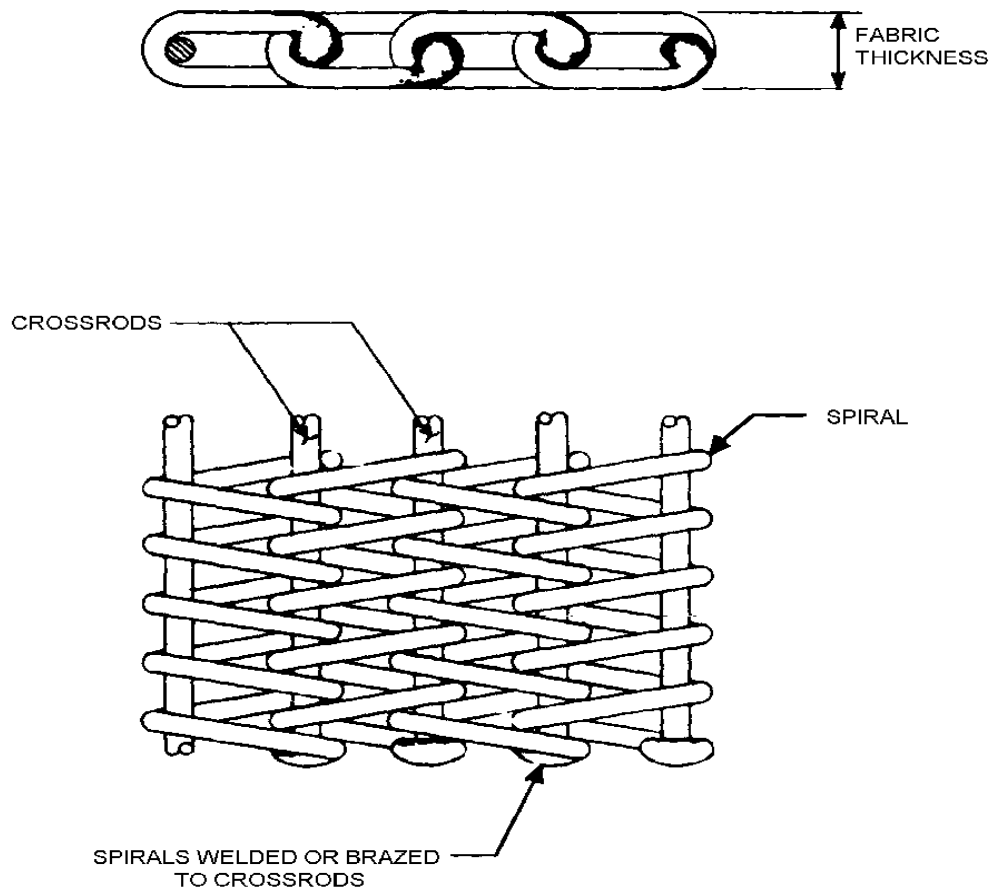
- z. Cab is the operator's compartment on a crane. ()
- aa. Cab-Operated Crane is a crane controlled by an operator in a cab located on the bridge or trolley. ()
- bb. Cable Laid Endless Sling Mechanical Joint is a wire rope sling made end-less by joining the ends of a single length of cable laid rope with one (1) or more metallic fittings. ()
- cc. Cable Laid Grommet-Hand Tucked is an endless wire rope sling made from one (1) length of rope wrapped six (6) times around a core formed by hand tucking the ends of the rope inside the six (6) wraps. ()
- dd. Cable Laid Rope is a wire rope composed of six (6) wire ropes wrapped around a fiber or wire rope core. ()
- ee. Cable Laid Rope Sling-Mechanical Joint is a wire rope sling made from a cable laid rope with eyes fabricated by pressing or swagging one (1) or more metal sleeves over the rope junction. ()
- ff. Cantilever Gantry Crane is a gantry or semi-gantry crane in which the bridge girders or trusses extend transversely beyond the crane runway on one (1) or both sides. ()
- gg. Charts are the United States Department of Transportation, National Highway Traffic Safety Administration, (NHTSA) publications entitled Safety Precautions for Mounting and Demounting Tube type Truck/ Bus Tires and Multi-Piece Rim/Wheel Matching Chart, or any other publications containing, at a minimum, the same instructions, safety precautions and other information contained on those charts that are applicable to the types of multi-piece rim wheels being serviced. ()
- hh. Choker Hitch is a sling configuration with one (1) end of the sling passing under the load and through an end attachment, handle or eye on the other end of the sling. ()
- ii. Clearance is the distance from any part of the crane to a point of the nearest obstruction. ()
- jj. Clutch is a fraction, electromagnetic, hydraulic, pneumatic, or positive mechanical device for engagement or disengagement of power. ()
- kk. Coating is an elastomer or other suitable material applied to a sling or to a sling component to impart desirable properties. ()
- ll. Collectors (current) are contacting devices for collecting current from runways or bridge conductors. ()
- mm. Conductors, Bridge, are the electrical conductors located along the bridge structure of a crane to provide power to the trolley. ()
- nn. Conductors, Runway (main), are the electrical conductors located along a crane runway to provide power to the crane. ()
- oo. Control Braking is a method of controlling crane motor speed when in an overhauling condition. ()
- pp. Controller, Spring Return, is a controller which when released will return automatically to a neutral position. ()
- qq. Counter Torque is a method of control by which the power to the motor is reversed to develop torque in the opposite direction. ()
- rr. Counterweight is a weight used to supplement the weight of the machine in providing stability for lifting working loads. ()

ss. 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. ()

tt. 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. ()

uu. Cross Rod is a wire used to join spirals of metal mesh to form a complete fabric. (See Figure 280.02-D). ()

FIGURE 280.02-D



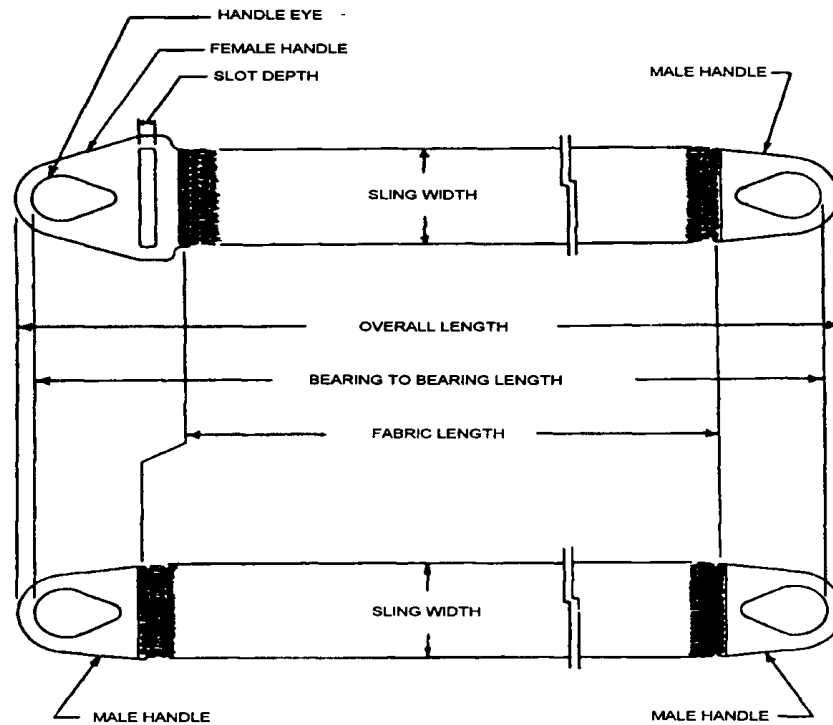
vv. Demounting means the opposite of mounting. ()

ww. Derrick is an apparatus consisting of a mast or equivalent member held at the head by guys or braces, with or without a boom, for use with a hoisting mechanism and operating ropes. ()

xx. Derrick Bullwheel is a horizontal ring or wheel, fastened to the foot of a derrick, for the purpose of turning the derrick by means of ropes leading from this wheel to a powered drum. ()

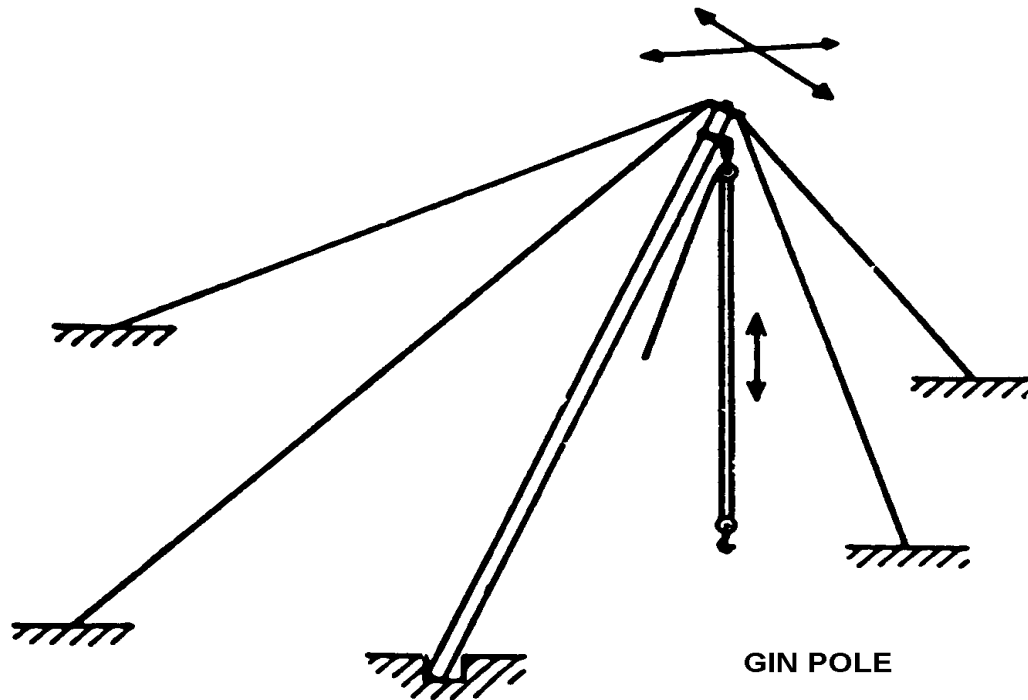
- yy. Drag Brake is a brake which provides retarding force without external control. ()
- zz. Drift Point is a point on a travel motion controller which releases the brake while the motor is not energized. This allows for coasting before the brake is set. ()
- aaa. Drum is the cylindrical member around which the ropes are wound for raising or lowering the load. ()
- bbb. Dynamic is a method of controlling crane motor speeds when in the overhauling condition to provide a retarding force. ()
- ccc. Dynamic (loading) is loads introduced into the machine or its components by forces in motion. ()
- ddd. Emergency Stop Switch is a manually or automatically operated electric switch to cut off electric power independently of the regular operating controls. ()
- eee. Equalizer is a device which compensates for unequal length or stretch of a rope. ()
- fff. Exposed is to be capable of being contacted inadvertently. Applied to hazardous objects not adequately guarded or isolated. ()
- ggg. Eye is a loop formed at the end of a rope by securing the dead end to the live end at the base of the loop. ()
- hhh. Fabric (Metal mesh) is the flexible portion of a metal mesh sling consisting of a series of transverse coils and cross rods. (See Figure 280.02-D.) ()
- iii. Fail-Safe is a provision designed to automatically stop or safely control any motion in which a malfunction occurs. ()
- jjj. Female Handle (choker) is a handle with a handle eye and slot of such dimension as to permit passage of a male handle thereby allowing the use of a metal mesh sling in a choker hitch. (See Figure 280.02-E) ()

FIGURE 280.02-E



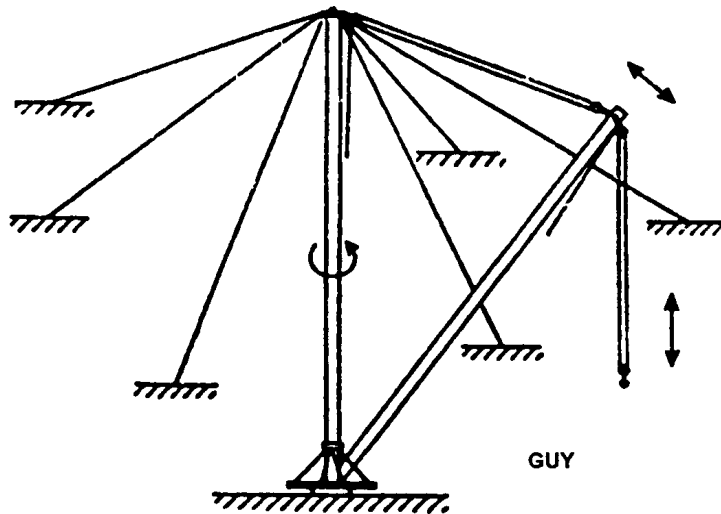
- kkk. Fiddle Block is a block consisting of two (2) sheaves in the same plane held in place by the same cheek plates. ()
- lll. Floor-Operated Crane is a crane which is pendant or nonconductive rope controlled by an operator on the floor or an independent platform. ()
- mmm. Foot Bearing or Foot Block (Sill Block) is the lower support on which the mast rotates. ()
- nnn. Footwalk is the walkway with handrail, attached to the bridge or trolley for access purposes. ()
- ooo. Gantry (A-frame) is a structure frame, extending above the superstructure, to which the boom support ropes are reeved. ()
- ppp. Gantry Crane is a crane similar to an overhead crane except that the bridge for carrying the trolley or trolleys is rigidly supported on two (2) or more legs running on fixed rails or other runway. ()
- qqq. Gin Pole Derrick is a derrick without a boom. Its guys are so arranged from its top as to permit leaning the mast in any direction. The load is raised and lowered by ropes reeved through sheaves or blocks at the top of the mast. (See Figure 280.02-F. ()

FIGURE 280.02-F



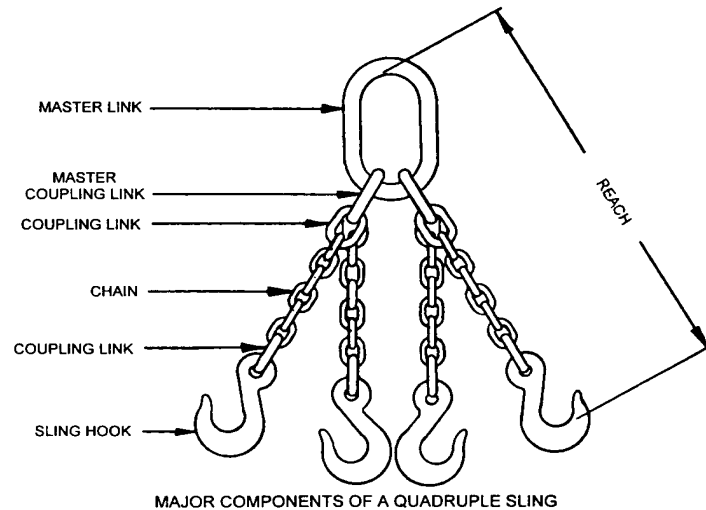
- rrr. Gudgeon Pin is a pin connecting the mast cap to the mast allowing rotation of the mast. ()
- sss. Guy is a rope used to steady or secure the mast or other member in the desired position. ()
- ttt. Guy Derrick is a fixed derrick consisting of a mast capable of being rotated, supported in a vertical position by guys, and a boom whose bottom end is hinged or pivoted to move in a vertical plane with a reeved rope between the head of the mast and the boom point for raising and lowering the boom, and a reeved rope from the boom point for raising and lowering the load. (See Figure 280.02-G.) ()

FIGURE 280.02-G



- uuu. Handle is a terminal fitting to which metal mesh fabric is attached. (See Figure 280.02-E). ()
- vvv. Handle Eye is an opening in a handle of a metal mesh sling shaped to accept a hook, shackle or other lifting device. (See Figure 280.02-E). ()
- www. Hitch is a sling configuration whereby the sling is fastened to an object or load, either directly to it or around it. ()
- xxx. Hoist is an apparatus which may be a part of a crane, exerting a force for lifting or lowering. ()
- yyy. Hoist Chain is the load bearing chain in a hoist. NOTE: Chain properties do not conform to those shown in ANSI B30.9, Safety Code for Slings. ()
- zzz. Hoist Motion is that motion of a crane which raises and lowers a load. ()
- aaaa. Holding Brake is a brake that automatically prevents motion when power is off. ()
- bbbb. Hot Metal Handling Crane is an overhead crane used for transporting or pouring molten material. ()
- cccc. Installing a Wheel is the transfer and attachment of an assembled wheel onto a vehicle axle hub. ()
- dddd. 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. ()
- eeee. 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. ()
- ffff. Link is a single ring of a chain. (See Figure 280.02-H). ()

FIGURE 280.02-H



- gggg. Load is the total superimposed weight on the load block or hook. ()
- hhhh. Load (working) is the external load, in pounds, applied to the crane/derrick, including the weight of load attaching equipment such as load blocks, shackles, and slings. ()
- iiii. Load Block is the assembly of hook or shackle, swivel, bearing, sheaves, pins, and frame suspended by the hoisting rope. ()
- jjjj. Load Block (upper) is the assembly of hook or shackle, swivel, sheaves, pins, and frame suspended from the boom point. ()
- kkkk. Load Block (lower) is the assembly of hook or shackle, swivel, sheaves, pins, and frame suspended by the hoisting ropes. ()
- llll. Load Hoist is a hoist drum and rope reeving system used for hoisting and lowering loads. ()
- mmmm. Load Ratings are crane ratings in pounds established by the manufacturer in accordance with Subsection 280.20.c of this section. ()
- nnnn. Magnet is an electromagnetic device carried on a crane hook to pick up loads magnetically. ()
- oooo. Main Hoist is the hoist mechanism provided for lifting the maximum rated load. ()
- pppp. Main Switch is a switch controlling the entire power supply to the crane. ()
- qqqq. Male Handle (Triangle) means a handle with a handle eye. (See Figure 280.02-E). ()
- rrrr. Man Trolley is a trolley having an operator's cab attached thereto. ()
- ssss. Mast is the upright member of the derrick. ()
- tttt. Mast Cap (spider) is the fitting at the top of the mast to which the guys are connected. ()

uuuu. Master Coupling Link is an alloy steel welded coupling link used as an intermediate link to join alloy steel chain to master links. (See Figure 280.02-G). ()

vvvv. Master Link or Gathering Ring is a forged or welded steel link used to support all members (legs) of an alloy steel chain sling or wire rope sling (See Figure 280.02-G). ()

www. Master Switch is a switch which dominates the operation of contractors, relays, or other remotely operated devices. ()

xxxx. Mechanical is a method of control by friction. ()

yyyy. Mechanical Coupling Link is a nonwelded, mechanically closed steel link used to attach master links, hooks, etc., to alloy steel chain. ()

zzzz. Mounting a Tire is the assembly or putting together of rim components, tube, liner (flap) and tire to form a wheel including inflation. ()

aaaa. Multi-piece Rim is a vehicle wheel rim consisting of two (2) or more parts, one of which is a side or locking ring designed to hold the tire on the rim by interlocking components when the tube is inflated, regardless of the sizes of the component parts. ()

bbbb. Outriggers are extendable or fixed metal arms, attached to the mounting base, which rests on supports at the outer ends. ()

cccc. Overhead Crane is a crane with a movable bridge carrying a movable or fixed hoisting mechanism and traveling on an overhead fixed runway structure. ()

dddd. Power-Operated Crane is a crane whose mechanism is driven by electric, air, hydraulic, or internal combustion means. ()

eeee. Proof Load is the load applied in performance of a proof test. ()

ffff. Proof Test is a nondestructive tension test performed by the sling manufacturer or an equivalent entity to verify construction and workmanship of a sling. ()

gggg. Pulpit-Operated Crane is a crane operated from a fixed operator station not attached to the crane. ()

hhhh. Rated Capacity or Working Load Limit is the maximum working load permitted by the provisions of this section. ()

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

jjjj. Reach is the effective length of an alloy steel chain sling measured from the top bearing surface of the upper terminal component to the bottom bearing surface of the lower terminal component. ()

kkkk. Reeving is a rope system in which the rope travels around drums and sheaves. ()

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

mmmm. 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. ()

nnnn. Removing is the opposite of installing. ()

ooooo. Restraining Device is a mechanical apparatus such as safety cage, rack, or safety bar arrangement or other machinery or equipment specifically designed for this purpose, that will constrain all multi-piece rim wheel components following their release during an explosive separation of the wheel components. ()

ppppp. Rim Manual is a publication containing instructions from the manufacturer or other qualified organization for correct mounting, demounting, maintenance and safety precautions peculiar to the multi-piece rim being serviced. ()

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

rrrrr. Running Sheave is a sheave which rotates as the load block is raised or lowered. ()

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

ttttt. Safety Hook is a hook with a latch to prevent slings or load from accidentally slipping off the hook. ()

uuuuu. Selvage Edge is the finished edge of synthetic webbing designed to prevent unraveling. ()

vvvvv. Semi-gantry Crane is a gantry crane with one (1) end of the bridge rigidly supported on one (1) 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. ()

wwwww. Service or Servicing is the mounting and demounting of multi-piece rim wheels, and related activity such as inflating, deflating, installing, removing, maintaining, handling or storing of multi-piece rim wheels, including inflating and deflating of wheels installed on vehicles. ()

xxxxx. Service Area is that part of an employer's premises for the servicing of multi-piece rim wheels, or any other place where an employee services multi-piece rim wheels. ()

yyyyy. Shearing Derrick is a derrick without a boom and similar to a breast derrick. The mast, wide at the bottom and narrow at the top, is hinged at the bottom and has its top secured by a multiple reeved guy to permit handling loads at various radii by means of load tackle suspended from the mast top. ()

zzzzz. Side Loading is a load applied at an angle to the vertical plane of the boom. ()

aaaaa. Side Pull is that portion of the hoist pull acting horizontally when the hoist lines are not operated vertically. ()

bbbbb. Sill is a member connecting the foot block and stiff-leg or a member connecting the lower ends of a double member mast. ()

ccccc. Sling is an assembly which connects the load to the material handling equipment. ()

ddddd. Sling Manufacturer is a person or organization that assembles sling components into their final form for sale to users. ()

eeeee. Spiral is a single transverse coil that is the basic element from which metal mesh is fabricated. (See Figure 280.02-D). ()

fffff. Span is the horizontal distance center to center of runway rails. ()

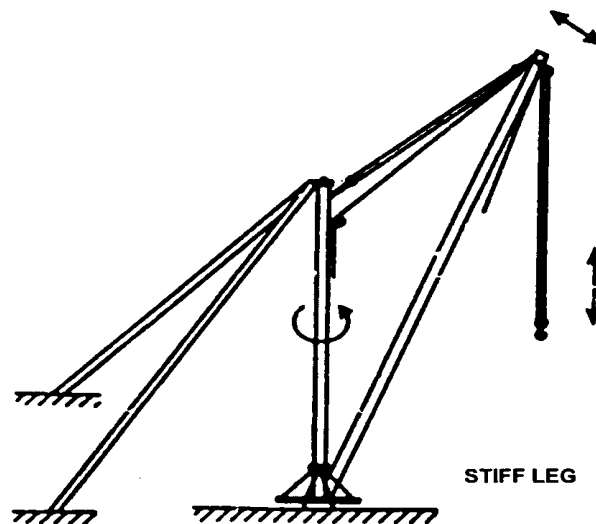
ggggg. Standby Derrick is a derrick not in regular service which is used occasionally or intermittently as required. ()

hhhhh. Standby Crane is a crane which is not in regular service but which is used occasionally or intermittently as required. ()

iiiiii. Standing (Guy) Rope is a supporting rope which maintains a constant distance between the points of attachment to the two (2) components connected by the rope. ()

jjjjj. Stiff Leg Derrick is a derrick similar to a guy derrick except that the mast is supported or held in place by two (2) or more stiff members, called stiff-legs, which are capable of resisting either tensile or compressive forces. Sills are generally provided to connect the lower ends of the stiff-legs to the foot of the mast. (See Figure 280.02-I.) ()

FIGURE 280.02-I



kkkkk. Still Leg is a rigid member supporting the mast at the head. ()

lllll. Structural Competence is the ability of the machine and its components to withstand the stresses imposed by applied loads. ()

mmmmm. 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. ()

nnnnn. Storage Bridge Crane is 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 (1) or more legs. It may have one (1) or more fixed or hinged cantilever ends. ()

ooooo. Strand Laid Endless Sling Mechanical Joint is a wire rope sling made endless from one (1) length or rope with the ends joined by one (1) or more metallic fittings. ()

ppppp. Strand Laid Grommet-hand Tucked is an endless wire rope sling made from one (1) length of strand wrapped six (6) times around a core formed by hand tucking the ends of the strand inside the six (6) wraps. ()

qqqqq. Strand Laid Rope is a wire rope made with strands (usually six (6) or eight (8) wrapped around a fiber core, wire strand core, or independent wire rope core (IWRC). ()

rrrrr. Superstructure is the rotating upper frame structure of the machine and the operating machinery mounted thereon. ()

sssss. Swing is the rotation of the superstructure for movement of loads in a horizontal direction about the axis of rotation. ()

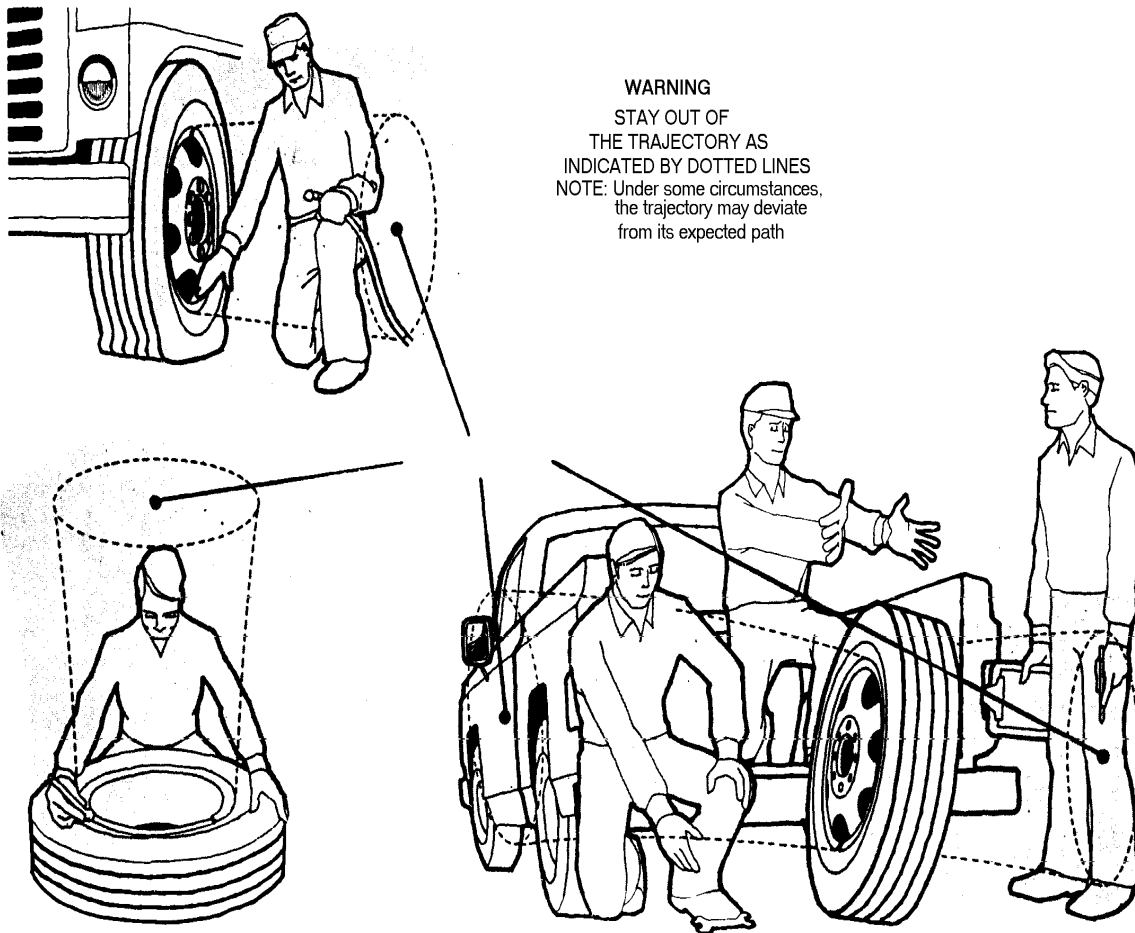
ttttt. Swing Mechanism is the machinery involved in providing rotation of the superstructure. ()

uuuuu. Switch is a device for making, breaking, or for changing the connections in an electric circuit. ()

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

wwwww. Trajectory is any potential path or route that a lock ring, side ring, rim base and/or time may travel during an explosive rim separation, and includes paths which may deviate from that perpendicular to the assembled position of the components on the rim base at the time of separation. (See Figure 280.02-J) ()

FIGURE 280.02-J



- xxxxxx. Transit is the moving or transporting of a crane from one (1) jobsite to another. ()
- yyyyyy. Travel is the functions of the machine moving from one (1) location to another, on a jobsite. ()
- zzzzzz. Travel Mechanism is the machinery involved in providing travel. ()
- aaaaaa. Trolley is the unit which travels on the bridge rails and carries the hoisting mechanism. ()
- bbbbbb. Trolley Travel is the trolley movement at right angles to the crane runway. ()
- cccccc. Trolley Truck is the unit consisting of a frame, wheels, bearings, and axles which supports the bridge girders or trolleys. ()
- dddddd. Truck Crane consists of a rotating superstructure with power plant, operating machinery and boom, mounted on an automotive truck equipped with a power plant for travel. Its function is to hoist and swing loads at various radii. ()
- eeeeee. Vertical Hitch is a method of supporting a load by a single, vertical part or leg of the sling. ()
- ffffff. Wall Crane is 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 of columns. ()
- gggggg. Wheel is an assemblage of tire, tube, and multi-piece rim components. ()
- hhhhhh. Wheelbase is the distance between centers of front and rear axles. For a multiple axle assembly the axle center for wheelbase measurement is taken as the mid-point of the assembly. ()
- iiiiii. Wheel Mounted Crane (Wagon Crane) consists of a rotating superstructure with power plant, 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. ()
- jjjjjj. Whipline (auxiliary hoist) is a separate hoist rope system of lighter load capacity and higher speed than provided by the main hoist. ()
- kkkkkk. Winch Head is a power driven spool for handling of loads by means of friction between fiber or wire rope and spool. ()
03. General Requirements. ()
- a. Where mechanical handling equipment is used, sufficient safe clearances shall be allowed for aisles, at leading docks, through doorways and wherever turns of passageways shall be kept clear and in good repair, with no obstruction across or in aisles that could create a hazard. Permanent aisles and passageways shall be appropriately marked. ()
- b. 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. 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. Proper drainage shall be provided. ()
- e. Clearance signs to warn of clearance limits shall be provided. ()

- f. Fire aisles, access to stairways, and fire equipment shall be kept clear. ()
04. Conveyors. ()
- a. Conveyors shall be constructed, operated, and maintained in accordance with the provisions of ANSI B20.1. ()
- b. When the return strand of a conveyor operates within seven (7) feet of the floor there shall be a trough provided of sufficient strength to carry the weight resulting from a broken chain. ()
- c. If the strands are over a passageway, a means shall be provided to catch and support the ends of the chain in the event of broken chain. ()
- d. When the working strand of a conveyor crosses within three (3) feet of the floor level in passageways, the trough in which it works shall be bridged the full width of the passageway. ()
- e. Whenever conveyors pass adjacent to or over working areas or passageways used by personnel, protective guards shall be installed. These guards shall be designed to catch and hold any load or materials which may fall off or become dislodged and injure a worker. ()
- f. Walking on rolls is prohibited. Employees shall not be allowed to walk on the rolls of roller type conveyors except for emergency. ()
- g. Guarding Shaftway and Material Entrances of Elevator Type Conveyors. Guards, screens or barricades of sufficient strength and size to prevent material from falling shall be installed on all sides of the shaftway of elevator-type conveyors except at openings where material is loaded or unloaded. Automatic shaftway gates or suitable barriers shall be installed at each floor level where material is loaded or unloaded from the platform. ()
- h. Conveyors shall be provided with an emergency stopping device which can be reached from the conveyor. Such device shall be located near the material entrance to each barker, chipper, saw, or similar type of equipment except where the conveyor leading into such equipment is under constant control of an operator who has full view of the material entrance and is located where he cannot possibly fall onto the conveyor. ()
- i. Where conveyors are in excess of seven (7) feet in height, means shall be provided to safely permit essential inspection and maintenance operations. ()
- j. Any part showing signs of significant wear shall be inspected carefully and replaced prior to reaching a condition where it may create a hazard. ()
- k. Replacement parts shall be equal to or exceed the manufacturer's specifications. ()
05. Servicing Multi-Piece Rim Wheels. ()
- a. These requirements apply to the servicing of vehicles wheels which have tube-type tires mounted on multi piece rims. ()
- b. The employer shall provide a training program to train and instruct all employees who service multi-piece rim wheels in the hazards involved in servicing multi-piece rim wheels and the safety procedures to be followed. ()
- c. The employer shall assure that no employee services any multi-piece rim wheel unless the employee has been trained and instructed in correct procedures of mounting, demounting, and all related services, activities, and correct safety precautions for the rim type being serviced, and the safe operating procedures described in Subsection 280.05 of this section. ()
- d. Information to be used in the training program shall include at a minimum, the data contained on the charts and the contents of this standard. ()

e. Where an employer knows or has reason to believe that any of his employees is unable to read and understand the charts or rim manual, the employer shall assure that the employee is instructed concerning the contents of the charts and rim manuals in a manner which the employee is able to understand. ()

f. The employer shall assure that each employee demonstrates and maintains his ability to service multi-piece rim wheels safely, including performance of the following tasks: demounting of tires (including deflation); inspection of wheel components; mounting of tires (including inflation within a restraining device); use of the restraining device; handling of wheels; inflation of tires when a wheel is mounted on the vehicle; installation and removal of wheels. ()

g. The employer shall evaluate each employee's ability to perform these tasks and to service multi-piece rim wheels safely and shall provide additional training as necessary to assure that each employee maintains his proficiency. ()

h. The employer shall furnish and shall assure that employees use a restraining device in servicing multi-piece rim wheels. ()

i. Each wheel restraining device shall have the capacity to withstand the maximum force that would be transferred to it during an explosive wheel separation occurring at one hundred fifty (150) percent of maximum tire specification pressure for the wheels being serviced. ()

j. Wheel restraining devices shall be capable of preventing rim components from being thrown outside or beyond the frame of the device for any wheel position within the device. ()

k. Wheel restraining devices shall be inspected prior to each day's use and after any explosive separation of wheel components and any restraining devices exhibiting any of the following defects shall be immediately removed from service: cracks at welds; cracked or broken components; or bent or sprung components due to excessive corrosion. ()

l. Wheel restraining devices removed from service in accordance with Subsection 280.05.k. of this section shall not be returned to service until they are inspected, repaired, if necessary, and are certified either by the manufacturer or by a Licensed Professional Engineer as meeting the strength requirements of Subsections 280.05.h. through 280.05.k of this section. ()

m. A clip-on-chuck with a sufficient length of hose to permit the employee to stand clear of the potential trajectory of the wheel components, and an inline valve with gauge or a pressure regulator preset to a desired value shall be furnished by the employer and used to inflate tires. ()

n. Current charts shall be available in the service area. ()

o. A current rim manual containing instructions for the type of rims being serviced shall be available in the service area. ()

p. The employer shall assure that only tools recommended in the rim manual for the type of wheel being serviced are used to service multi-piece rim wheels. ()

q. Wheel components shall not be interchanged except as provided in the charts, or in the applicable rim manuals. ()

r. Wheel components shall be inspected prior to assembly. Rim bases, side rings, or lock rings which are bent out of shape, pitted from corrosion, broken or cracked, shall not be used and shall be rendered unusable and discarded. ()

s. Mating surfaces of the rim gutter, rings and tire shall be free of any dirt, surface rust, scale or rubber buildup prior to mounting and inflation. ()

t. The employer shall establish a safe operating procedure for servicing multi-piece rim wheels and shall assure that employees are instructed in and follow that procedure. The procedure shall include at least the following elements: ()

u. Tire shall be completely deflated by removal of the valve core before demounting. ()

v. Tires shall be completely deflated by removing the valve core, before a wheel is removed from the axle in either of the following situations: when the tire has been driven under inflated at eighty (80) percent or less of its recommended pressure; or when there is obvious or suspected damage to the tire or wheel components. ()

w. Rubber lubricant shall be applied to bead and rim mating surfaces during assembly of the wheel and inflation of the tire. ()

x. Tires shall be inflated only when contained by a restraining device, except that when the wheel assembly is on a vehicle, tires that are under inflated but have more than eighty (80) of the recommended pressure, may be inflated while the wheel is on the vehicle if remote control inflation equipment is used and no employees are in the trajectory, and except as provided in Subsection 280.05.u. of this section. ()

y. When a tire is being partially inflated without a restraining device for the purpose of seating the lock ring or to round out the tube, such inflation shall not exceed three (3) psig. ()

z. Whenever a tire is in a restraining device the employee shall not rest or lean any part of his body or equipment on or against the restraining device. ()

aa. After tire inflation, the tire, rim and rings shall be inspected while still within the restraining device to make sure that they are properly seated and locked. If further adjustment to the tire, rim or rings is necessary, the tire shall be deflated by removal of the valve core before the adjustment is made. ()

bb. Cracked, broken, bent or otherwise damaged rim components shall not be reworked, welded, brazed, or otherwise heated. ()

cc. No attempt shall be made to correct the seating of side and lock rings by hammering, striking or forcing the components while the tire is pressurized. ()

dd. Whenever multi-piece rim wheels are being handled, employees shall stay out of the trajectory unless the employer can demonstrate that performance of the servicing makes the employee's presence in the trajectory necessary. ()

06. Powered Industrial Trucks. ()

a. This section contains safety requirements relating to fire protection design, maintenance, and use of fork trucks, tractors, platform lift trucks, motorized hand trucks, and other specialized industrial trucks, powered by electric motors, or internal combustion engines. This section does not apply to compressed gas-operated industrial trucks, nor to farm vehicles, to vehicles intended primarily for earth moving or over-the-road hauling. ()

b. All new powered industrial trucks acquired and used by an employer after the effective date of these standards shall meet the design and construction requirements for powered industrial trucks established in the American National Standard for Powered Industrial Trucks Part II, ANSI B56.1, except for vehicles intended primarily for earth moving or over-the-road hauling. ()

c. Approved trucks shall bear a label or some other identifying mark indicating approval by the testing laboratory as meeting the specifications and requirements of ANSI B56.1. ()

d. 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 maintenance instruction plates, tags, or decals shall be changed accordingly. ()

- e. If the truck is equipped with front end attachments other than factory installed attachments, it shall be marked to identify the attachments and show the approximate weight of the truck and attachment combination at maximum elevation with load laterally centered. ()
- f. The user shall see that all nameplates and markings are in place and are maintained in a legible condition. ()
- g. For the purpose of this standard, there are 11 different designations of industrial trucks or tractors as follows: D, DS, DY, E, ES, EE, EX, G, GS, LP, and LPS. ()
- h. The D designated units are units similar to the G units except that they are diesel engine powered instead of gasoline engine powered. ()
- i. 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. ()
- j. 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. ()
- k. The E designated units are electrically powered units that have minimum acceptable safeguards against inherent fire hazards. ()
- l. 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. ()
- m. 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. ()
- n. The EX designated units are electrically powered units that differ from 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. ()
- o. The G designated units are gasoline powered units having minimum acceptable safeguards against inherent fire hazards. ()
- p. The GS designated units are gasoline powered units having minimum acceptable safeguards against inherent fire hazards. ()
- q. The LP designated unit is similar to the G unit except that liquefied petroleum gas is used for fuel instead of gasoline. ()
- r. The LPS designated units are liquefied petroleum gas powered units that are provided with additional safeguards to the exhaust, fuel, and electrical systems. They may be used in some locations where the use of an LP unit may not be considered suitable. ()
- s. The atmosphere or location shall have been classified as to whether it is hazardous or nonhazardous prior to the consideration of industrial trucks being used therein and the type of industrial trucks required shall be as provided in Subsection 280.06.u. of this section, for such location. ()
- t. The industrial trucks specified under 280.06.w. through 280.06.cc. of this section are the minimum types required but industrial trucks having greater safeguards may be used if desired. ()

u. For specific areas of use, see Table 280.06-A in this Subsection, which tabulates the information contained in this section. References in parentheses are to the corresponding classification as used in the National Electrical Code; and ANSI Standard CI for the convenience of persons familiar with those classifications. ()

v. 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). 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. 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. ()

w. Only approved power operated industrial trucks designated as EX may be used in atmospheres containing acetone, acrylonitrile, alcohol, ammonia, benzene, bensol, butane, ethylene dichloride, gasoline, hexane, lacquer solvent vapors, naphtha, natural gas, propane, propylene, of zylenes in quantities sufficient to produce explosives 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. ()

x. 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 from 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 ventilation equipment; or in locations which are adjacent to Class I, Division I locations, and to which hazardous concentration 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. ()

y. In locations used for the storage of hazardous liquids in sealed containers or liquefied 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 operation 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 liquefied or compressed gases in sealed containers would not normally be considered hazardous unless subject to other hazardous conditions also. Only approved power operated 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 of abnormal operation of machinery or equipment might cause such mixtures to be produced. The EX classification usually includes the working areas of grain handling and storage plants, room containing grinders or pulverizers, cleaners, graders, scalpels, 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. ()

z. 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. ()

aa. 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. ()

bb. Only approved power operated industrial trucks designated as DS, DY, ES, EE, EX, GS, or LPS shall 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. ()

cc. 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. ()

dd. If storage warehouses and outside storage locations are hazardous only the approved power operated industrial truck specified for such locations in Subsection 280.06.u. through 280.06.cc. of this section 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. ()

ee. If general industrial or commercial properties are hazardous, only approved power operated industrial trucks specified for such locations in this section 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. ()

TABLE 280.06-A - PART 1									
SUMMARY TABLE ON USE OF INDUSTRIAL TRUCKS IN VARIOUS LOCATIONS									
Classes	Unclassified		Class I locations		Class II locations		Class III locations		
Description of classes	Locations not possessing atmospheres as described in other columns.		Locations in which flammable gases or vapors are, or may be, present in the air in quantities sufficient to produce explosive or ignitable mixtures.		Locations which are hazardous because of the presence of combustible dust.		Locations where easily ignitable fibers or flyings are present but not likely to be in suspension in quantities sufficient to produce ignitable mixtures.		
Groups in classes	None	A	B	C	D	E	F	G	None

TABLE 280.06-A - PART 1									
SUMMARY TABLE ON USE OF INDUSTRIAL TRUCKS IN VARIOUS LOCATIONS									
Classes	Unclassified		Class I locations		Class II locations		Class III locations		
Examples of locations or atmospheres in classes and groups.	Piers and wharves inside and outside general storage, general industrial or commercial properties.	Acetylene	Hydrogen	Ethyl ether	Gasoline Naphtha Alcohols Acetone Lacquer solvent Benzene	Metal dust	Carbon black coal dust, coke dust	Grain dust, flour dust, starch dust, organic dust	Baled waste, cocoa fiber, cotton, excelsior, hemp, istle, jute, kapok, oakum, sisal, Spanish moss, synthetic fibers, tow.

TABLE 280.06-A - PART 2																	
SUMMARY TABLE ON USE OF INDUSTRIAL TRUCKS IN VARIOUS LOCATIONS - CONTINUED																	
Authorized uses of trucks by types is groups of classes and divisions																	
Groups in classes	None	A	B	C	D	A	B	C	D	E	F	G	E	F	G	None	None
Type of truck authorized:																	
Diesel:																	
Type D	D**																
Type DS									DS						DS		DS
Type Y									DY						DY	DY	DY
Electric:																	
Type E	E**																E
Type ES									ES						ES		ES
Type E									EE						EE	EE	EE
Type EX					EX				EX		EX	EX			EX	EX	EX
Gasoline:																	

TABLE 280.06-A - PART 2																	
SUMMARY TABLE ON USE OF INDUSTRIAL TRUCKS IN VARIOUS LOCATIONS - CONTINUED																	
Authorized uses of trucks by types is groups of classes and divisions																	
Groups in classes	None	A	B	C	D	A	B	C	D	E	F	G	E	F	G	None	None
Type of truck authorized:																	
Type G	G**																
Type GS									GS						GS		GS
LP-Gas:																	
Type LP	LP**																
Type LPS									LPS						LP S		LPS

**Trucks conforming to these types may also be used.

ff. 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 Subsection 280.06.sss. of this section may be used in those locations where G, GS, or LP and LPS designated trucks have been specified in the preceding sections. ()

gg. High lift rider trucks shall be fitted with an overhead guard manufactured in accordance with Subsection 280.06.a. through 280.06.f. of this section unless operating conditions do not permit. ()

hh. If the type of load presents a hazard, the user shall equip fork trucks with a vertical load backrest extension manufactured in accordance with Subsection 280.06.b. of this section. ()

ii. Powered industrial trucks when in use shall have audible and visual warning devices in operation. ()

jj. 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. ()

kk. Industrial trucks shall not be driven up to anyone standing in front of a bench or other fixed object. ()

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

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

nn. The employer shall prohibit arms or legs from being placed between the uprights of the forklift truck mast or outside the running lines of powered industrial trucks. ()

oo. When leaving a powered industrial truck unattended, load engaging means shall be shut off, and brakes set. Wheels blocked if the industrial truck is parked on an incline. ()

pp. A powered industrial truck is unattended when the operator is twenty-five (25) feet or more away from the vehicle which remains in his view, or whenever the operator leaves the vehicle and it is not in his view. When the operator of an industrial truck is dismounted and within twenty-five (25) feet of the truck still in his view, the load engaging means shall be fully lowered, controls neutralized, and the brakes set to prevent movement. ()

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

rr. There shall be sufficient headroom under overhead installations, lights, pipes, sprinkler systems, etc. to allow forklift and powered industrial trucks. ()

ss. 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. ()

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

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

vv. Whenever a forklift 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. Use of a safety platform firmly secured to the lifting carriage and/or forks. Means shall be provided whereby personnel on the platform can shut off power to the truck. Such protection from falling objects as indicated necessary to the operating conditions shall be provided. ()

ww. When using forklifts as elevated work platforms, a platform or structure built specifically for hoisting persons shall be used providing the following requirements are complied with: The structure must be securely attached to the forks and shall have standard guardrails and toeboards installed on all sides. The hydraulic system shall be so designed that the lift mechanism will not drop faster than one hundred twenty-five (125) feet per minute in the event of a failure in any part of the system. Forklifts used for elevating work platforms shall be identified that they are so designed. A safety strap shall be installed or the control lever shall be locked to prevent the boom from tilting. An operator shall attend the lift equipment while workers are on the platform. The operator shall be in the normal operating position while raising or lowering the platform. The vehicle shall not travel from point to point while workers are on the platform except that inching or maneuvering at very slow speed is permissible. The area between workers on the platform and the mast shall be adequately guarded to prevent contact with chains or other shear points. ()

xx. The driver of powered industrial trucks 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. ()

yy. Railroad tracks shall be crossed diagonally wherever possible by powered industrial trucks. Parking closer than eight (8) feet from the center of railroad tracks is prohibited. ()

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

aaa. Grades shall be ascended or descended slowly. When ascending or descending grades in excess of ten (10) percent, loaded trucks shall be driven with the load upgrade. Unloaded trucks should be operated on all grades with the load engaging means downgrade. 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. ()

bbb. Under all travel conditions industrial trucks shall be operated at a speed that will permit them to be brought to a stop in a safe manner. Stunt driving and horseplay shall not be permitted. The driver shall be required to slow down for wet and slippery floors. Running over loose objects on the roadway surface shall be avoided. ()

ccc. 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. ()

ddd. 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. ()

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

fff. 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. ()

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

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

iii. The long or high (including multiple-tiered) loads which may affect capacity of the truck shall be adjusted. ()

jjj. When attachments are used, particular care shall 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. ()

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

lll. 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. ()

mmm. 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. ()

nnn. Any power operated industrial truck not in safe operating condition shall be removed from service. All repairs shall be made by authorized personnel. ()

ooo. No repairs shall be made in Class I, II, and III locations. ()

ppp. 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 Subsection 280.06.a. through 280.06.f. of this section. Additional counter-weighting of fork trucks shall not be done unless approved by the truck manufacturer. ()

qqq. 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. ()

rrr. 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 one hundred (100) degrees Fahrenheit) solvents shall not be used. High flash point (at or above one hundred (100) degrees Fahrenheit) solvents may be used. Precautions regarding toxicity, ventilation, and fire hazard shall be consonant with the agent or solvent used. ()

sss. 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 shall be approved. ()

07. Fuel Handling and Storage. ()

a. 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) and the requirements of Section 220 of this standard. ()

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

08. Changing and Charging Storage Batteries. ()

a. Battery charging installations shall be located in areas designated for that purpose. ()

b. 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. ()

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

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

e. Reinstalled batteries shall be properly positioned and secured in the vehicle ()

f. A carboy filter or siphon shall be provided for handling electrolyte. ()

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

h. Vehicles shall be properly positioned and brake applied or chocked before attempting to change or charge batteries. ()

i. When charging batteries, the vent caps shall be kept in place to avoid electrolyte spray. Care shall be taken to assure that vent caps are functioning. Non-venting caps shall not be used. EXCEPTION: Maintenance free batteries. ()

j. When charging batteries in the vehicle the battery (or compartment) cover(s) shall be open to dissipate heat. ()

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

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

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

09. Lighting for Operating Areas. ()

a. Controlled lighting of adequate intensity shall be provided in vehicle operating areas. (See American National Standard Practice for Industrial Lighting, A11.1). ()

b. Where general lighting is less than two (2) lumens per square foot, auxiliary directional lighting

- shall be provided on the vehicle. ()
10. Control of Noxious Gases and Fumes. ()
- a. Concentration levels of carbon monoxide gas created by vehicle operations shall not exceed the levels specified in Section 300 of this standard. ()
- b. Questions concerning degrees of concentration and methods of sampling to ascertain the conditions shall be referred to a qualified industrial hygienist or department personnel. ()
11. Dockboards (Bridge Plates). ()
- a. Portable and powered dockboards shall be strong enough to carry the load imposed on them. ()
- b. Portable dockboards shall be secured in position, either by being anchored or equipped with devices which will prevent their slipping. ()
- c. Powered dockboards shall be designed and constructed in accordance with Commercial Standard CS202-56, Industrial Lifts and Hinged Loading Ramps published by the U.S. Department of Commerce. ()
- d. Handholds, or other effective means, shall be provided on portable dockboards to permit safe handling. ()
12. Trucks and Vehicles, General. ()
- a. 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. ()
- b. Fixed jacks shall be used to support a semi-trailer and prevent upending during the loading or unloading when the trailer is not coupled to a tractor. ()
- c. Brakes shall be set and wheel blocks shall be in place to prevent movement of trucks or trailers 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 truck trailers shall be checked for breaks and weakness before they are driven onto. ()
- d. All traffic regulations shall be observed, including authorized speed limits. A safe distance shall be maintained between vehicles, and vehicles shall be kept under control at all times. ()
- e. The right of way shall be yielded to ambulances, fire trucks, or other vehicles in emergency situations. ()
- f. Other vehicles traveling in the same direction at intersections, blind spots, or other dangerous locations shall not be passed. ()
- g. Fuel tanks shall not be filled while the engine is running. Spillage shall be avoided. ()
- h. Spillage of oil or fuel shall be carefully washed away or completely evaporated and the fuel tank cap replaced before restarting engine. ()
- i. No truck shall be operated with a leak in the fuel system until the leak has been corrected. ()
- j. Open flames shall not be used for checking electrolyte level in storage batteries or gasoline level in fuel tanks. ()
- k. Any vehicle not in a safe operating condition shall be removed from service. All repairs shall be made by authorized personnel. ()

- l. No repairs shall be made in Class I, II, and III locations. ()
- m. Repairs to the fuel and ignition systems of vehicles which involve fire hazards shall be conducted only in locations designated for such repairs. ()
- n. Vehicles in need of repairs to the electrical system shall have the battery disconnected prior to such repairs. ()
- o. All parts of any vehicle requiring replacement shall be replaced only by parts equivalent as to safety with those used in the original design. ()
- p. Vehicles 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 vehicles are used on a round-the-clock basis, they shall be examined after each shift. Defects when found shall be immediately reported and corrected. ()
- q. Water mufflers shall be filled daily or as frequently as is necessary to prevent depletion of the supply of water below seventy-five (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. A 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 of the emission of such sparks and flames has been eliminated. ()
- r. When the temperature of any part of any vehicle 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. ()
- s. Vehicles shall be kept in a clean condition, free of trash, excess oil and grease. Noncombustible agents should be used for cleaning vehicles. Low flash point (below one hundred (100) degrees Fahrenheit) solvents shall not be used. High flash point (at or above one hundred (100) degrees Fahrenheit) solvents may be used. Precautions regarding toxicity, ventilation, and fire hazard shall be consonant with the agent or solvent used. ()
- t. Where it is necessary to use antifreeze in the engine cooling system, only those products having glycol base shall be used. ()
- u. Only qualified drivers shall be permitted to operate motor vehicles/trucks, and shall possess a current Motor Vehicle Operator's license. ()
- v. Motor vehicles/trucks must be equipped with brakes which will safely hold the maximum load on maximum grades. ()
- w. Trailers equipped with air brakes, shall have the air hooked up to the trailer brake system at the time that the trailer is coupled to the tow vehicle. ()
- x. Brakes on trucks and trailers must be tested before equipment descends a steep grade. ()
- y. Vehicle drivers shall at all times operate equipment at a safe speed for roadway conditions. ()
- z. Safe methods of loading and unloading motor vehicle trucks and trailers shall be observed at all times. ()
- aa. To prevent accidents during the backing of vehicles where vision is obstructed, a backup alarm shall be in operation. In the event the backup alarm becomes non-operational then a spotter shall be stationed at a point giving a clear view of the rear of the truck and the operator of the vehicle at all times or the vehicle driver shall sound their horn before starting to back, and shall sound the horn intermittently during the entire backing operation. Backup alarms shall be maintained in an operational condition at all times. The employer shall not allow employees to disable backup alarms. EXCEPTION: Combat military vehicles may use a spotter instead of a backup alarm.

()

bb. Dump trucks shall have a device installed on the frame which will be of sufficient strength to hold the bed in the raised position when employees are working in an exposed position underneath. ()

cc. All parts and accessories of vehicles/trucks and trailers shall be kept in good repair and safe condition. Tires worn beyond the point of safety shall not be used. ()

dd. All motor vehicles/trucks and trailers shall be equipped with standard lights, horn, flags, etc. to conform to the State of Idaho Motor Vehicle Laws. ()

ee. All loads transported on vehicles/trucks and/or trucks and trailers shall be properly secured and distributed, and limited to a safe operating load for the condition of the roadway, and the capacity of the bridges, trestles, and other structures. ()

ff. Trucks parked on an incline shall have the steered wheels turned into the curb and shall have at least one (1) "Driver" wheel chocked on each side, independent of the braking system. ()

gg. Motor vehicles used regularly for transportation of persons shall be well equipped, covered against the weather, and maintained in good mechanical condition at all times. ()

hh. Seats, which shall be properly secured, shall be provided in each vehicle to accommodate the total number of persons normally transported. Where it becomes necessary under emergency conditions to transport more persons than the seating capacity of the vehicle will accommodate, all persons not having seats shall ride within the vehicle. Under no circumstances shall persons ride on fenders or running boards of a vehicle. No person shall ride in or on any vehicle with their legs hanging over the end or sides. A safety bar shall be placed across the rear opening of all trucks used to transport persons which are not equipped with tailgates. ()

ii. Vehicles shall be equipped with compartments or screen of such strength to retain sharp tools which could present a hazard to employees being transported. ()

jj. All dump-trucks used to transport workers shall be equipped with an adequate safety chain or locking device which will eliminate the possibility of the body of the truck being raised while workers are riding in the truck. ()

kk. Explosives or highly inflammable materials shall not be carried in or on any vehicle while it is used to transport persons. ()

ll. Exhaust systems shall be installed and maintained in proper condition, and shall be so designed as to eliminate the exposure of the persons to the exhaust gases and fumes. ()

mm. The number of persons allowed in the cab of a single bench seat truck shall not exceed two (2) in addition to the driver. Personnel transport trucks designed and constructed with additional seating capacity behind the normal driver's seat may carry additional passengers in the seating area behind the driver's seat. Personnel transport trucks with bucket-type seats shall carry only the number of passengers for which the bucket seats are provided. In any seating arrangement, the driver must be able to maintain full freedom of motion. Additionally, the number of passengers or seating arrangement shall not obstruct the driver's normal vision. When trucks are designed and constructed with larger than normal seating capacity in the front seat, the total number of passengers may be increased provided that the operator's vision and control functions are maintained. ()

nn. All enclosed personnel transport vehicles shall have an emergency exit in addition to the regular entrance. ()

oo. Trucks used for hauling gravel shall not be used as crew trucks unless they are equipped as follows: steps in proper place or places; wooden floors; seats that are securely fastened; truck is properly covered; and all other general regulations covering crew trucks are fully complied with. ()

- pp. Half-ton vehicles shall haul not more than six (6) persons including the driver. Three-quarter (3/4) ton vehicles shall haul not more than eight (8) persons including the driver. ()
- qq. All vehicles shall be equipped with first aid kits and fire extinguishers. ()
- rr. No heating units in which there are open flames shall be used in vehicles. ()
13. Cranes. ()
- a. 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 Subsection 280.16 of this section. New rated load shall be displayed in accordance with Subsection 280.13.b. of this section. ()
- b. The rated load of the crane shall be plainly marked on each side of the crane, and if the crane has more than one (1) 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. ()
- c. Minimum clearance of three (3) inches overhead and two (2) inches laterally shall be provided and maintained between crane and obstructions in conformity with Specification No. 61, Crane Manufacturers Association of America, Inc., Thomas Circle N. W., Washington, D. C. 20005. ()
- d. Where passageways or walkways are provided obstructions shall not be placed so that safety of personnel will be jeopardized by movements of the crane. An unobstructed aisle not less than three (3) feet wide shall be maintained for travel of the operator except in such cases where the control handles are hung from the trolleys of traveling cranes. ()
- e. If the runways of two (2) cranes are parallel and there are no intervening walls, of structure, there shall be adequate clearance provided and maintained between the two (2) bridges. ()
- f. Only designated personnel shall be permitted to operate a crane covered by this section. ()
- g. The handles of control ropes shall be distinctly different in contour so that, without looking, the operator will know which is the hoisting and which is the lowering handle. The direction of all movements of the crane shall be clearly indicated in some manner so that the operator can easily become familiar with them. ()
- h. 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. ()
- i. The cab shall be located to afford a minimum of three (3) inches clearance from all fixed structures within its area of possible movement. ()
- j. The clearance of the cab above the working floor or passageway shall be not less than seven (7) feet. ()
- k. Access to the cab and/or bridge walkway of a crane shall be by a conveniently placed fixed ladder, stairs, or platform, requiring no step over any gap exceeding twelve (12) inches. Fixed ladders shall be in conformance with the American National Standard Safety Code for Fixed Ladders, ANSI A14.3. The employer shall insure that hands are free from encumbrances while personnel are using ladders. Articles which are too large to be carried in pockets or belts shall be lifted and lowered by hand line. ()
- l. A carbon dioxide, dry-chemical, or equivalent hand fire extinguisher shall be kept in the crane cab. The employer shall insure that operators are familiar with the operation and care of fire extinguishers provided. ()

- m. The light in the crane cab shall be sufficient to enable the operator to see clearly enough to perform his work. ()
- n. 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 shall 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. ()
- o. Footwalks shall be located to give a headroom not less than seventy-eight (78) inches. In no case shall head room be less than forty-eight (48) inches. Footwalks shall be of rigid construction and designed to sustain a distributed load of at least fifty (50) pounds per square foot. Footwalks shall have an anti-slip walking surface. NOTE: Wood will meet this requirement. Footwalks shall be continuous and permanently secured. Footwalks shall have a clear passageway at least eighteen (18) inches wide except opposite the bridge motor, where they shall be not less than fifteen (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. ()
- p. Toeboards and handrails shall be in compliance with Subsection 070.16 of this standard. ()
- q. Where required cranes shall be provided with ladders or stairways extending from the ground to the footwalk or cab platform. Stairways shall be equipped with rigid and substantial metal handrails. Walking surfaces shall be of an anti-slip type. Ladders and stairways shall be permanently and securely fastened in place and shall be constructed in compliance with Sections 071 and 072 of this standard. ()
- r. Trolley stops shall be provided at the limits of travel of the trolley. Stops shall be fastened to resist forces applied when contacted. A stop engaging the tread of the wheel shall be of a height at least equal to the radius of the wheel. ()
- s. Traveling cranes shall be provided with bumpers or other automatic means providing equivalent effect, unless the crane travels at a slow rate of speed and has a faster deceleration rate due to the use of sleeve bearings, or is not operated near the ends of bridge and trolley travel, or is restricted to a limited distance by the nature of the crane operation and there is no hazard of striking any object in this limited distance or is used in similar operating conditions. The bumpers shall be capable of stopping the crane (not including the lifted load) at an average rate of deceleration not to exceed three (3) feet/second/second when traveling in either direction at twenty (20) percent of the rated load speed. The bumpers shall have sufficient energy absorbing capacity to stop the crane when traveling at a speed of at least forty (40) percent of rated load speed. The bumpers shall be so mounted that there is no direct shear on bolts. Bumpers shall be so designed and installed as to minimize parts falling from the crane in case of breakage. ()
- t. A trolley shall be provided with bumpers or other automatic means of equivalent effect, unless the trolley travels at a slow rate of speed, or is not operated near the ends of the bridge and trolley travel, or is restricted to a limited distance of the runway and there is no hazard of striking any object in this limited distance, or is used in similar operating conditions. The bumpers shall be capable of stopping the trolley (not including the lifted load) at an average rate of deceleration not to exceed four point seven (4.7) feet/second/second when traveling in either direction at one third (1/3) of the rated load speed. When more than one (1) trolley is operated on the same bridge, each shall be equipped with bumpers or equivalent on their adjacent ends. Bumpers or equivalent shall be designed and installed to minimize parts falling from the trolley in case of age. ()
- u. Bridge trucks shall be equipped with sweeps which extend below the top of the rail and project in front of the truck wheels. ()
- v. If hoisting ropes that run near enough to other parts to make fouling or chafing possible, shall have guards installed to prevent this condition. A guard shall be provided to prevent contact between bridge conductors and hoisting ropes. ()
- w. Exposed moving parts such as gears, set screws, projecting keys, chains, chain sprockets, and reciprocating components which might constitute a hazard under normal conditions shall be guarded. Guards shall be

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

x. Each independent hoisting unit of a crane shall be equipped with at least one (1) self-setting brake, hereafter referred to as a holding brake, applied directly to motor shaft or some part of the gear train. 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: one hundred twenty-five (125) percent when used with a control braking means other than mechanical; one hundred (100) percent when used in conjunction with a mechanical control braking means; or one hundred (100) percent each if two (2) holding brakes are provided; Holding brakes on hoists shall have ample thermal capacity for the frequency of operation required by the service. Holding brakes on hoists shall be applied automatically when power is removed. Where necessary, holding brakes shall be provided with adjustment means to compensate for wear. The wearing surface of all holding-brake drums or discs shall be smooth. Each independent hoisting unit of a crane handling hot metal and having power control braking means shall be equipped with at least two (2) holding brakes. ()

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

z. Foot operated brakes for trolleys and bridges shall not require an applied force of more than seventy (70) pounds to develop manufacturer's rated brake torque. Brakes may be applied by mechanical, electrical, pneumatic, hydraulic, or gravity means. Where necessary, brakes shall be provided with adjustment means to compensate for wear. The wearing surface of all brake drums or discs shall be smooth. All foot-brake pedals shall be constructed so that the operator's foot will not easily slip off the pedal. Foot-operated brakes shall be equipped with automatic means for positive release when pressure is released from the pedal. 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 ten (10) percent of full load speed in feet per minute when traveling at full speed with full load. 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. 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. ()

aa. On cab-operated cranes with cab on trolley, a trolley brake shall be required as specified under Subsection 280.13.z. of this section. 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. ()

bb. On cab-operated cranes with cab on bridge, a bridge brake is required as specified under Subsection 280.13.z. of this section. On cab-operated cranes with cab on trolley, a bridge brake of the holding type shall be required. On all floor, remote, and pulpit-operated crane bridge drives, a brake or noncoasting mechanical drive shall be provided. ()

cc. Wiring and equipment shall comply with Section 150 of this standard and the National Electrical Code. The control circuit voltage shall not exceed six hundred (600) volts for a.c. or d.c. current. The voltage at pendant push buttons shall not exceed one hundred fifty (150) volts for a.c. and three hundred (300) volts for d.c. Where multiple conductor cable is used with a suspended push button station, the station shall be supported in a manner that will protect the electrical conductors against strain. Pendant control boxes shall be constructed to prevent electrical shock and shall be clearly marked for identification of functions. ()

dd. Electrical equipment shall be so located or enclosed that live parts will not be exposed to accidental contact under normal operating conditions. Electric equipment shall be protected from dirt, grease, oil, and moisture. 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. ()

ee. Cranes not equipped with spring-return controllers or momentary contact push buttons 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. ()

ff. 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. ()

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

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

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

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

kk. Push buttons in pendant stations shall return to the OFF position when pressure is released by the crane operator. ()

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

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

nn. Enclosures for resistors shall have openings to provide adequate ventilation, and shall be installed to prevent the accumulation of combustible matter near hot parts. Resistor units shall be supported so as to be free as possible from vibration. Provision shall be made to prevent broken resistor parts or molten metal falling upon the operator or from the crane. ()

oo. 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. 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. 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 (1) of the following types of floor operated disconnects shall be provided: nonconductive rope attached to the main disconnect switch; an under-voltage trip for the main circuit breaker operated by an emergency stop button in the pendant push button station; or a main line contactor operated by a switch or push button on the pendant push button station. ()

pp. The hoisting motion of all electric traveling cranes shall be provided with an over-travel limit switch in the hoisting direction. ()

qq. 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 discharging the inductive load of the magnet shall be provided. ()

rr. 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. ()

ss. If a service receptacle is provided in the cab or on the bridge of cab-operated cranes, it shall be a grounded three (3) prong type permanent receptacle, not exceeding three hundred (300) volts. ()

tt. When repairing runways, repairmen shall place rail stops and warning signs or signals so as to protect both ends of the section to be repaired. Repairmen shall take care to prevent loose parts from falling or being thrown upon the floor beneath. ()

14. Rigging. ()

a. Whenever used in connection with work, employment, occupations or uses to which these standards are applicable, wire rope shall not be subjected to loads in excess of one fifth (1/5) the breaking load as given in the schedule of the cable manufacturer. Except as required in Standard for Material Hoists. ()

b. When cables deteriorate through rust, wear, broken wires, undue strain or other conditions to the extent of fifteen (15) percent of their original strength, use of cables shall be discontinued. ()

c. The strap or steel ribbon type of cable shall not be used in the suspension of scaffolding. ()

d. There shall be not less than monthly inspection of all wire rope in use, and all wire rope must be inspected before put into use. ()

e. The following methods of fastening and attaching wire rope shall be adhered to. The end of wire rope to be set into socket fittings held securely with molten babbitt or zinc (not lead). The wires of the cable shall be frayed out and each wire bent toward the outside of socket, so that the end of each wire projects well into the depth of the socket. This method of fastening cables should be left in the hands of an experienced workman in this kind of work. Thimbles spliced into rope and the splice securely wrapped. Thimbles inserted and held in place by at least a three (3) bolt clamp or three (3) U-bolt clips. Clamps shall be of standard size for the sizes of the cable in use. For temporary work, by passing rope at least twice around large objects such as a post, avoiding sharp points and carrying the end back several feet and securing it by clamps, clips or lashing to the cable. ()

f. Whenever hemp rope is used, it shall be first grade long fiber Manila hemp rope. Rope shall not be used to support loads in excess of the rating for hemp and Manila rope. Supporting ropes shall be double lashed at each point of suspension. Where supporting ropes are brought over sharp corners of steel, stone, or other material liable to cut the rope, or are in any other way subject to abrasion, they shall be protected at such points by the use of bagging, wooden blocks, or other protective padding. Rope knots shall have their loose and free ends lashed to the standing part in order to prevent their becoming untied. All ropes shall be inspected before use. Rope badly frayed, rotted, exposed to the action of acid or caustic, or otherwise defective and unsafe, shall be condemned and destroyed to avoid all possibility of future use by mistake. ()

g. 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; reduction of rope diameter below nominal diameter due to loss of core support, internal or external corrosion, or wear of outside wires; a number of broken outside wires and the degree of distribution or concentration of such broken wires; worn outside wires, corroded or broken wires at end connections; corroded, cracked, bent, worn, or improperly applied end connections; and severe kinking, crushing, cutting, or unstranding. 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. Particular care shall be taken in the inspection of non rotating rope. ()

h. 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. ()

i. All rope slings shall be inspected thoroughly and regularly at intervals of not more than one (1) month, and when not in use, shall be stored in a dry place. Rope slings shall be protected with pads or blocks when wrapped around sharp edges of structural shapes casting, etc. Slings shall not be used in single strand slip-noose form. Hemp rope shall not be used as slings for handling objects contaminated with acid. Hand ropes (guide ropes) shall not be attached to slings but to hoisting tackle, or (only when necessary) attached to the object handled. All

slings shall be of sufficient strength for handling the imposed loads. Double slings shall be used on all horizontal loads over twelve (12) feet in length, and the distance between the points where slings are attached shall be sufficient to prevent the load from tipping up endwise. Spreaders shall be used where there is a danger of sling ends or hitches slipping together. Defective and unsafe slings shall be destroyed in order to avoid the possibility of their being used by mistake. ()

j. Guy wires and ropes shall be of sufficient strength to carry the load imposed upon them and shall be securely fastened in place. ()

k. Wherever rope is permanently fastened by a single wrap to a metal object less in diameter or shortest measurement than three (3) times the diameter of the rope, a galvanized thimble (of size intended for the rope) shall be inserted between the object and the loop of the rope. ()

l. Blocks and falls shall be carefully inspected before being used. Blocks shall be of substantial construction and maintained in good condition while in use. Blocks shall fit the sizes of ropes they carry and shall not chafe or abrade the ropes running through them. ()

m. If at any time, any three (3) foot length of chain is found to have stretched one third (1/3) the length of a link, it shall be discarded. The practice of placing bolts or nails between two (2) links to shorten chains is prohibited. Splicing broken chains by inserting a bolt between two (2) links with the heads of the bolt and the nut sustaining the load, or passing one (1) link through another and inserting a bolt or nail to hold it, is prohibited. Wherever annealing of chains is attempted, it shall be done in properly equipped annealing furnaces and under the direct supervision of a competent person thoroughly versed in heat treating. ()

n. Cables shall be periodically inspected. A copy of the report of the inspections of each running cable shall be filed in a place readily accessible to the Department, or authorized representative. ()

o. Whenever any sling is used, the following practices shall be observed: slings that are damaged or defective shall not be used; slings shall not be shortened with knots or bolts or other makeshift devices; sling legs shall not be kinked; slings shall not be loaded in excess of their rated capacities; slings used in a basket hitch shall have the loads balanced to prevent slippage; slings shall be securely attached to their loads; slings shall be padded or protected from the sharp edges of their loads; and suspended loads shall be kept clear of all obstructions. All employees shall be kept clear of loads about to be lifted and of suspended loads. Hands or fingers shall not be placed between the sling and its load while the sling is being tightened around the load. Shock loading is prohibited. A sling shall not be pulled from under a load when the load is resting on the sling. ()

p. Each day before being used, the sling and all fastenings and attachments shall be inspected for damage or defects by a competent person designated by the employer. Additional inspections shall be performed during sling use, where service conditions warrant. Damaged or defective slings shall be immediately removed from service. ()

q. Alloy steel chain slings shall have permanently affixed durable identification stating size, grade, rated capacity and reach. Hooks, rings, oblong links, pear-shaped links, welded or mechanical coupling links or other attachments shall have a rated capacity at least equal to that of the alloy steel chain with which they are used or the sling shall not be used in excess of the rated capacity of the weakest component. Makeshift links or fasteners formed from bolts or rods, or other such attachments, shall not be used. A thorough periodic inspection of alloy steel chain slings in use shall be made on a regular basis, to be determined on the basis of: frequency of sling use; severity of service conditions; nature of lifts being made; and experience gained on the service life of slings used in similar circumstances. Such inspections shall in no event be at intervals greater than once every twelve (12) months. The employer shall make and maintain a record of the most recent month in which each alloy steel chain sling was thoroughly inspected, and shall make such record available for examination by the Department. The thorough inspection of alloy steel chain slings shall be performed by a competent person designated by the employer, and shall include a thorough inspection for wear, defective welds, deformation and increase in length. Where such defects or deterioration are present, the sling shall be immediately removed from service. The employer shall ensure that before use, each new, repaired, or reconditioned alloy steel chain sling, including all welded components in the sling assembly, shall be proof tested by the sling manufacturer or equivalent entity, in accordance with Paragraph 5.2 of the American Society of Testing and Materials Specification A391-65 (ANSI G61.1). The employer shall retain a

certificate of proof test and shall make it available for examination by the Department. Alloy steel chain slings shall not be used with loads in excess of the rated capacities prescribed in Table 280.14-A. Slings not included in this table shall be used only in accordance with the manufacturer's recommendations. Alloy steel chain slings shall be permanently removed from service if they are heated above one thousand (1000) degrees Fahrenheit. When exposed to service temperatures in excess of six hundred (600) degrees Fahrenheit maximum working load limits permitted in Table 280.14-A shall be reduced in accordance with the chain or sling manufacturer's recommendations. Worn or damaged alloy steel chain slings or attachments shall not be used until repaired. When welding or heat testing is performed, slings shall not be used unless repaired, reconditioned, and proof tested by the sling manufacturer or an equivalent entity. Mechanical coupling links or low carbon steel repair links shall not be used to repair broken lengths of chain. If the chain size at any point of any links is less than that stated in Table 280.14-B, the sling shall be removed from service. Alloy steel chain sling with cracked or deformed master links, coupling links or other components shall be removed from service. Slings shall be removed from service if hooks are cracked, have been opened more than fifteen (15) percent of the normal throat opening measured at the narrowest point or twisted more than ten (10) degrees from the plane of the unbent hook. ()

TABLE 280.14-A				
RATED CAPACITY (WORKING LOAD LIMIT), FOR ALLOY STEEL CHAIN SLINGS* RATED CAPACITY (WORKING LOAD LIMIT), POUNDS				
Part 1--Double Slings				
Chain Size Inches	Single Branch Sling - 90 Degree Loading	30 Degree 60 Degree	Double Sling Vertical Angle¹ 45 Degree Horizontal Angle² 45 Degree	60 Degree 30 Degree
1/4	3,250	5,650	4,555	3,250
3/8	6,600	11,400	9,300	6,600
1/2	11,250	19,500	15,900	11,250
5/8	16,500	28,500	23,300	16,500
3/4	23,000	39,800	32,500	23,000
7/8	28,750	49,800	40,600	28,450
1	38,750	67,100	54,800	38,750
1 1/8	44,500	77,000	63,000	44,500
1 1/4	57,500	99,500	81,000	57,500
1 3/8	67,000	116,000	94,000	67,000
1 1/2	80,000	138,000	112,500	80,000
1 3/4	100,000	172,000	140,000	100,000

TABLE 280.14-A - Part 2--Triple and Quadruple Slings				
Chain Size Inches	Single Branch Sling - 90 Degree Loading	30 Degree 60 Degree	Triple and Quadruple Sling³ Vertical Angle¹ 45 Degree Horizontal Angle² 45 Degree	60 Degree 30 Degree
1/4	3,250	8,400	6,800	4,900
3/8	6,600	17,000	14,000	9,900
1/2	11,250	29,000	24,000	17,000
5/8	16,500	43,000	35,000	24,500
3/4	23,000	59,500	48,500	34,500
7/8	28,750	74,500	61,000	43,000
1	38,750	101,000	82,000	58,000
1 1/8	44,500	115,500	94,500	66,500
1 1/4	57,500	149,000	121,500	86,000
1 3/8	67,000	174,000	141,000	100,500
1 1/2	80,000	207,000	169,000	119,500
1 3/4	100,000	258,000	210,000	150,000
¹ Rating of multileg slings adjusted for angle of loading measured as the included angle between the inclined leg and the vertical as shown in Figure 329.10-C				
² Rating of multileg slings adjusted for angle of loading between the inclined leg and the horizontal plane of the load as shown in Figure 329.10-C				
³ Quadruple sling rating is the same as triple sling because normal lifting practice may not distribute load uniformly to all 4 legs.				

TABLE 280.14-B	
MINIMUM ALLOWABLE CHAIN SIZE AT ANY POINT OF LINK	
Chain Size, Inches	Minimum Allowable Chain Size, Inches
1/4	13/64
3/8	19/64
1/2	25/64
5/8	31/64
3/4	19/32

TABLE 280.14-B	
MINIMUM ALLOWABLE CHAIN SIZE AT ANY POINT OF LINK	
Chain Size, Inches	Minimum Allowable Chain Size, Inches
7/8	45/64
1	13/16
1 1/8	29/32
1 1/4	1
1 3/8	1 3/32
1 1/2	1 3/16
1 3/4	1 13/32

r. Wire rope slings shall not be used with loads in excess of the rated capacities shown in Table 280.14-C through Table 280.14-N. Slings not included in these tables shall be used only in accordance with the manufacturer's recommendations. Cable laid and six (6) x nineteen (19) and six (6) x thirty-seven (37) slings shall have a minimum clear length of wire rope ten (10) times the component rope diameter between splices sleeves, or end fittings. Braided slings shall have a minimum clear length of wire rope forty (40) times the component rope diameter between the loops or end fittings. Cable laid grommets, strand laid grommets and endless slings shall have a minimum circumferential length of ninety-six (96) times their body diameter. Fiber core wire rope slings of all grades shall be permanently removed from service if they are exposed to temperatures in excess of two hundred (200) degrees Fahrenheit. When nonfiber core wire rope slings of any grade are used at temperatures above four hundred (400) degrees Fahrenheit or below minus sixty (-60) degrees Fahrenheit or recommendations of the sling manufacturer regarding use at that temperature shall be followed. Welding of end attachments, except covers to thimbles, shall be performed prior to the assembly of the sling. All welded end attachments shall not be used unless proof tested by the manufacturer or equivalent entity at twice their rated capacity prior to initial use. The employer shall retain a certificate of the proof test, and make it available for examination by the Department. Wire rope slings shall be immediately removed from service if any of the following conditions are present: ten (10) randomly distributed broken wires in one (1) rope lay, or five (5) broken wires in one (1) strand in one (1) rope lay; wear or scraping of one third (1/3) the original diameter of outside individual wires; kinking, crushing, bird caging or any other damage resulting in distortion of the wire rope structure; evidence of heat damage; end attachments that are cracked, deformed or worn; hooks that have been opened more than fifteen (15) percent of the normal throat opening measured at the narrowest point or twisted more than ten (10) degrees from the plane of the unbent hook; or corrosion of the rope or end attachments. ()

TABLE 280.14-C										
RATED CAPACITIES FOR SINGLE LEG SLINGS 6 X 19 AND 6 X 37 CLASSIFICATION IMPROVED PLOW STEEL GRADE ROPE WITH FIBER CORE (FC)										
Rope Dia. Const (inches)		Rated Capacities, Tons (2,000 lbs)								
		Vertical			Choker			Vertical Basket*		
		HT	MS	S	HT	MS	S	HT	MS	S
1/4	6 x 19	0.49	0.51	0.55	0.37	0.38	0.41	0.99	1.0	1.1
5/16	6 x 19	0.76	0.79	0.85	3.57	0.59	0.64	1.5	1.6	1.7
3/8	6 x 19	1.1	1.1	1.2	0.80	0.85	0.91	2.1	2.2	2.4
7/16	6 x 19	1.4	1.5	1.6	1.1	1.1	1.2	2.9	3.0	3.3
1/2	6 x 19	1.8	2.0	2.1	1.4	1.5	1.6	3.7	3.9	4.3
9/16	6 x 19	2.3	2.5	2.7	1.7	1.9	2.0	4.6	5.0	5.4
5/8	6 x 19	2.8	3.1	3.3	2.1	2.3	2.5	5.6	6.2	6.7
3/4	6 x 19	3.9	4.4	4.8	2.9	3.3	3.6	7.8	8.8	9.5
7/8	6 x 19	5.1	5.9	6.4	3.9	4.5	4.8	10.0	12.0	13.0
1	6 x 19	6.7	7.7	8.4	5.0	5.8	6.3	13.0	15.0	17.0
1 1/8	6 x 19	8.4	9.5	10.0	6.3	7.1	7.9	17.0	19.0	21.0
1 1/4	6 x 37	9.8	11.0	12.0	7.4	8.3	9.2	20.0	22.0	25.0
1 3/8	6 x 37	12.0	13.0	15.0	8.9	10.0	11.0	24.0	27.0	30.0
1 1/2	6 x 37	14.0	16.0	17.0	10.0	12.0	13.0	28.0	32.0	35.0
1 5/8	6 x 37	16.0	18.0	21.0	12.0	14.0	15.0	33.0	37.0	41.0
1 3/4	6 x 37	19.0	21.0	24.0	14.0	16.0	18.0	38.0	43.0	48.0
2	6 x 37	25.0	28.0	31.0	18.0	21.0	23.0	49.0	55.0	62.0

TABLE 280.14-D										
RATED CAPACITIES FOR SINGLE LEG SLINGS 6 X 19 AND 6 X 37 CLASSIFICATION IMPROVED PLOW STEEL GRADE ROPE WITH INDEPENDENT WIRE ROPE CORE (IWRC)										
Rope Dia. Const (inches)		Rated Capacities, Tons (2,000 lbs)								
		Vertical			Choker			Vertical Basket*		
		HT	MS	S	HT	MS	S	HT	MS	S
1/4	6 x 19	0.53	0.56	0.59	0.40	0.42	0.44	1.0	1.1	1.2
5/16	6 x 19	0.81	0.87	0.92	0.61	0.62	0.69	1.6	1.7	1.8
3/8	6 x 19	1.1	1.2	1.3	0.86	0.93	0.98	2.3	2.5	2.6
7/16	6 x 19	1.5	1.7	1.8	1.2	1.3	1.3	3.1	3.4	3.5
1/2	6 x 19	2.0	2.2	2.3	1.5	1.6	1.7	3.9	4.4	4.6
9/16	6 x 19	2.5	2.7	2.9	1.8	2.1	2.2	4.9	5.5	5.8
5/8	6 x 19	3.0	3.4	3.6	2.2	2.5	2.7	6.0	6.8	7.2
3/4	6 x 19	4.2	4.9	5.1	3.1	3.6	3.8	8.4	9.7	10.0
7/8	6 x 19	5.5	6.6	6.9	4.1	4.9	5.2	11.0	13.0	14.0
1	6 x 19	7.2	8.5	9.0	5.4	6.4	6.7	14.0	17.0	18.0
1 1/8	6 x 19	9.0	10.0	11.0	6.8	7.8	8.5	18.0	21.0	23.0
1 1/4	6x37	10.0	12.0	13.0	7.9	9.2	9.9	21.0	24.0	26.0
1 3/8	6 x 37	13.0	15.0	16.0	9.6	11.0	12.0	25.0	29.0	32.0
1 1/2	6 x 37	15.0	17.0	19.0	11.0	13.0	14.0	30.0	35.0	38.0
1 5/8	6 x 37	18.0	20.0	22.0	13.0	15.0	17.0	35.0	41.0	44.0
1 3/4	6 x 37	20.0	24.0	26.0	15.0	18.0	19.0	41.0	47.0	51.0
2	6 x 37	26.0	30.0	33.0	20.0	23.0	25.0	53.0	61.0	66.0

HT = Hand Tucked Splice and Hidden Tuck Splice, for hidden tuck splice (IWRC) use value in HT columns.
MS = Mechanical Splice.
S = Swagged or Zinc Poured Socket. *These values only apply when the D/d ratio for HT slings is ten (10) or greater and for MS and S slings is twenty (20) or greater where:
D = Diameter of curvature around which the body of the sling is bent.
d = Diameter of rope.

TABLE 280.14-E				
RATED CAPACITIES FOR SINGLE LEG SLINGS CABLE LAID ROPE - MECHANICAL SPLICE ONLY 7 X 7 X 7 & 7 X 7 X 19 CONSTRUCTIONS GALVANIZED AIRCRAFT GRADE ROPE 7 X 6 X 19 IWRC CONSTRUCTION IMPROVED PLOW STEEL GRADE ROPE				
Rope		Rated Capacities, Tons (2,000 lb)		
Dia. (Inches)	Construction	Vertical	Choker	Vertical Basket ¹
1/4	7 x 7 x 7	0.50	0.38	1.0
3/8	7 x 7 x 7	1.1	0.81	2.0
1/2	7 x 7 x 7	1.8	1.4	3.7
5/8	7 x 7 x 7	2.8	2.1	5.5
3/4	7 x 7 x 7	3.8	2.9	7.6
5/8	7 x 7 x 19	2.9	2.2	5.8
3/4	7 x 7 x 19	4.1	3.0	8.1
7/8	7 x 7 x 19	5.4	4.0	11.0
1	7 x 7 x 19	6.9	5.1	14.0
1 1/8	7 x 7 x 19	8.2	6.2	16.0
1 1/4	7 x 7 x 19	9.9	7.4	20.0
3/4	7 x 7 x 19 IWRC	3.8	2.8	7.6
7/8	7 x 7 x 19 IWRC	5.0	3.8	10.0
1	7 x 7 x 19 IWRC	6.4	4.8	13.0
1 1/8	7 x 7 x 19 IWRC	7.7	5.8	15.0
1 1/4	7 x 7 x 19 IWRC	9.2	6.9	18.0
1 5/16	7 x 7 x 19 IWRC	10.0	7.5	20.0
1 3/8	7 x 7 x 19 IWRC	11.0	8.2	22.0
1 1/2	7 x 7 x 19 IWRC	13.0	9.6	26.0

¹These values only apply when the D/d ratio is 10 or greater where:
 D = Diameter of curvature around which the body of the sling is bent.
 d = Diameter of rope.

TABLE 280.14-F							
RATED CAPACITIES FOR SINGLE LEG SLINGS 8-PART AND 6-PART BRAIDED ROPE 6 X 7 AND 6 X 19 CONSTRUCTION IMPROVED FLOW STEEL GRADE ROPE 7 X 7 CONSTRUCTION GALVANIZED AIRCRAFT GRADE ROPE							
Component Ropes		Rated Capacities, Tons (2,000 lb)					
Diameter (inches)	Construction	Vertical		Choker		Basket Vertical to 30°	
		8-Part	6-Part	8-Part	6-Part	8-Part	6-Part
3/32	6 x 7	0.42	0.32	0.32	0.24	0.74	0.55
1/8	6 x 7	0.76	0.57	0.57	0.42	1.3	0.98
3/16	6 x 7	1.7	1.3	1.3	0.94	2.9	2.2
3/32	7 x 7	0.51	0.39	0.38	0.29	0.89	0.67
1/8	7 x 7	0.95	0.71	0.71	0.53	1.6	1.2
3/16	7 x 7	2.1	1.5	1.5	1.2	3.6	2.7
3/16	6 x 19	1.7	1.3	1.3	0.98	3.0	2.2
1/4	6 x 19	3.1	2.3	2.3	1.7	5.3	4.0
5/16	6 x 19	4.8	3.6	3.6	2.7	8.3	6.2
3/8	6 x 19	6.8	5.1	5.1	3.8	12.0	8.9
7/16	6 x 19	9.3	6.9	6.9	5.2	16.0	12.0
1/2	6 x 19	12.0	9.0	9.0	6.7	21.0	15.0
9/16	6 x 19	15.0	11.0	11.0	8.5	26.0	20.0
5/8	6 x 19	19.0	14.0	14.0	10.0	32.0	24.0
3/4	6 x 19	27.0	20.0	20.0	15.0	46.0	35.0
7/8	6 x 19	36.0	27.0	27.0	20.0	62.0	47.0
1	6 x 19	47.0	35.0	35.0	26.0	81.0	61.0

¹These values only apply when the D/d ratio is 20 or greater where:
D = Diameter of curvature around which the body of the sling is bent.
d = Diameter of component rope.

TABLE 280.14-G							
RATED CAPACITIES FOR 2-LEG & 3-LEG BRIDLE SLINGS 6 X 19 AND 6 X 37 CLASSIFICATION IMPROVED PLOW STEEL GRADE ROPE WITH FIBER CORE (FC)							
Part 1--2-Leg Bridle Slings							
Rope		Rated Capacities, Tons (2,000 lb)					
		2-Leg Bridle Slings					
Dia. (inches)	Constr.	Vert 30 degrees Horz 60 degrees		45 degree Angle		Vert 60 degrees Horz 30 degrees	
		HT	MS	HT	MS	HT	MS
1/4	6 X 19	0.85	0.88	0.70	0.72	0.49	0.51
5/16	6 X 19	1.3	1.4	1.1	1.1	0.76	0.79
3/8	6 X 19	1.8	1.9	1.5	1.6	1.1	1.1
7/16	6 X 19	2.5	2.6	2.0	2.2	1.4	1.5
1/2	6 X 19	3.2	3.4	2.6	2.8	1.8	2.0
9/16	6 X 19	4.0	4.3	3.2	3.5	2.3	2.5
5/8	6 X 19	4.8	5.3	4.0	4.4	2.8	3.1
3/4	6 X 19	6.8	7.6	5.5	6.2	3.9	4.4
7/8	6 X 19	8.9	10.0	7.3	8.4	5.1	5.9
1	6 X 19	11.0	13.0	9.4	11.0	6.7	7.7
1 1/8	6 X 19	14.0	16.0	12.0	13.0	8.4	9.5
1 1/4	6 X 37	17.0	19.0	14.0	16.0	9.8	11.0
1 3/8	6 X 37	20.0	23.0	17.0	19.0	12.0	13.0
1 1/2	6 X 37	24.0	27.0	20.0	22.0	14.0	16.0
1 5/8	6 X 37	28.0	32.0	23.0	26.0	16.0	18.0
1 3/4	6 X 37	33.0	37.0	27.0	30.0	19.0	21.0
2	6 X 37	43.0	48.0	35.0	39.0	25.0	28.0

TABLE 280.14-G							
Part 2--3-Leg Bridle Sling							
Rope		Rated Capacities, Tons (2,000 lb)					
		3-Leg Bridle Slings					
Dia. (inches)	Constr.	Vert 30 degrees Horz 60 degrees		45 degree Angle		Vert 60 degrees Horz 30 degrees	
		HT	MS	HT	MS	HT	MS
1/4	6 X 19	1.3	1.3	1.0	1.1	0.74	0.76
5/16	6 X 19	2.0	2.0	1.6	1.7	1.1	1.2
3/8	6 X 19	2.8	2.9	2.3	2.4	1.6	1.7
7/16	6 X 19	3.7	4.0	3.0	3.2	2.1	2.3
1/2	6 X 19	4.8	5.1	3.9	4.2	2.8	3.0
9/16	6 X 19	6.0	6.5	4.9	5.3	3.4	3.7
5/8	6 X 19	7.3	8.0	5.9	6.5	4.2	4.6
3/4	6 X 19	10.0	11.0	8.3	9.3	5.8	6.6
7/8	6 X 19	13.0	15.0	11.0	13.0	7.7	8.9
1	6 X 19	17.0	20.0	14.0	16.0	10.0	11.0
1 1/8	6 X 19	22.0	24.0	18.0	20.0	13.0	14.0
1 1/4	6 X 37	25.0	29.0	21.0	23.0	15.0	17.0
1 3/8	6 X 37	31.0	35.0	25.0	28.0	18.0	20.0
1 1/2	6 X 37	36.0	41.0	30.0	33.0	21.0	24.0
1 5/8	6 X 37	43.0	48.0	35.0	39.0	25.0	28.0
1 3/4	6 X 37	49.0	56.0	40.0	45.0	28.0	32.0
2	6 X 37	64.0	72.0	52.0	59.0	37.0	41.0

TABLE 280.14-H							
RATED CAPACITIES FOR 2-LEG & 3-LEG BRIDLE SLINGS 6 X 19 AND 6 X 37 CLASSIFICATION IMPROVED PLOW STEEL GRADE ROPE WITH INDEPENDENT WIRE ROPE CORE (IWRC)							
Part 1--2-Leg Bridle Slings							
Rope		Rated Capacities, Tons (2,000 lb)					
		2-Leg Bridle Slings					
Dia. (inches)	Constr.	Vert 30 degrees Horz 60 degrees		45 degree Angle		Vert 60 degrees Horz 30 degrees	
		HT	MS	HT	MS	HT	MS
1/4	6 X 19	0.92	0.97	0.75	0.79	0.53	0.56
5/16	6 X 19	1.4	1.5	1.1	1.2	0.81	0.87
3/8	6 X 19	2.0	2.1	1.6	1.8	1.1	1.2
7/16	6 X 19	2.7	2.9	2.2	2.4	1.5	1.7
1/2	6 X 19	3.4	3.8	2.8	3.1	2.0	2.2
9/16	6 X 19	4.3	4.8	3.5	3.9	2.5	2.7
5/8	6 X 19	5.2	5.9	4.2	4.8	3.0	3.4
3/4	6 X 19	7.3	8.4	5.9	6.9	4.2	4.9
7/8	6 X 19	9.6	11.0	7.8	9.3	5.5	6.6
1	6 X 19	12.0	15.0	10.0	12.0	7.2	8.5
1 1/8	6 X 19	16.0	18.0	13.0	15.0	9.0	10.0
1 1/4	6 X 37	18.0	21.0	15.0	17.0	10.0	12.0
1 3/8	6 X 37	22.0	25.0	18.0	21.0	13.0	15.0
1 1/2	6 X 37	26.0	30.0	21.0	25.0	15.0	17.0
1 5/8	6 X 37	31.0	35.0	25.0	29.0	18.0	20.0
1 3/4	6 X 37	35.0	41.0	29.0	33.0	20.0	24.0
2	6 X 37	46.0	53.0	37.0	43.0	26.0	30.0

TABLE 280.14-H							
Part 2--3-Leg Bridle Slings							
Rope		Rated Capacities, Tons (2,000 lb)					
		3-Leg Bridle Slings					
Dia. (inches)	Constr.	Vert 30 degrees Horz 60 degrees		45 degree Angle		Vert 60 degrees Horz 30 degrees	
		HT	MS	HT	MS	HT	MS
1/4	6 X 19	1.4	1.4	1.1	1.2	0.79	0.84
5/16	6 X 19	2.1	2.3	1.7	1.8	1.2	1.3
3/8	6 X 19	3.0	3.2	2.4	2.6	1.7	1.9
7/16	6 X 19	4.0	4.4	3.3	3.6	2.3	2.5
1/2	6 X 19	5.1	5.7	4.2	4.6	3.0	3.3
9/16	6 X 19	6.4	7.1	5.2	5.8	3.7	4.1
5/8	6 X 19	7.8	8.8	6.4	7.2	4.5	5.1
3/4	6 X 19	11.0	13.0	8.9	10.0	6.3	7.3
7/8	6 X 19	14.0	17.0	12.0	14.0	8.3	9.9
1	6 X 19	19.0	22.0	15.0	18.0	11.0	13.0
1 1/8	6 X 19	23.0	27.0	19.0	22.0	13.0	16.0
1 1/4	6 X 37	27.0	32.0	22.0	26.0	16.0	18.0
1 3/8	6 X 37	33.0	38.0	27.0	31.0	19.0	22.0
1 1/2	6 X 37	39.0	45.0	32.0	37.0	23.0	26.0
1 5/8	6 X 37	46.0	53.0	38.0	43.0	27.0	31.0
1 3/4	6 X 37	53.0	61.0	43.0	50.0	31.0	35.0
2	6 X 37	68.0	79.0	56.0	65.0	40.0	46.0

TABLE 280.14-I				
RATED CAPACITIES FOR 2-LEG & 3-LEG BRIDLE SLINGS CABLE LAID ROPE -MECHANICAL SPLICE ONLY 7 X 7 X 7 AND 7 X 7 X 19 CONSTRUCTIONS GALVANIZED AIRCRAFT GRADE ROPE 7 X 6 X 19 IWRC CONSTRUCTION IMPROVED PLOW STEEL GRADE ROPE				
Part 1--2-Leg Bridle Slings				
Rope		Rated Capacities, Tons (2,000 lb)		
		2-Leg Bridle Slings		
Dia. (inches)	Constr.	Vert 30 degrees Horz 60 degrees	45 degree Angle	Vert 60 degrees Horz 30 degrees
1/4	7 x 7	0.87	0.71	0.50
3/8	7 x 7	1.9	1.5	1.1
1/2	7 x 7	3.2	2.6	1.8
5/8	7 x 7	4.8	3.9	2.8
3/4	7 x 7	6.6	5.4	3.8
5/8	7 x 7 x 19	5.0	4.1	2.9
3/4	7 x 7 x 19	7.0	5.7	4.1
7/8	7 x 7 x 19	9.3	7.6	5.4
1	7 x 7 x 19	12.0	9.7	6.9
1 1/8	7 x 7 x 19	14.0	12.0	8.2
1 1/4	7 x 7 x 19	17.0	14.0	9.9
3/4	7 x 7 x 19 IWRC	6.6	5.4	3.8
7/8	7 x 7 x 19 IWRC	8.7	7.1	5.0
1	7 x 7 x 19 IWRC	11.0	9.0	6.4
1 1/8	7 x 7 x 19 IWRC	13.0	11.0	7.7
1 1/4	7 x 7 x 19 IWRC	16.0	13.0	9.2
1 5/16	7 x 7 x 19 IWRC	17.0	14.0	10.0
1 3/8	7 x 7 x 19 IWRC	19.0	15.0	11.0
1 1/2	7 x 7 x 19 IWRC	22.0	18.0	13.0

TABLE 280.14-I				
Part 2--3-Leg Bridle Slings				
Rope		Rated Capacities, Tons (2,000 lb)		
		3-Leg Bridle Slings		
Dia. (inches)	Constr.	Vert 30 degrees Horz 60 degrees	45 degree Angle	Vert 60 degrees Horz 30 degrees
1/4	7 x 7	1.3	1.1	0.75
3/8	7 x 7	2.8	2.3	1.6
1/2	7 x 7	4.8	3.9	2.8
5/8	7 x 7	7.2	5.9	4.2
3/4	7 x 7	9.9	8.1	5.7
5/8	7 x 7 x 19	7.5	6.1	4.3
3/4	7 x 7 x 19	10.0	8.6	6.1
7/8	7 x 7 x 19	14.0	11.0	8.1
1	7 x 7 x 19	18.0	14.0	10.0
1 1/8	7 x 7 x 19	21.0	17.0	12.0
1 1/4	7 x 7 x 19	26.0	21.0	15.0
3/4	7 x 7 x 19 IWRC	9.9	8.0	5.7
7/8	7 x 7 x 19 IWRC	13.0	11.0	7.5
1	7 x 7 x 19 IWRC	17.0	13.0	9.6
1 1/8	7 x 7 x 19 IWRC	20.0	16.0	11.0
1 1/4	7 x 7 x 19 IWRC	24.0	20.0	14.0
1 5/16	7 x 7 x 19 IWRC	26.0	21.0	15.0
1 3/8	7 x 7 x 19 IWRC	28.0	23.0	16.0
1 1/2	7 x 7 x 19 IWRC	33.0	27.0	19.0

TABLE 280.14-J							
RATED CAPACITIES FOR 2-LEG AND 3-LEG BRIDLE SLINGS 8-PART AND 6-PART BRAIDED ROPE 6 X 7 AND 6 X 19 CONSTRUCTION IMPROVED PLOW STEEL GRADE ROPE 7 X 7 CONSTRUCTION GALVANIZED AIRCRAFT GRADE ROPE							
Part 1--2-Leg Bridle Slings							
Component		Rated Capacities, Tons (2,000 lb)					
Rope		2-Leg Bridle Slings					
Dia. (Inches)	Constr.	Vert 30 degree Horz 60 degree		45 degree Angle		Vert 60 degree Horz 30 degree	
		8-Part	6-Part	8-Part	6-Part	8-Part	6-Part
3/32	6 x 7	0.74	0.55	0.60	0.45	0.42	0.32
1/8	6 x 7	1.3	0.98	1.1	0.80	0.76	0.57
3/16	6 x 7	2.9	2.2	2.4	1.8	1.7	1.3
3/32	7 x 7	0.89	0.67	0.72	0.55	0.51	0.39
1/8	7 x 7	1.6	1.2	1.3	1.0	0.95	0.71
3/16	7 x 7	3.6	2.7	2.9	2.2	2.1	1.5
3/16	6 x 19	3.0	2.2	2.4	1.8	1.7	1.3
1/4	6 x 19	5.3	4.0	4.3	3.2	3.1	2.3
5/16	6 x 19	8.3	6.2	6.7	5.0	4.8	3.6
3/8	6 x 19	12.0	8.9	9.7	7.2	6.8	5.1
7/16	6 x 19	16.0	12.0	13.0	9.8	9.3	6.9
1/2	6 x 19	21.0	15.0	17.0	13.0	12.0	9.0
9/16	6 x 19	26.0	20.0	21.0	16.0	15.0	11.0
5/8	6 x 19	32.0	24.0	26.0	20.0	19.0	14.0
3/4	6 x 19	46.0	35.0	38.0	28.0	27.0	20.0
7/8	6 x 19	62.0	47.0	51.0	38.0	36.0	27.0
1	6 x 19	81.0	61.0	66.0	50.0	47.0	35.0

TABLE 280.14-J							
Part 2--3-Leg Bridle Slings							
Component		Rated Capacities, Tons (2,000 lb)					
Rope		3-Leg Bridle Slings					
Dia. (Inches)	Constr.	Vert 30 degree Horz 60 degree		45 degree Angle		Vert 60 degree Horz 30 degree	
		8-Part	6-Part	8-Part	6-Part	8-Part	6-Part
3/32	6 x 7	1.1	0.83	0.90	0.68	0.64	0.48
1/8	6 x 7	2.0	1.5	1.6	1.2	1.1	0.85
3/16	6 x 7	4.4	3.3	3.6	2.7	2.5	1.9
3/32	7 x 7	1.3	1.0	1.1	0.82	0.77	0.58
1/8	7 x 7	2.5	1.8	2.0	1.5	1.4	1.1
3/16	7 x 7	5.4	4.0	4.4	3.3	3.1	2.3
3/16	6 x 19	4.5	3.4	3.7	2.8	2.6	1.9
1/4	6 x 19	8.0	6.0	6.5	4.9	4.6	3.4
5/16	6 x 19	12.0	9.3	10.0	7.6	7.1	5.4
3/8	6 x 19	18.0	13.0	14.0	11.0	10.0	7.7
7/16	6 x 19	24.0	18.0	20.0	15.0	14.0	10.0
1/2	6 x 19	31.0	23.0	25.0	19.0	18.0	13.0
9/16	6 x 19	39.0	29.0	32.0	24.0	23.0	17.0
5/8	6 x 19	48.0	36.0	40.0	30.0	28.0	21.0
3/4	6 x 19	69.0	52.0	56.0	42.0	40.0	30.0
7/8	6 x 19	94.0	70.0	76.0	57.0	54.0	40.0
1	6 x 19	122.0	91.0	99.0	74.0	70.0	53.0

TABLE 280.14-K				
RATED CAPACITIES FOR STRAND LAID GROMMET - HAND TUCKED IMPROVED PLOW STEEL GRADE ROPE				
ROPE BODY		RATED CAPACITIES, TONS (2,000 lb)		
		(Illus.)	(Illus.)	(Illus.)
Dia. (Inches)	Construction	Vertical	Choker	Vertical Basket¹
1/4	7 x 19	0.85	0.64	1.7
5/16	7 x 19	1.3	1.0	2.6
3/8	7 x 19	1.9	1.4	3.8
7/16	7 x 19	2.6	1.9	5.2
1/2	7 x 19	3.3	2.5	6.7
9/16	7 x 19	4.2	3.1	8.4
5/8	7 x 19	5.2	3.9	10.0
3/4	7 x 19	7.4	5.6	15.0
7/8	7 x 19	10.0	7.5	20.0
1	7 x 19	13.0	9.7	26.0
1 1/8	7 x 19	16.0	12.0	32.0
1 1/4	7 x 37	18.0	14.0	37.0
1 3/8	7 x 37	22.0	16.0	44.0
1 1/2	7 x 37	26.0	19.0	52.0
¹ These values only apply when the D/d ratio is 5 or greater where: D = Diameter of curvature around which rope is bent. d = Diameter of rope.				

TABLE 280.14-K				
RATED CAPACITIES FOR CABLE LAID GROMMET - HAND TUCKED 7 X 6 X 7 AND 7 X 6 X 19 CONSTRUCTIONS IMPROVED PLOW STEEL GRADE ROPE 7 X 7 X 7 CONSTRUCTION GALVANIZED AIRCRAFT GRADE ROPE				
CABLE BODY		RATED CAPACITIES, TONS (2,000 lb)		
		(Illus.)	(Illus.)	(Illus.)
Dia. (Inches)	Construction	Vertical	Choker	Vertical Basket¹
3/8	7 X 6 X 7	1.3	0.95	2.5
9/16	7 X 6 X 7	2.8	2.1	5.6
5/8	7 X 6 X 7	3.8	2.8	7.6
3/8	7 X 7 X 7	1.6	1.2	3.2
9/16	7 X 7 X 7	3.5	2.6	6.9
5/8	7 X 7 X 7	4.5	3.4	9.0
5/8	7 x 6 x 19	3.9	3.0	7.9
3/4	7 X 6 X 19	5.1	3.8	10.0
15/16	7 X 6 X 19	7.9	5.9	16.0
1 1/8	7 X 6 X 19	11.0	8.4	22.0
1 5/16	7 X 6 X 19	15.0	11.0	30.0
1 1/2	7 X 6 X 19	19.0	14.0	39.0
1 11/16	7 X 6 X 19	24.0	18.0	49.0
1 7/8	7 X 6 X 19	30.0	22.0	60.0
2 1/4	7 X 6 X 19	42.0	31.0	84.0
2 5/8	7 X 6 X 19	56.0	42.0	112.0
¹ These values only apply when the D/d ratio is 5 or greater where: D = Diameter of curvature around which cable body is bent. d = Diameter of cable body.				

TABLE 280.14-M				
RATED CAPACITIES FOR STRAND LAID ENDLESS SLINGS -MECHANICAL JOINT IMPROVED PLOW STEEL GRADE ROPE				
ROPE BODY		RATED CAPACITIES, TONS (2,000 lb)		
		(Illus.)	(Illus.)	(Illus.)
Dia. (Inches)	Construction	Vertical	Choker	Vertical Basket¹
1/4	6 x 19 IWRC	0.92	0.69	1.8
3/8	6 x 19 IWRC	2.0	1.5	4.1
1/2	6 x 19 IWRC	3.6	2.7	7.2
5/8	6 x 19 IWRC	5.6	4.2	11.0
3/4	6 x 19 IWRC	8.0	6.0	16.0
7/8	6 x 19 IWRC	11.0	8.1	21.0
1	6 x 19 IWRC	14.0	10.0	28.0
1 1/8	6 x 19 IWRC	18.0	13.0	35.0
1 1/4	6 x 37 IWRC	21.0	15.0	41.0
1 3/8	6 x 37 IWRC	25.0	19.0	50.0
1 1/2	6 x 37 IWRC	29.0	22.0	59.0

¹These values only apply when the D/d ratio is 5 or greater where:
D = Diameter of curvature around which rope is bent.
d = Diameter of rope body.

TABLE 280.14-N				
RATED CAPACITIES FOR CABLE LAID ENDLESS SLINGS -MECHANICAL JOINT 7 X 7 X 7 AND 7 X 7 X 19 CONSTRUCTIONS GALVANIZED AIRCRAFT GRADE ROPE 7 X 6 X 19 IWRC CONSTRUCTION IMPROVED PLOW STEEL GRADE ROPE				
CABLE BODY		RATED CAPACITIES, TONS (2,000 lb)		
		(Illus.)	(Illus.)	(Illus.)
Dia. (Inches)	Construction	Vertical	Choker	Vertical Basket¹
1/4	7 x 7 x 7	0.83	0.62	1.6
3/8	7 x 7 x 7	1.8	1.3	3.5
1/2	7 x 7 x 7	3.0	2.3	6.1

TABLE 280.14-N				
RATED CAPACITIES FOR CABLE LAID ENDLESS SLINGS -MECHANICAL JOINT 7 X 7 X 7 AND 7 X 7 X 19 CONSTRUCTIONS GALVANIZED AIRCRAFT GRADE ROPE 7 X 6 X 19 IWRC CONSTRUCTION IMPROVED PLOW STEEL GRADE ROPE				
CABLE BODY		RATED CAPACITIES, TONS (2,000 lb)		
		(Illus.)	(Illus.)	(Illus.)
Dia. (Inches)	Construction	Vertical	Choker	Vertical Basket¹
5/8	7 x 7 x 7	4.5	3.4	9.1
3/4	7 x 7 x 7	6.3	4.7	12.0
5/8	7 x 7 x 19	4.7	3.5	9.5
3/4	7 x 7 x 19	6.7	5.0	13.0
7/8	7 x 7 x 19	8.9	6.6	18.0
1	7 x 7 x 19	11.0	8.5	22.0
1 1/8	7 x 7 x 19	14.0	10.0	28.0
1 1/4	7 x 7 x 19	17.0	12.0	33.0
3/4	7 x 6 x 19 IWRC	6.2	4.7	12.0
7/8	7 x 6 x 19 IWRC	8.3	6.2	16.0
1	7 x 6 x 19 IWRC	10.0	7.9	21.0
1 1/8	7 x 6 x 19 IWRC	13.0	9.7	26.0
1 1/4	7 x 6 x 19 IWRC	16.0	12.0	31.0
1 3/8	7 x 6 x 19 IWRC	18.0	14.0	37.0
1 1/2	7 x 6 x 19 IWRC	22.0	16.0	43.0
¹ These values only apply when the D/d ratio is 5 or greater where: D = Diameter of curvature around which cable body is bent. d = Diameter of cable body.				

s. Each metal mesh sling shall have permanently affixed to it a durable marking that states the rated capacity for vertical basket hitch and choker hitch loadings. Handles shall have a rated capacity at least equal to the metal fabric and exhibit no deformation after proof testing. Attachments of handles to fabric shall be joined so that: the rated capacity of the sling is not reduced; the load is evenly distributed across the width of the fabric; or sharp edges will not damage the fabric. Coatings which diminish the rated capacity of a sling shall not be applied. All new and repaired metal mesh slings, including handles, shall not be used unless proof tested by the manufacturer or equivalent entity at a minimum of one and one-half (1 1/2) times their rated capacity. Elastomer impregnated slings shall be proof tested before coating. Metal mesh slings shall not be used to lift loads in excess of their rated capacities as prescribed in Table 280.14-O. Slings not included in this table shall be used only in accordance with the manufacturer's recommendations. Metal mesh slings which are not impregnated with elastomers may be used in a temperature range from minus twenty (-20) degrees Fahrenheit to plus five hundred fifty (+550) degrees Fahrenheit without decreasing the working load limit. Metal mesh slings impregnated with polyvinyl chloride or neoprene may be used only in a temperature range from 0-degrees Fahrenheit to plus two hundred (+200) degrees-Fahrenheit. For

operations outside these temperature ranges or for metal mesh slings impregnated with other materials, the sling manufacturer's recommendations shall be followed. Metal mesh slings which are repaired shall not be used unless repaired by a metal mesh sling manufacturer or an equivalent entity. Once repaired, each sling shall be permanently marked or tagged, or a written record maintained, to indicate the date and nature of the repairs and the person or organization that performed the repairs. Records of repairs shall be made available for examination by the Department. Metal mesh slings shall be immediately removed from service if any of the following conditions are present: a broken weld or broken brazed joint along the sling edge; reduction in wire diameter of twenty-five (25) percent due to abrasion or fifteen (15) percent due to corrosion; lack of flexibility due to distortion of the fabric; distortion of the female handle so that the depth of the slot is increased more than ten (10) percent; distortion of either handle so that the width of the eye is decreased more than ten (10) percent. A fifteen (15) percent reduction of the original cross sectional area of metal at any point around the handle eye. Distortion of either handle out of its plane.

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TABLE 280.14-O					
RATED CAPACITIES CARBON STEEL & STAINLESS STEEL METAL MESH SLINGS					
SLING WIDTH IN INCHES	EFFECT OF ANGLE ON RATED CAPACITIES IN BASKET HITCH				
	(Illus.)	(Illus.)	(Illus.)	(Illus.)	(Illus.)
	VERTICAL OR CHOKER	VERTICAL BASKET	30 deg Vert 60 deg Horz	45 deg Vert 45 deg Horz	60 deg Vert 30 deg Horz
Heavy Duty - 10 Ga 35 Spirals/Ft of sling width					
2	1,500	3,000	2,600	2,100	1,500
3	2,700	5,400	4,700	3,800	2,700
4	4,000	8,000	6,900	5,600	4,000
6	6,000	12,000	10,400	8,400	6,000
8	8,000	16,000	13,800	11,300	8,000
10	10,000	20,000	17,000	14,100	10,000
12	12,000	24,000	20,700	16,900	12,000
14	14,000	28,000	24,200	19,700	14,000
16	16,000	32,000	27,700	22,600	16,000
18	18,000	36,000	31,100	25,400	18,000
20	20,000	40,000	34,600	28,200	20,000
Medium Duty - 12 Ga 43 Spirals/Ft of sling width					
2	1,350	2,700	2,300	1,900	1,400
3	2,000	4,000	3,500	2,800	2,000
4	2,700	5,400	4,700	3,800	2,700
6	4,500	9,000	7,800	6,400	4,500
8	6,000	12,000	10,400	8,500	6,000
10	7,500	15,000	13,000	10,600	7,500

TABLE 280.14-O					
RATED CAPACITIES CARBON STEEL & STAINLESS STEEL METAL MESH SLINGS					
SLING WIDTH IN INCHES	EFFECT OF ANGLE ON RATED CAPACITIES IN BASKET HITCH				
	(Illus.)	(Illus.)	(Illus.)	(Illus.)	(Illus.)
	VERTICAL OR CHOKER	VERTICAL BASKET	30 deg Vert 60 deg Horz	45 deg Vert 45 deg Horz	60 deg Vert 30 deg Horz
12	9,000	18,000	15,600	12,700	9,000
14	10,500	21,000	18,200	14,800	10,500
16	12,000	24,000	20,800	17,000	12,000
18	13,500	27,000	23,400	19,100	13,500
20	15,000	30,000	26,000	21,200	15,000
Light Duty - 14 Ga 59 Spirals/Ft of sling width					
2	900	1,800	1,600	1,300	900
3	1,400	2,800	2,400	2,000	1,400
4	2,000	4,000	3,500	2,800	2,000
6	3,000	6,000	5,200	4,200	3,000
8	4,000	8,000	6,900	5,700	4,000
10	5,000	10,000	8,600	7,100	5,000
12	6,000	12,000	10,400	8,500	6,000
14	7,000	14,000	12,100	9,900	7,000
16	8,000	16,000	13,900	11,300	8,000
18	9,000	18,000	15,600	12,700	9,000
20	10,000	20,000	17,300	14,100	10,000

t. Fiber rope slings made from conventional three (3) strand construction fiber rope shall not be used with loads in excess of the rated capacities prescribed in Tables 280.14-P through 280.14-S of this section. Fiber rope slings shall have a diameter of curvature meeting at least the minimums specified in Figure 280.02-A. Slings not included in these tables shall be used only in accordance with the manufacturer's recommendations. Natural and synthetic fiber rope slings, except for wet frozen slings, may be used in a temperature range from minus twenty (-20) degrees Fahrenheit to plus one hundred eighty (+180) degrees Fahrenheit without decreasing the working load limit. For operations outside this temperature range and for wet frozen slings, the sling manufacturer's recommendations shall be followed. Spliced fiber rope slings shall not be used unless they have been spliced in accordance with the following minimum requirements and in accordance with any additional recommendations of the manufacturer. In manila rope, eye splices shall consist of at least three (3) full tucks, and short splices shall consist of at least six (6) full tucks, three (3) on each side of the splice center lines. In synthetic fiber rope, eye splices shall consist of at least four (4) full tucks, and short splices shall consist of at least eight (8) full tucks, four (4) on each side of the center line. Strand end tails shall not be trimmed flush with the surface of the rope immediately adjacent to the full tucks. This applies to all types of fiber rope and both eye and short splices. For fiber rope under one (1) inch in diameter, the tail shall project at least six (6) rope diameters beyond the last full tuck. For fiber rope one (1) inch in diameter and larger,

the tail shall project at least six (6) inches beyond the last full tuck. Where a projecting tail interferes with the use of the sling, the tail shall be tapered and spliced into the body of the rope using at least two (2) additional tucks (which will require a tail length of approximately six (6) rope diameters beyond the last full tuck). Fiber rope slings shall have a minimum clear length of rope between eye splices equal to ten (10) times the rope diameter. Knots shall not be used in lieu of splices. Clamps not designed specifically for fiber ropes shall not be used for splicing. For all eye splices, the eye shall be of such size to provide an included angle of not greater than sixty (60) degrees at the splice when the eye is placed over the load or support. Fiber rope slings shall not be used if end attachments in contact with the rope have sharp edges or projections. Natural and synthetic fiber rope slings shall be immediately removed from service if any of the following conditions are present: abnormal wear; powdered fiber between strands; broken or cut fibers; variations in the size or roundness of strands; discoloration or rotting; and distortion of hardware in the sling. Only fiber rope slings made from new rope shall be used. Use of repaired or reconditioned fiber rope slings is prohibited. ()

TABLE 280.14-P							
MANILA ROPE SLINGS							
Part 1--Eye and Eye Sling							
Rope Diameter nominal in Inches	Nominal Weight per 100 ft. in Pounds	Vertical Hitch	EYE & EYE SLING				
			Choker Hitch	BASKET HITCH			
				Angle of Rope to Horizontal			
				90°	60°	45°	30°
				Angle of Rope to Vertical			
				0°	30°	45°	60°
1/2	7.5	480	240	960	830	680	480
9/16	10.4	620	310	1,240	1,070	875	620
5/8	13.3	790	395	1,580	1,370	1,120	790
3/4	16.7	970	485	1,940	1,680	1,370	970
13/16	19.5	1,170	585	2,340	2,030	1,650	1,170
7/8	22.5	1,390	695	2,780	2,410	1,970	1,390
1	27.0	1,620	810	3,240	2,810	2,290	1,620
1 1/16	31.3	1,890	945	3,780	3,270	2,670	1,890
1 1/8	36.0	2,160	1,080	4,320	3,740	3,050	2,160
1 1/4	41.7	2,430	1,220	4,860	4,210	3,440	2,430
1 5/16	47.9	2,700	1,350	5,400	4,680	3,820	2,700
1 1/2	59.9	3,330	1,670	6,660	5,770	4,710	3,330
1 5/8	74.6	4,050	2,030	8,100	7,010	5,730	4,050
1 3/4	89.3	4,770	2,390	9,540	8,260	6,740	4,770
2	107.5	5,580	2,790	11,200	9,660	7,890	5,580

TABLE 280.14-P							
MANILA ROPE SLINGS							
Part 1--Eye and Eye Sling							
Rope Diameter nominal in Inches	Nominal Weight per 100 ft. in Pounds	Vertical Hitch	EYE & EYE SLING				
			Choker Hitch	BASKET HITCH			
				Angle of Rope to Horizontal			
				90°	60°	45°	30°
				Angle of Rope to Vertical			
				0°	30°	45°	60°
2 1/8	125.0	6,480	3,240	13,000	11,200	9,160	6,480
2 1/4	146.0	7,380	3,690	14,800	12,800	10,400	7,380
2 1/2	166.7	8,370	4,190	16,700	14,500	11,800	8,370
2 5/8	190.8	9,360	4,680	18,700	16,200	13,200	9,360

TABLE 280.14-P							
Part 2--Endless Sling							
Rope Diameter nominal in Inches	Nominal Weight per 100 ft. in Pounds	Vertical Hitch	ENDLESS SLING				
			Choker Hitch	BASKET HITCH			
				Angle of Rope to Horizontal			
				90°	60°	45°	30°
				Angle of Rope to Vertical			
				0°	30°	45°	60°
1/2	7.5	865	430	1,730	1,500	1,220	865
9/16	10.4	1,120	560	2,230	1,930	1,580	1,120
5/8	13.3	1,420	710	2,840	2,460	2,010	1,420
3/4	16.7	1,750	875	3,490	3,020	2,470	1,750
13/16	19.5	2,110	1,050	4,210	3,650	2,980	2,110
7/8	22.5	2,500	1,250	5,000	4,330	3,540	2,500
1	27.0	2,920	1,460	5,830	5,050	4,120	2,920
1 1/16	31.3	3,400	1,700	6,800	5,890	4,810	3,400

TABLE 280.14-P							
Part 2--Endless Sling							
Rope Diameter nominal in Inches	Nominal Weight per 100 ft. in Pounds	Vertical Hitch	ENDLESS SLING				
			Choker Hitch	BASKET HITCH			
				Angle of Rope to Horizontal			
				90°	60°	45°	30°
				Angle of Rope to Vertical			
				0°	30°	45°	60°
1 1/8	36.0	3,890	1,940	7,780	6,730	5,500	3,890
1 1/4	41.7	4,370	2,190	8,750	7,580	6,190	4,370
1 5/16	47.9	4,860	2,430	9,720	8,420	6,780	4,860
1 1/2	59.9	5,990	3,000	12,000	10,400	8,480	5,990
1 5/8	74.6	7,290	3,650	14,600	12,600	10,300	7,290
1 3/4	89.3	8,590	4,290	17,200	14,900	12,100	8,590
2	107.5	10,000	5,020	20,100	17,400	14,200	10,000
2 1/8	125.0	11,700	5,830	23,300	20,200	16,500	11,700
2 1/4	146.0	13,300	6,640	26,600	23,000	18,800	13,300
2 1/2	166.7	15,100	7,530	30,100	26,100	21,300	15,100
2 5/8	190.8	16,800	8,420	33,700	29,200	23,800	16,800

TABLE 280.14-Q							
NYLON ROPE SLINGS							
Part 1--Eye and Eye Sling							
Rope Diameter nominal in Inches	Nominal Weight per 100 ft. in Pounds	Vertical Hitch	EYE & EYE SLING				
			Choker Hitch	BASKET HITCH			
				Angle of Rope to Horizontal			
				90°	60°	45°	30°
				Angle of Rope to Vertical			
				0°	30°	45°	60°
1/2	6.5	635	320	1,270	1,100	900	635

TABLE 280.14-Q							
NYLON ROPE SLINGS							
Part 1--Eye and Eye Sling							
Rope Diameter nominal in Inches	Nominal Weight per 100 ft. in Pounds	Vertical Hitch	EYE & EYE SLING				
			Choker Hitch	BASKET HITCH			
				Angle of Rope to Horizontal			
				90°	60°	45°	30°
				Angle of Rope to Vertical			
				0°	30°	45°	60°
9/16	8.3	790	395	1,580	1,370	1,120	790
5/8	10.5	1,030	515	2,060	1,780	1,460	1,030
3/4	14.5	1,410	705	2,820	2,440	1,990	1,410
13/16	17.0	1,680	840	3,360	2,910	2,380	1,680
7/8	20.0	1,980	990	3,960	3,430	2,800	1,980
1	26.0	2,480	1,240	4,960	4,300	3,510	2,480
1 1/16	29.0	2,850	1,430	5,700	4,940	4,030	2,850
1 1/8	34.0	3,270	1,640	6,540	5,600	4,620	3,270
1 1/4	40.0	3,710	1,860	7,420	6,430	5,250	3,710
1 5/16	45.0	4,260	2,130	8,520	7,380	6,020	4,260
1 1/2	55.0	5,250	2,630	10,500	9,090	7,420	5,250
1 5/8	68.0	6,440	3,220	12,900	11,200	9,110	6,440
1 3/4	83.0	7,720	3,860	15,400	13,400	10,900	7,720
2	95.0	9,110	4,560	18,200	15,800	12,900	9,110
2 1/8	109.0	10,500	5,250	21,000	18,200	14,800	10,500
2 1/4	129.0	12,400	6,200	24,800	21,500	17,500	12,400
2 1/2	149.0	13,900	6,950	27,800	24,100	19,700	13,900
2 5/8	168.0	16,000	8,000	32,000	27,700	22,600	16,000

TABLE 280.14-Q							
Part 2--Endless Sling							
Rope Diameter nominal in Inches	Nominal Weight per 100 ft. in Pounds	Vertical Hitch	EYE & EYE SLING				
			Choker Hitch	BASKET HITCH			
				Angle of Rope to Horizontal			
				90°	60°	45°	30°
				Angle of Rope to Vertical			
				0°	30°	45°	60°
1/2	6.5	1,140	570	2,290	1,980	1,620	1,140
9/16	8.3	1,420	710	2,840	2,460	2,010	1,420
5/8	10.5	1,850	925	3,710	3,210	2,620	1,850
3/4	14.5	2,540	1,270	5,080	4,400	3,590	2,540
13/16	17.0	3,020	1,510	6,050	5,240	4,280	3,020
7/8	20.0	3,560	1,780	7,130	6,170	5,040	3,560
1	26.0	4,460	2,230	8,930	7,730	6,310	4,460
1 1/16	29.0	5,130	2,570	10,300	8,890	7,260	5,130
1 1/8	34.0	5,890	2,940	11,800	10,200	8,330	5,890
1 1/4	40.0	6,680	3,340	13,400	11,600	9,450	6,680
1 5/16	45.0	7,670	3,830	15,300	13,300	10,800	7,670
1 1/2	55.0	9,450	4,730	18,900	16,400	13,400	9,450
1 5/8	68.0	11,600	5,800	23,200	20,100	16,400	11,600
1 3/4	83.0	13,900	6,950	27,800	24,100	19,700	13,900
2	95.0	16,400	8,200	32,800	28,400	23,200	16,400
2 1/8	109.0	18,900	9,450	37,800	32,700	26,700	18,900
2 1/4	129.0	22,300	11,200	44,600	38,700	31,600	22,300
2 1/2	149.0	25,000	12,500	50,000	43,300	35,400	25,000
2 5/8	168.0	28,800	14,400	57,600	49,900	40,700	28,800

TABLE 280.14-R							
POLYESTER ROPE SLINGS							
Part 1--Eye and Eye Sling							
Rope Diameter nominal in Inches	Nominal Weight per 100 ft. in Pounds	Vertical Hitch	EYE & EYE SLING				
			Choker Hitch	BASKET HITCH			
				Angle of Rope to Horizonte			
				90°	60°	45°	30°
				Angle of Rope to Vertical			
				0°	30°	45°	60°
1/2	8.0	635	320	1,270	1,100	900	635
9/16	10.2	790	395	1,580	1,370	1,120	790
5/8	13.0	990	495	1,980	1,710	1,400	990
3/4	17.5	1,240	620	2,480	2,150	1,750	1,240
13/16	21.0	1,540	770	3,080	2,670	2,180	1,540
7/8	25.0	1,780	890	3,560	3,080	2,520	1,780
1	30.5	2,180	1,090	4,360	3,780	3,080	2,180
1 1/16	34.5	2,530	1,270	5,060	4,380	3,580	2,530
1 1/8	40.0	2,920	1,460	5,840	5,060	4,130	2,920
1 1/4	46.3	3,290	1,650	6,580	5,700	4,650	3,290
1 5/16	52.5	3,710	1,860	7,420	6,430	5,250	3,710
1 1/2	66.8	4,630	2,320	9,260	8,020	6,550	4,630
1 5/8	82.0	5,640	2,820	11,300	9,770	7,980	5,640
1 3/4	98.0	6,710	3,360	13,400	11,600	9,490	6,710
2	118.0	7,920	3,960	15,800	13,700	11,200	7,920
2 1/8	135.0	9,110	4,460	18,200	15,800	12,900	9,110
2 1/4	157.0	10,600	5,300	21,200	18,400	15,000	10,600
2 1/2	181.0	12,100	6,050	24,200	21,000	17,100	12,100
2 5/8	205.0	13,600	6,800	27,200	23,600	19,200	13,600

TABLE 280.14-R							
Part 2--Endless Sling							
Rope Diame- ter nominal in Inches	Nominal Weight per 100 ft. in Pounds	Vertical Hitch	ENDLESS SLING				
			Choker Hitch	BASKET HITCH			
				Angle of Rope to Horizontal			
				90°	60°	45°	30°
				Angle of Rope to Vertical			
				0°	30°	45°	60°
1/2	8.0	1,140	570	2,290	1,980	1,620	1,140
9/16	10.2	1,420	710	2,840	2,460	2,010	1,420
5/8	13.0	1,780	890	3,570	3,090	2,520	1,780
3/4	17.5	2,230	1,120	4,470	3,870	3,160	2,230
13/16	21.0	2,770	1,390	5,540	4,800	3,920	2,770
7/8	25.0	3,200	1,600	6,410	5,550	4,530	3,200
1	30.5	3,920	1,960	7,850	6,800	5,550	3,920
1 1/16	34.5	4,550	2,280	9,110	7,990	6,440	4,550
1 1/8	40.0	5,260	2,630	10,500	9,100	7,440	5,260
1 1/4	46.3	5,920	2,960	11,800	10,300	8,380	5,920
1 5/16	52.5	6,680	3,340	13,400	11,600	9,450	6,680
1 1/2	66.8	8,330	4,170	16,700	14,400	11,800	8,330
1 5/8	82.0	10,200	5,080	20,300	17,600	14,400	10,200
1 3/4	98.0	12,100	6,040	24,200	20,900	17,100	12,100
2	118.0	14,300	7,130	28,500	24,700	20,200	14,300
2 1/8	135.0	16,400	8,200	32,800	28,400	23,200	16,400
2 1/4	157.0	19,100	9,540	38,200	33,100	27,000	19,100
2 1/2	181.0	21,800	10,900	43,600	37,700	30,800	21,800
2 5/8	205.0	24,500	12,200	49,000	42,400	34,600	24,500

TABLE 280.14-S							
POLYPROPYLENE ROPE SLINGS							
Part 1--Eye and Eye Sling							
Rope Diameter nominal in Inches	Nominal Weight per 100 ft. in Pounds	Vertical Hitch	EYE & EYE SLING				
			Choker Hitch	BASKET HITCH			
				Angle of Rope to Horizontal			
				90°	60°	45°	30°
				Angle of Rope to Vertical			
				0°	30°	45°	60°
1/2	4.7	645	325	1,290	1,120	910	645
9/16	6.1	780	390	1,560	1,350	1,100	780
5/8	7.5	950	475	1,900	1,650	1,340	950
3/4	10.7	1,300	650	2,600	2,250	1,840	1,300
13/16	12.7	1,520	760	3,040	2,630	2,150	1,520
7/8	15.0	1,760	880	3,520	3,050	2,490	1,760
1	18.0	2,140	1,070	4,280	3,700	3,030	2,140
1 1/16	20.4	2,450	1,230	4,900	4,240	3,460	2,450
1 1/8	23.7	2,800	1,400	5,600	4,850	3,960	2,800
1 1/4	27.0	3,210	1,610	6,420	5,560	4,540	3,210
1 5/16	30.5	3,600	1,800	7,200	6,240	5,090	3,600
1 1/2	38.5	4,540	2,270	9,080	7,860	6,420	4,540
1 5/8	47.5	5,510	2,760	11,000	9,540	7,790	5,510
1 3/4	57.0	6,580	3,290	13,200	11,400	9,300	6,580
2	69.0	7,960	3,980	15,900	13,800	11,300	7,960
2 1/8	80.0	9,330	4,670	18,700	16,200	13,200	9,330
2 1/4	92.0	10,600	5,300	21,200	18,400	15,000	10,600
2 1/2	107.0	12,200	6,100	24,400	21,100	17,300	12,200
2 5/8	120.0	13,800	6,900	27,600	23,900	19,600	13,800

TABLE 280.14-S							
Part 2--Endless Sling							
Rope Diameter nominal in Inches	Nominal Weight per 100 ft. in Pounds	Vertical Hitch	ENDLESS SLING				
			Choker Hitch	BASKET HITCH			
				Angle of Rope to Horizontal			
				90°	60°	45°	30°
				Angle of Rope to Vertical			
				0°	30°	45°	60°
1/2	4.7	1,160	580	2,320	2,010	1,640	1,160
9/16	6.1	1,400	700	2,810	2,430	1,990	1,400
5/8	7.5	1,710	855	3,420	2,960	2,420	1,710
3/4	10.7	2,340	1,170	4,680	4,050	3,310	2,340
13/16	12.7	2,740	1,370	5,470	4,740	3,870	2,740
7/8	15.0	3,170	1,580	6,340	5,490	4,480	3,170
1	18.0	3,850	1,930	7,700	6,670	5,450	3,860
1 1/16	20.4	4,410	2,210	8,820	7,640	6,240	4,410
1 1/8	23.7	5,040	2,520	10,100	8,730	7,130	5,040
1 1/4	27.0	5,780	2,890	11,600	10,000	8,170	5,780
1 5/16	30.5	6,480	3,240	13,000	11,200	9,170	6,480
1 1/2	38.5	8,170	4,090	16,300	14,200	11,600	8,170
1 5/8	47.5	9,920	4,960	19,800	17,200	14,000	9,920
1 3/4	57.0	11,800	5,920	23,700	20,500	16,800	11,800
2	69.0	14,300	7,160	28,700	24,800	20,300	14,300
2 1/8	80.0	16,800	8,400	33,600	29,100	23,800	16,800
2 1/4	92.0	19,100	9,540	38,200	33,100	27,000	19,100
2 1/2	107.0	22,000	11,000	43,900	38,000	31,100	22,000
2 5/8	120.0	24,800	12,400	49,700	43,000	35,100	24,800

u. Synthetic web slings shall be marked or coded to show the rated capacities for each type of hitch and type of synthetic web material. Synthetic webbing shall be of uniform thickness and width and selvage edges shall not be split from the webbing width. Fittings shall be: Of a minimum breaking strength equal to that of the sling; and free of all sharp edges that could in any way damage the webbing. Stitching shall be the only method used to attach end fittings to webbing and to form eyes. The thread shall be in an even pattern and contain a sufficient number

of stitches to develop the full breaking strength of the sling. Synthetic web slings shall not be used with loads in excess of the rated capacities specified in Tables 280.14-T through 280.14-V. Slings not included in these tables shall be used only in accordance with the manufacturer's recommendations. When synthetic web slings are used, the following precautions shall be taken: nylon web slings shall not be used where fumes, vapors, sprays, mists, or liquids of acids or phenolics are present; polyester and polypropylene web slings shall not be used where fumes, vapors, sprays, mists or liquids of caustics are present; and web slings with aluminum fittings shall not be used where fumes, vapors, sprays, mists, or liquids of caustics are present. Synthetic web slings of polyester and nylon shall not be used at temperatures in excess of one hundred eighty (180) degrees Fahrenheit. Polypropylene web slings shall not be used at temperatures in excess of two hundred (200) degrees Fahrenheit. Synthetic web slings which are repaired shall not be used unless repaired by a sling manufacturer or an equivalent entity. Each repaired sling shall be proof tested by the manufacturer or equivalent entity to twice the rated capacity prior to its return to service. The employer shall retain a certificate of proof test and make it available for examination by the Department. Slings, including webbing and fittings, which have been repaired in a temporary manner shall not be used. Synthetic web slings shall be immediately removed from service if any of the following conditions are present: acid or caustic burns; melting or charring of any part of the sling surface; snags, punctures, tears, or cuts; broken or worn stitches; or distortion of fittings. ()

TABLE 280.14-T						
RATED CAPACITY IN POUNDS SYNTHETIC WEB SLINGS 1,000 LBS. PER INCH OF WIDTH SINGLE PLY						
Part 1--Types I, II, III, & IV						
Sling Body Width Inches	Triangle - Choker Slings, Type I Triangle - Triangle Slings, Type II Eye & Eye with Flat Eye Slings, Type III Eye & Eye with Twisted Eye Slings, Type IV					
	Vert.	Choker	Vert. Basket	30° Basket	45° Basket	60° Basket
1	1,000	750	2,000	1,700	1,400	1,000
2	2,000	1,500	4,000	3,500	2,800	2,000
3	3,000	2,200	6,000	5,200	4,200	3,000
4	4,000	3,000	8,000	6,900	5,700	4,000
5	5,000	3,700	10,000	8,700	7,100	5,000
6	6,000	4,500	12,000	10,400	8,500	6,000

NOTES: 1. All angles shown are measured from the vertical.
2. Capacities for intermediate width not shown may be obtained by interpolation.

TABLE 280.14-T						
Part 2--Type V						
Sling Body Width Inches	Endless Slings, Type V					
	Vert.	Choker	Vert. Basket	30° Basket	45° Basket	60° Basket
TABLE 280.14-T						
1	1,600	1,300	3,200	2,800	2,300	1,600
2	3,200	2,600	6,400	5,500	4,500	3,200
3	4,800	3,800	9,600	8,300	6,800	4,800
4	6,400	5,100	12,800	11,100	9,000	6,400
5	8,000	6,400	16,000	13,900	11,300	8,000
6	9,600	7,700	19,200	16,600	13,600	9,600
NOTES: 1. All angles shown are measured from the vertical. 2. Capacities for intermediate width not shown may be obtained by interpolation.						

TABLE 280.14-T						
Part 3--Type VI						
Sling Body Width Inches	Return Eye Slings, Type VI					
	Vert.	Choker	Vert. Basket	30° Basket	45° Basket	60° Basket
1	800	650	1,600	1,400	1,150	800
2	1,600	1,300	3,200	2,800	2,300	1,600
3	2,400	1,950	4,800	4,150	3,400	2,400
4	3,200	2,600	6,400	5,500	4,500	3,200
5	4,000	3,250	8,000	6,900	5,650	4,000
6	4,800	3,800	9,600	8,300	6,800	4,800
NOTES: 1. All angles shown are measured from the vertical. 2. Capacities for intermediate width not shown may be obtained by interpolation.						

TABLE 280.14-U						
RATED CAPACITY IN POUNDS SYNTHETIC WEB SLINGS 1,200 LBS. PER INCH OF WIDTH SINGLE PLY						
Part 1--Types I, II, III, & IV						
Sling Body Width Inches	Triangle - Choker Slings, Type I Triangle - Triangle Slings, Type II Eye & Eye with Flat Eye Slings, Type III Eye & Eye with Twisted Eye Slings, Type IV					
	Vert.	Choker	Vert. Basket	30° Basket	45° Basket	60° Basket
1	1,200	900	2,400	2,100	1,700	1,200
2	2,400	1,800	4,800	4,200	3,400	2,400
3	3,600	2,700	7,200	6,200	5,100	3,600
4	4,800	3,600	9,600	8,300	6,800	4,800
5	6,000	4,500	12,000	10,400	8,500	6,000
6	7,200	5,400	14,400	12,500	10,200	7,200

NOTES: 1. All angles shown are measured from the vertical.
2. Capacities for intermediate width not shown may be obtained by interpolation.

TABLE 280.14-U						
Part 2--Type V						
Sling Body Width Inches	Endless Slings, Type V					
	Vert.	Choker	Vert. Basket	30° Basket	45° Basket	60° Basket
1	1,900	1,500	3,800	3,300	2,700	1,900
2	3,800	3,000	7,600	6,600	5,400	3,800
3	5,800	4,600	11,600	10,000	8,200	5,800
4	7,700	6,200	15,400	13,300	10,900	7,700
5	9,600	7,700	19,200	16,600	13,600	9,600
6	11,500	9,200	23,000	19,900	16,300	11,500

NOTES: 1. All angles shown are measured from the vertical.
2. Capacities for intermediate width not shown may be obtained by interpolation.

TABLE 280.14-U						
Part 3--Type VI						
Sling Body Width Inches	Return Eye Slings, Type VI					
	Vert.	Choker	Vert. Basket	30° Basket	45° Basket	60° Basket
1	950	750	1,900	1,650	1,350	950
2	1,900	1,500	3,800	3,300	2,700	1,900
3	2,850	2,250	5,700	4,950	4,050	2,850
4	3,800	3,000	7,600	6,600	5,400	3,800
5	4,750	3,750	9,500	8,250	6,750	4,750
6	5,800	4,600	11,600	10,000	8,200	5,800

NOTES: 1. All angles shown are measured from the vertical.
2. Capacities for intermediate width not shown may be obtained by interpolation.

TABLE 280.14-V						
RATED CAPACITY IN POUNDS SYNTHETIC WEB SLINGS 1,200 LBS. PER INCH OF WIDTH SINGLE PLY						
Part 1--Types I, II, III, & IV						
Sling Body Width Inches	Triangle - Choker Slings, Type I Triangle - Triangle Slings, Type II Eye & Eye with Flat Eye Slings, Type III Eye & Eye with Twisted Eye Slings, Type IV					
	Vert.	Choker	Vert. Basket	30° Basket	45° Basket	60° Basket
1	1,600	1,200	3,200	2,800	2,300	1,600
2	3,200	2,400	6,400	5,500	4,500	3,200
3	4,800	3,600	9,600	8,300	6,800	4,800
4	6,400	4,800	12,800	11,100	9,000	6,400
5	8,000	6,000	16,000	13,800	11,300	8,000
6	9,600	7,200	19,200	16,600	13,600	9,600

NOTES: 1. All angles shown are measured from the vertical.
2. Capacities for intermediate width not shown may be obtained by interpolation.

TABLE 280.14-V						
Part 2--Type V						
Sling Body Width Inches	Endless Slings, Type V					
	Vert.	Choker	Vert. Basket	30° Basket	45° Basket	60° Basket
1	2,600	2,100	5,200	4,500	3,700	2,600
2	5,100	4,100	10,200	8,800	7,200	5,100
3	7,700	6,200	15,400	13,300	10,900	7,700
4	10,100	8,200	20,400	17,700	14,400	10,200
5	12,800	10,200	25,600	22,200	18,100	12,800
6	15,400	12,300	30,800	26,700	21,800	15,400

NOTES: 1. All angles shown are measured from the vertical.
 2. Capacities for intermediate width not shown may be obtained by interpolation.

TABLE 280.14						
Part 3--Type VI						
Sling Body Width Inches	Return Eye Slings, Type VI					
	Vert.	Choker	Vert. Basket	30° Basket	45° Basket	60° Basket
1	1,050	1,050	2,600	2,250	1,850	1,300
2	2,600	2,100	5,200	4,500	3,700	2,600
3	3,900	3,150	7,800	6,750	5,500	3,900
4	5,100	4,100	10,200	8,800	7,200	5,100
5	6,400	5,150	12,800	11,050	9,050	6,400
6	7,700	6,200	15,400	13,300	10,900	7,700

NOTES: 1. All angles shown are measured from the vertical.
 2. Capacities for intermediate width not shown may be obtained by interpolation.

- 15. Hoisting Equipment. ()
 - a. Sheave grooves shall be smooth and free from surface defects which could cause rope damage. ()
 - b. Sheaves carrying ropes which can be momentarily unled 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. ()

- c. 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. ()
- d. Pockets and flanges of sheaves used with hoist chains shall be of such dimensions that the chain does not catch or bind during operation. ()
- e. All running sheaves shall be equipped with means for lubrication. Permanently lubricated, sealed and/or shielded bearings meet this requirement. ()
- f. 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 twenty (20) percent of the nominal breaking strength of the rope. ()
- g. Socketing shall be done in the manner specified by the manufacturer of the assembly. ()
- h. Rope shall be secured to the drum as follows: no less than two (2) wraps of rope shall remain on the drum when the hook is in its extreme low position. 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. ()
- i. 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 Table 280.15-A. 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. ()

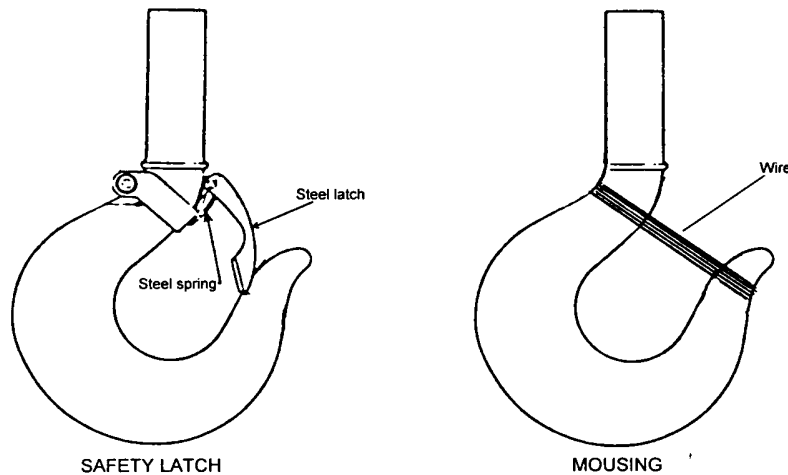
TABLE 280.15-A		
Diameter of rope	Number of Clips Required	Space Between Clips
1 1/2-inch	8	10-inches
1 3/8-inch	7	9-inches
1 1/4-inch	6	8-inches
1 1/8-inch	5	7-inches
1-inch	5	6-inches
7/8-inch	5	5 1/4-inches
3/4-inch	5	4 1/2-inches
3/8 to 5/8-inch	4	3-inches

- ()
- j. Swagged or compressed fittings shall be applied as recommended by the rope or crane manufacturer. ()
- k. 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. ()
- l. 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. ()
- m. If a load is supported by more than one (1) part of rope, the tension in the parts shall be equalized.

()

n. Hooks shall meet the manufacturer's recommendations and shall not be overloaded. Safety latch-type hooks shall be used or the hook shall be moused. (See Figure 280.15-A). ()

FIGURE 280.15-A



16. Inspection and Maintenance of Cranes. ()

a. Prior to initial use, all new and altered cranes shall be inspected to insure compliance with the provisions of these standards. ()

b. Inspection procedure for cranes in regular service is divided into two (2) 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 (2) general classifications are herein designated as frequent and periodic with respective intervals between inspections as defined below: frequent inspection - daily to monthly intervals; and periodic inspection one (1) to twelve (12) month intervals. ()

c. The following items shall be inspected for defects at frequent intervals as defined in Subsection 280.16.b. of this section or as specifically indicated, including observation during operation for any defects which might appear between regular inspections. All deficiencies such as herein listed shall be carefully examined and determination made as to whether they constitute a safety hazard: all functional operating mechanisms for maladjustment interfering with proper operation - Daily; deterioration or leakage in lines, tanks, valves, drain pumps, and other parts of air or hydraulic system - Daily; hooks with deformation or cracks - visual inspection daily; monthly inspection with signed reports. For hooks with cracks or having more than fifteen (15) percent in excess of normal throat opening or more than ten (10) degrees twist from the plane of the unbent hook shall be discarded immediately and not reused on any equipment subject to the provisions of this standard. Hoist or load attachment chains, including end connections, shall be inspected for excessive wear, twist, distorted links interfering with proper function, or stretch beyond manufacturer's recommendations. Visual inspection daily; monthly inspection with signed reports. Rope slings, including end connections, for excessive wear, broken wires, stretch, kinking or twisting - visual inspection daily; monthly inspection with signed report. All functional operating mechanisms for excessive wear of components. Rope reeving for noncompliance with manufacturer's recommendations. ()

d. Complete inspections of the crane shall be performed at periodic intervals as generally defined in Subsection 280.16.b. of this section, depending upon its activity severity of service, and environment, or as

specifically indicated below. These inspections shall include the requirements of Subsection 280.16.c. of this section 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: deformed, cracked, or corroded members; loose bolts or rivets; cracked or worn sheaves and drums; worn, cracked or distorted parts such as pins, bearings, shafts, gears, rollers, locking and clamping devices; excessive wear on brake system parts, linings, pawls, and ratchets; load, wind, and other indicators over their full range, for any significant inaccuracies; gasoline, diesel, electric, or other powerplants for improper performance or noncompliance with applicable safety requirements; excessive wear of chain drive sprockets and excessive chain stretch. ()

e. Magnetic particle or other suitable crack detecting inspection shall be performed at least once each year. ()

f. Electric apparatus, shall be inspected for signs of pitting or any deterioration of controller contactors, limit switches and push button stations. ()

g. A crane which has been idle for a period of one (1) month or more, but less than six (6) months, shall be given an inspection conforming with requirements of Subsection 280.16.c. of this section and Subsection 280.16.r. of this section before placing in service. ()

h. A crane which has been idle for a period of over six (6) months shall be given a complete inspection conforming with requirements of Subsections 280.16.c. and 280.16.d. of this section and Subsection 280.16.r. of this section before placing in service. ()

i. Standby cranes shall be inspected at least semi annually in accordance with requirements of Subsection 280.16.c. of this section and Subsection 280.16.r. of this section. Standby cranes exposed to adverse environment should be inspected more frequently. ()

j. Prior to initial use, all new and altered cranes shall be operationally tested to insure compliance with this section including the following functions: hoisting and lowering; trolley travel; bridge travel; and limit switches, locking and safety devices. ()

k. 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. ()

l. Prior to initial use all new, extensively repaired, and altered cranes shall be tested by or under the direction of an appointed or authorized person, confirming the load rating of the crane. The load rating shall not be more than eighty (80) percent of the maximum load sustained during the test. Test loads shall not be more than one hundred twenty-five (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. ()

m. A preventive maintenance program based on the crane manufacturer's recommendations shall be established. ()

n. Before adjustments and repairs are started on the crane, the following precautions shall be taken: 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; all controllers shall be at the off position; the main or emergency switch shall be open and locked in the open position; 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; 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; 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. ()

o. 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. ()

p. Any unsafe conditions disclosed by the inspection requirements of this section shall be corrected before operation of the crane is resumed. Adjustments and repairs shall be done only by designated personnel. Adjustments shall be maintained to assure correct functioning of components. The following are examples: all functional operating mechanisms; limit switches; control systems; brakes; and power plants. ()

q. Repairs or replacements shall be provided promptly as needed for safe operation. The following are examples: accessory components, such as hooks, shall be carefully examined periodically and at the time of annual examination and inspection; cracked or deformed hooks shall be discarded immediately and not reused on any equipment subject to the provisions of this standard; load attachment chains and rope slings showing defects described in Subsection 280.14 of this section; all critical parts which are cracked, broken, bent, or excessively worn; and pendant control stations shall be kept clean and function labels kept legible. ()

17. Operation of Cranes and Handling of Loads. ()

a. Cranes shall not be loaded beyond their rated load except for test purposes as provided in Subsection 280.16.j. through 280.16.l. of this section. When loads which are limited by structural competence rather than by stability are to be handled, it shall be ascertained that the weight of the load has been determined within plus or minus ten (10) percent before it is lifted. ()

b. The load shall be attached to the load block hook by means of slings or other approved devices. The hoist chain or hoist rope shall be free from kinks. The hoist rope shall not be wrapped around the load. Care shall be taken to make certain that the sling clears all obstacles. The load shall be well secured and properly balanced in the sling or lifting device before it is lifted more than a few inches. ()

c. Before starting to hoist the following conditions shall be noted: hoist rope shall not be kinked; multiple part lines shall not be twisted around each other; and the hook shall be brought over the load in such a manner as to prevent swinging. ()

d. During hoisting care shall be taken that: there is no sudden acceleration or deceleration of the moving load and the load does not contact any obstructions. ()

e. Cranes/derricks 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 over-stressed. ()

f. While any employee is on the load or hook, there shall be no hoisting, lowering or traveling. Operators shall not permit anyone to ride on the load or hooks, unless using a lifeline or safety device approved by the Department. ()

g. No person should be permitted to stand or pass under a load on the hook. The operator shall avoid carrying the load over people. ()

h. 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. ()

i. Neither the load nor the boom shall be lowered below the point where less than two (2) full wraps of rope remain on their respective drums. ()

j. When two (2) or more cranes are used to lift a load one (1) designated person shall be in charge of the operation. This person shall analyze the operation and instruct all personnel involved in the proper positioning, rigging of the load, and the movements to be made. ()

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

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

m. 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 at slow speed. If the switch does not operate properly, the appointed person shall be immediately notified. ()

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

o. The operator shall not move the load or crane unless the floor signals are clearly understood. The operator shall take care that the load does not swing so that the hook-person or floor-person are endangered, ensure that they are clear before hoisting or moving the load. When raising or lowering the load the operator shall ascertain that the load shall safely clear adjacent stockpiles or machinery. The operator shall not pick up a load greater than the capacity of the crane. In case of doubt contact the supervisor or designated person. ()

p. Cranes shall be operated only by regular crane operators, authorized substitutes who have had adequate experience and training under the supervision of a competent operator, or by crane repairmen or inspectors. No person shall be permitted to operate a crane who cannot speak and read the English language, or who is under eighteen (18) years of age. No person shall be permitted to operate a crane whose hearing or eyesight is impaired, or who may be suffering from heart disease or similar ailments. The operator shall be fully familiar with all crane rules and with the crane mechanism and its proper care. If adjustments or repairs are necessary, the operator shall report the same at once to the proper authority. The operator shall not eat, smoke, or read while actually engaged in the operation of the crane or operate the crane when physically unfit. ()

q. The operator or someone especially designated shall properly lubricate all working parts of the crane. ()

r. Cranes shall be kept clean. Necessary clothing and personal belongings shall be stored in such a manner as not to interfere with access or operation. Tools, oil cans, waste, extra fuses, and other necessary articles, shall be stored in the tool box or in such a manner as not to interfere with access or operation and shall not be permitted to lie loose in or about the cab. ()

s. Whenever the operator finds the main or emergency switch open, the operator shall not close it, even when starting on regular duty, until it has been determined that no one is on or about the crane. The operator shall not oil or repair the crane unless the main switch is open. ()

t. If the power goes off, the operator shall immediately throw all controllers to OFF position until the power is again available. ()

u. Before closing the main switch the operator shall make sure that all controllers are in the OFF position. ()

v. The operator shall recognize signals only from the person who is supervising the lift. Operating signals shall be as established in Figure 280.17-A. Whistle signals may be used where one (1) crane only is in operation. ()

FIGURE 280.17-A

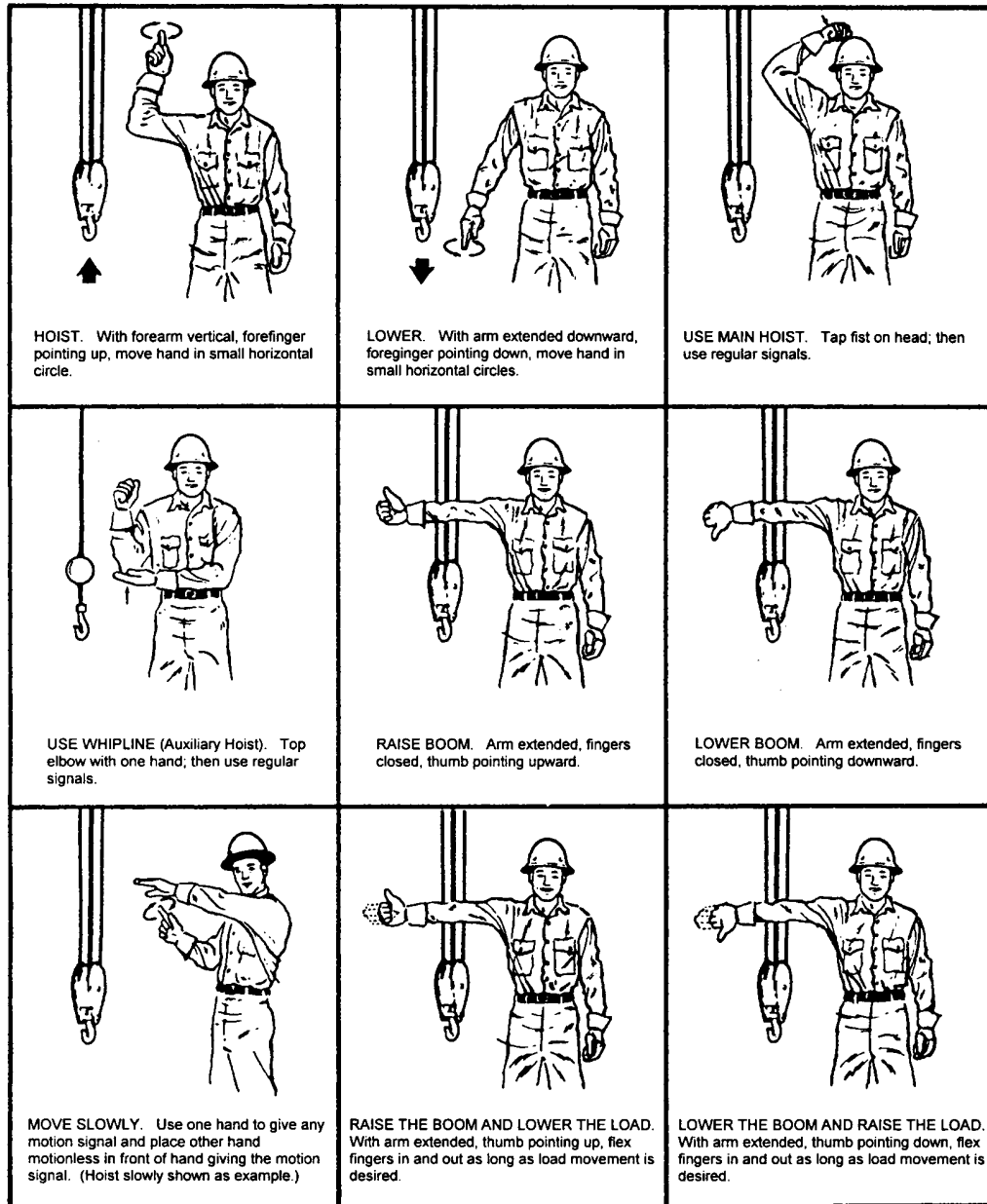
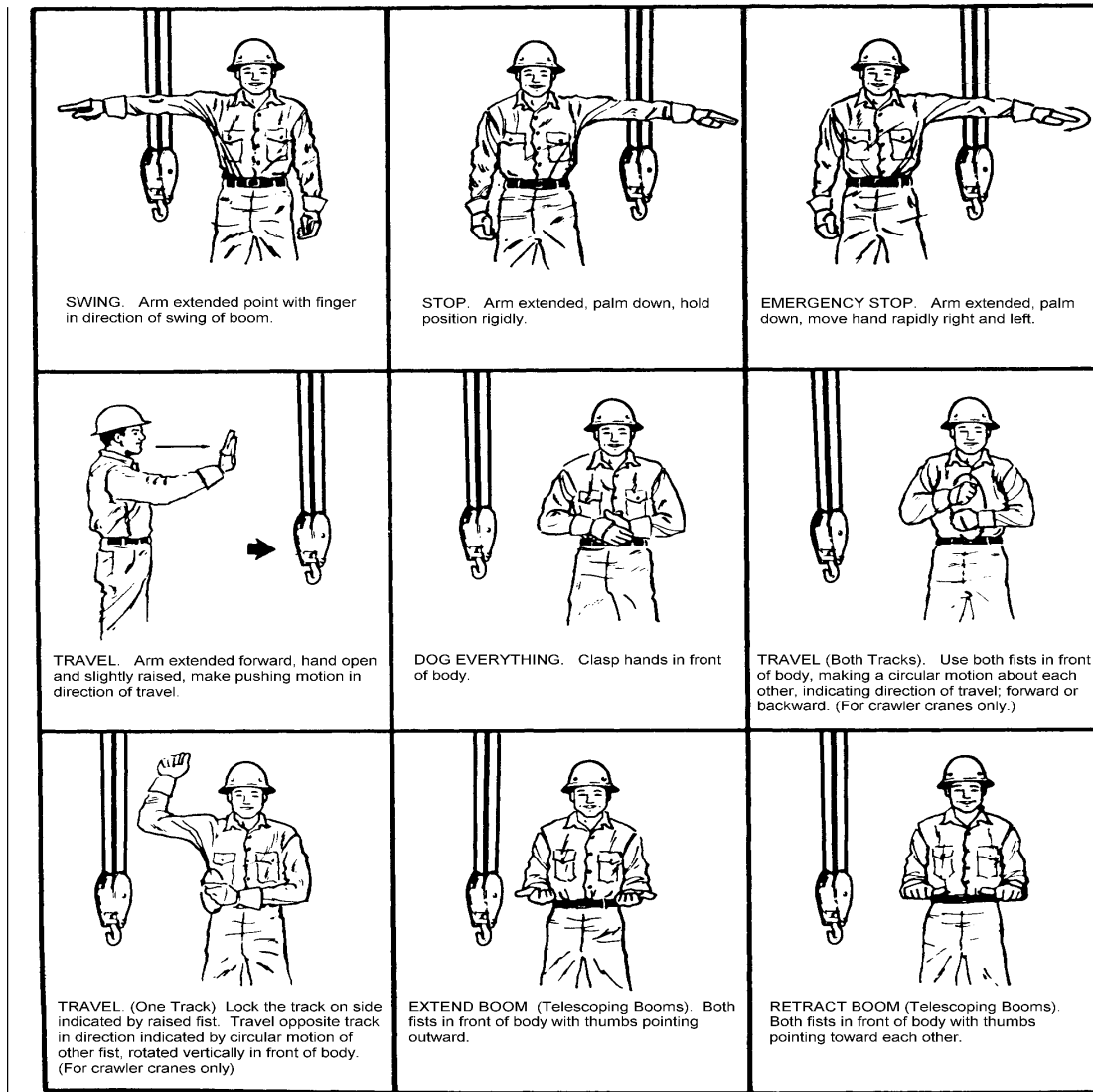


FIGURE 280.17-AA



w. Bumping into runway stops or other cranes shall be avoided. When the operator is ordered to engage with or push other cranes, it shall be done with special care for the safety of persons on or below cranes. ()

x. When lowering a load, the operator shall proceed carefully and make sure that the load is under safe control. ()

y. When leaving the cage/cab, the operator shall throw all controllers to the OFF position and open the main switch. ()

z. While a winch head is being used, the operator shall be within convenient reach of the power unit control lever. Ropes shall not be handled on a winch head without the knowledge of the operator. ()

18. Chain and Electric Hoists. ()

a. Chain and electric hoists shall be of what is known as all steel construction. No case iron shall be used in parts subject to tension except drums, bearings, or brake shoes. ()

b. The chains shall be made of the best quality steel or iron with welded links. ()

c. Chain and electric hoists shall have a factor of safety of at least five (5). ()

d. Chain and electric hoists shall be equipped with an approved device which will automatically lock the load when hoisting is stopped. ()

e. Electric hoists shall be provided with an approved limit stop to prevent the hoist block from traveling too far in case the operating handle is not released in time. ()

19. Air Hoists. ()

a. To prevent piston rod lock nuts from becoming loose and allowing rod to drop when supporting a load lock nut shall be secured to piston rod by a castellated nut and cotter-pin. ()

b. A clevis or other means shall be used to prevent hoists cylinder becoming detached from hanger. ()

20. Truck and Crawler Cranes. ()

a. This Subsection applies to crawler cranes, and wheel mounted cranes of both truck and self-propelled wheel type, and any variations thereof which retain the same fundamental characteristics. This Subsection 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 automobile wreck clearances are excepted. The requirements of this standard are applicable only to machines when used as lifting cranes. ()

b. All new crawler and truck cranes constructed and utilized on or after the effective date of these standards shall meet the design specifications of the American National Standard Safety Code for Crawler, Locomotive and Truck Cranes, ANSI B30.5. Crawler and truck cranes constructed prior to the effective date of these standards shall be modified to conform to those design specifications by December 31, 1973, unless it can be shown that the crane can not feasibly or economically be altered and that the crane substantially complies with the requirements of this section. Replacement parts shall be of equal or better quality than the original equipment and suitable for the purpose. Repairs or modifications shall be such as to render the equipment equal to or better than the original construction or design. ()

c. 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 percentages for cranes in Table 280.20-A, with the indicated types of mounting under conditions stipulated in Subsection 280.19.d. of this section. ()

TABLE 280.20-A	
Maximum load ratings (percent of tipping loads)	
Type of crane mounting:	
Locomotive, without outriggers;	
Booms 60 ft. or less	85
Booms over 60 ft.	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

()

d. Stipulations governing the application of the values in Subsection 280.20.c. of this section for crawler, truck, and wheel-mounted cranes shall be in accordance with Crane Load-Stability Test Code. Society of Automotive Engineers (SAE) J765.

()

e. NOTE: Effectiveness of the preceding stability factors will be influenced by such additional factors as freely 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.

()

f. A chart indicating the manufacturer's rated capacity at all operating radii for all permissible boom lengths and jib lengths with alternate ratings for optional equipment affecting such ratings shall be posted in all mobile type cranes and shall be readily visible to the operator in his normal operating position.

()

g. Inspections shall be as required in Subsection 280.16 of this section and the following: deformed, cracked, or corroded members, in the crane structure and boom; loose bolts or rivets; cracked or worn sheaves and drums; worn, cracked, or distorted parts such as pins, bearings, shafts, gears, rollers and locking devices; excessive wear on brake and clutch system parts, linings, pawls, and ratchets; load, boom angle, and other indicators over their full range, for any significant inaccuracies; gasoline, diesel, electric, or other power plants for improper performance or noncompliance with safety requirements; excessive wear of chain-drive sprockets and excessive chain stretch; travel steering, braking, and locking devices, for malfunction; and excessively worn or damaged tires or treads.

()

h. A crane which has been idle for a period of one (1) month or more, but less than six (6) months, shall be given an inspection conforming with requirements of Subsection 280.16.c. and Subsection 280.14 before placing in service.

()

i. A crane which has been idle for a period of six (6) months shall be given a complete inspection conforming with requirements of Subsection 280.16.c. and d. and Subsection 280.14 of this section before placing in service.

()

j. Standby cranes shall be inspected at least semi-annually in accordance with requirements of Subsection 280.16.d. and Subsection 280.14 of this section. Such cranes which are exposed to adverse environment should be inspected more frequently.

()

k. 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 made available to representatives of the Department.

()

l. In addition to prototype tests and quality-control measure, the user of each new production crane shall require that it be tested and related data supplied by the manufacturer to the extent necessary to assure compliance with the operational requirements of this subsection including functions such as the following: load hoisting and lowering mechanism; boom hoisting and lowering mechanism; swinging mechanism; travel mechanism; and safety devices. Where the complete production crane is not supplied by one (1) manufacturer, such tests shall be conducted at final assembly. 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. Certified production crane test results shall be made available to representatives of the Department. ()

m. Written reports of rated load tests shall be available showing test procedures and confirming the adequacy of repairs or alterations. Test loads shall not exceed one hundred (100) percent of the rated load at any selected working radius. Where rerating is necessary; crawler, truck, and wheel-mounted cranes shall be tested in accordance with SAE Recommended Practice, Crane Load Stability Test Code J765. Test reports shall be made available to representatives of the Department. ()

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

o. A thorough inspection of all ropes in use shall be made in accordance with the provisions of Subsection 280.16.r. and Subsection 280.16.s. of this section. ()

p. Prior to moving the load the employer shall assure that: the crane is level and where necessary, blocked properly; the load is well secured and properly balanced in the sling or lifting device before it is lifted more than a few inches; the hook shall be brought over the load in such a manner as to prevent swinging; and if there is a slack rope condition, it shall be determined that the rope is properly seated on the drum and in the sheaves. ()

q. On truck mounted cranes, no loads shall be lifted over the front area except as approved by the crane manufacturer. ()

r. Outriggers shall be used when the load to be handled at that particular radius exceeds the rated load without outriggers as given by the manufacturer for that crane. Where floats are used, they shall be securely attached to the outriggers. Wood blocks used to support outriggers shall: be strong enough to prevent crushing; be free from defects; and be of sufficient width and length to prevent shifting or toppling under load. ()

s. In transit, the following additional precautions shall be exercised: the boom shall be carried in line with the direction of motion; the superstructure shall be secured against rotation, except when negotiating turns when there is an operator in the cab or the boom is supported on a dolly; and the empty hook shall be lashed or otherwise restrained so that it cannot swing freely. Before traveling a crane with load, a designated person shall be responsible for determining and controlling safety. Decisions such as position of load, boom location, ground support, travel route, and speed of movement shall be in accord with determinations of the designated person. A crane with or without load shall not be traveled with the boom so high that it may bounce back over the cab. ()

t. When rotating the crane, sudden starts and stops shall be avoided. Rotational speed shall be such that the load does not swing out beyond the radii at which it can be controlled. A tag or restraint line shall be used when rotation of the load is hazardous. When a crane is to be operated at a fixed radius, the boom-hoist pawl or other positive locking device shall be engaged. ()

u. If the load must remain suspended for any considerable length of time, the operator shall hold the drum from rotating in the lower direction by activating the positive controllable means of the operator's station. ()

v. Cranes shall not be operated without the full amount of any ballast or counterweight in place as specified by the maker, but truck cranes that have dropped the ballast or counterweight may be operated temporarily

with special care and only for light loads without the full ballast or counterweight in place. The ballast or counterweight in place specified by the manufacturer shall not be exceeded. ()

w. Refueling with small portable containers shall be done with Underwriter's Laboratories or Factory Mutual Laboratories approved, or equivalent, safety type metal can equipped with an automatic closing cap and flame arrestor. Machines shall not be refueled with the engine running. ()

x. A carbon dioxide, dry chemical, or equivalent fire extinguisher shall be kept in the cab or on the crane. Operating and maintenance personnel shall be made familiar with the use and care of the fire extinguishers provided. ()

y. Except where the electrical distribution and transmission lines have been deenergized and visibly grounded at point of work or where insulating barriers not a part of or an attachment to the crane have been erected to prevent physical contact with the lines, cranes shall be operated proximate to, under, over, by, or near power-lines only in accordance with Section 151 of this standard. Cage-type boom guards, insulating links, or proximity warning devices may be used on cranes, but the use of such devices shall not operate to alter the requirements of this Subsection. Before the commencement of operations near electrical lines, the owners of the lines or their authorized representative shall be notified and provided with all pertinent information. The cooperation of the owner shall be requested. Any overhead wire shall be considered to be an energized line unless and until the person owning such line or the electrical utility authorities indicate that it is not an energized line. ()

21. Derricks and A-Frames. ()

a. This Subsection applies to guy, still-leg, breast, gin, pole, and A-frame derricks of the stationary type, capable of handling loads at variable reaches and powered by hoists through systems of rope reeving, used to perform lifting hook work, single or multiple line bucket work, grab, grapple, and magnet work. Derricks may be permanently installed or for temporary use as in construction work. The requirements of this Subsection also apply to any modification of these types derricks which retain their fundamental features, except for fleeting derricks. ()

b. All new derricks constructed and installed on or after the effective date of this standard shall meet the design specifications of the American National Standard Institute Safety Code for Derricks, ANSI B30.6. Derricks constructed prior to the effective date of this standard shall be modified to conform to these design specifications by December 31, 1973 unless it can be shown that the derrick cannot feasibly or economically be altered and that the derrick substantially complies with the requirements of this section. ()

c. Operating controls shall be marked or an explanation of the controls shall be posted in full view of the operator. Cranes or derricks having a movable working boom shall have a radius or boom angle indicator installed. This shall be located where the operator can readily read it while in his normal operating position. ()

d. The top six (6) feet of the boom or jib shall be painted bright yellow. ()

e. Only designated personnel shall be permitted to operate a derrick and shall meet the requirements of Subsection 280.17.o. of this section. ()

f. For permanently installed derricks with fixed lengths of boom, guy, and mast rigging, a substantial, durable, and clearly legible rating chart shall be provided with each derrick and securely affixed where it is visible to personnel responsible for the safe operation of the equipment. The chart shall include the following data: manufacturer's approved load ratings at corresponding ranges of boom angle or operating radii; specific lengths of components on which the load ratings are based; and required parts for hoist reeving (size and construction of rope may be shown either on the rating chart or in the operating manual). For nonpermanent installations, the employer shall provide sufficient information from which capacity charts can be prepared for the particular installation. The capacity charts shall be located at the derricks or the job site office. ()

g. Prior to initial use, all new and altered derricks shall be inspected to insure compliance with the provisions of this standard. ()

h. Inspection procedure for derricks in regular service is divided into two (2) general classifications

based upon the intervals at which inspection shall be performed. The intervals in turn are dependent upon the nature of the critical components of the derrick and the degree of their exposure to wear, deterioration, or malfunction. The two (2) general classifications are herein designated as frequent and period with respective intervals between inspections as defined below: frequent inspection - daily to monthly intervals and periodic inspection - one (1) to twelve (12) month intervals, or as specified by the manufacturer. ()

i. Items such as the following shall be inspected at frequent intervals for defects at intervals as defined in Subsection 280.21.h. of this section or as specifically indicated, including observation during operation for any defects which might appear between regular inspections. Deficiencies shall be carefully examined for any safety hazard. All control mechanisms shall be inspected daily for adjustment, wear, and lubrication. All chords and lacing shall be inspected daily visually. Tension in guys and plumb of the mast shall be inspected daily. Inspection for deterioration or leakage in air or hydraulic systems shall be done daily. Derrick hooks shall be inspected for deformations or cracks. Hooks with cracks or having more than fifteen (15) percent in excess of normal throat opening or more than ten (10) degree twist from the plane of the unbent hook shall be discarded immediately and not reused on any equipment subject to the provisions of this standard. Rope reeving shall be visually inspected for noncompliance with derrick manufacturer's recommendations. Hoist brakes, clutches, and operating levers shall be checked daily for proper functioning before beginning operations. Electrical apparatus shall be inspected for malfunctioning, signs of excessive deterioration, dirt, and moisture accumulation. ()

j. Complete inspections of the derrick shall be performed at periodic intervals as defined in Subsection 280.21.h. of this section depending upon its activity, severity of service, and environment, or as specifically indicated below. These inspections shall include the requirements of Subsection 221.20.i. of this section and in addition, items such as the following. Deficiencies shall be carefully examined and a determination made as to whether they constitute a safety hazard: bolts or rivets for tightness; parts such as pins, bearings, shafts, gears, sheaves, drums, rollers, locking and clamping devices, for wear, cracks, and distortion; structural members for deformations, cracks, and corrosion; gudgeon pin for cracks, wear and distortion each time the derrick is to be erected; and power plants for proper performance and compliance with applicable safety requirements. Hooks shall have magnetic particle or other suitable crack detecting inspection should be performed at least once each year. Foundation or supports shall be inspected for continued ability to sustain the imposed loads. ()

k. A derrick which has been idle for a period of one (1) month or more, but less than six (6) months shall be given an inspection conforming with requirements of Subsection 280.21.h. and Subsection 280.14 of this section before placing in service. A derrick which has been idle for a period of over six (6) months shall be given a complete inspection conforming with requirements of Subsections 280.21.h. and 280.21.i. and Subsection 280.14 of this section before placing in service. Standby derricks shall be inspected at least semi-annually in accordance with requirements of Subsection 280.21.i. and Subsection 280.14 of this section. Those exposed to adverse environment should be inspected more frequently. Prior to initial use all new and altered derricks shall be tested to ensure compliance with this section, including the following functions: load hoisting and lowering; boom up and down; swing; and operation of clutches and brakes of hoist. ()

l. All anchorages shall be approved by the appointed person. Rock and hairpin anchorages shall require special testing. ()

m. A preventive maintenance program based on the derrick manufacturer's recommendations shall be established. ()

n. Before adjustments and repairs are started on a derrick, the following precautions shall be taken: the derrick to be repaired shall be arranged so it will cause the least interference with other equipment and operations in the area; all hoist drum dogs shall be engaged; the main or emergency switch shall be locked in the open position, if an electric hoist is used; warning or out of order signs shall be placed on the derrick and hoist; the repairs of booms or derricks shall either be made when the booms are lowered and adequately supported or safely tied off; a good communication system shall be set up between the hoist operator and the appointed individual in charge of the derrick operations before any work on the equipment is started; and welding repairs shall be approved by an appointed person. After adjustments and repairs have been made, the derrick shall not be operated until all guards have been reinstalled, safety devices reactivated, and maintenance equipment removed. Any unsafe conditions disclosed by inspection shall be corrected before operation of the derrick is resumed. Adjustments shall be maintained to assure correct functioning of components. ()

o. Repairs or replacements shall be provided promptly as needed for safe operation. The following are examples of conditions requiring prompt repair or replacement: hooks showing defects described in Subsection 280.14 of this section shall be discarded; all critical parts which are cracked, broken, bent, or excessively worn; pitted or burned electrical contacts shall be corrected only by the replacement and in sets; controller parts should be lubricated as recommended by the manufacturer; and all replacement and repaired parts shall have at least the original safety factor. ()

p. Derrick operation shall be directed only by the individual specifically designated for that purpose. ()

q. No derrick shall be loaded beyond the rated load. When loads approach the maximum rating of the derrick, it shall be ascertained that the weight of the load has been determined within plus or minus ten (10) percent before it is lifted. A derrick shall not be used for side loading except when specifically authorized by a responsible person who has determined that the various structural components will not be over-stressed. Boom and hoisting rope systems shall not be twisted. ()

r. The operator shall not be allowed to leave his position at the controls while the load is suspended. People shall not be permitted to stand or pass under a load on the hook. If the load must remain suspended for any considerable length of time, a dog, or pawl and ratchet, or other equivalent means, rather than the brake alone, shall be used to hold the load. ()

s. Dogs, pawls, or other positive holding mechanism on the hoist shall be engaged. When not in use, the derrick boom shall: be laid down; be secured to a stationary member, as nearly under the head as possible, by attachment of a sling to the load block; or be hoisted to a vertical position and secured to the mast. ()

t. Exposed moving parts, such as gears, ropes, setscrews, projecting keys, chains, chain sprockets and reciprocating components which constitute a hazard under normal operating conditions shall be guarded. Guards shall be securely fastened. Each guard shall be capable of supporting without permanent distortion, the weight of a two hundred (200) pound person unless the guard is located where it is impossible for a person to step on it. ()

u. Hooks shall meet the manufacturer's recommendations and shall not be overloaded. Safety latch type hooks shall be used or the hooks shall be moused. ()

v. A carbon dioxide, dry chemical, or equivalent fire extinguisher shall be kept in the immediate vicinity of the derrick. Operating and maintenance personnel shall be familiar with the use and care of the fire extinguishers provided. ()

w. Refueling with portable containers shall be done with Underwriters' Laboratory, Inc., (UL) or Factory Mutual Laboratories approved or equivalent, safety type metal containers equipped with automatic closing spout and flame arrester. Machines shall not be refueled with the engine running. ()

x. Except where the electrical distribution and transmission lines have been deenergized and visibility grounded at point of work or where insulating barriers not a part of or an attachment to the derrick have been erected to prevent physical contact with the lines, derricks shall be operated proximate to, under, over, by, or near power-lines only in accordance with the provisions of Section 151 of this standard. Cage-type boom guards, insulating links, or proximity warning devices may be used on derricks, but the use of such devices shall not operate to alter the requirements of above. Before the commencement of operations near electrical lines, the owners of the lines or their authorized representatives shall be notified and provided with pertinent information. The owner's cooperation shall be requested. Any overhead wire shall be considered to be an energized line until the owner of the line or their authorized representatives state that it is deenergized. ()

y. All timbers for A-frames shall be of correct size, length, and condition to sustain the maximum contemplated loads. A-frame timbers shall be braced with two (2) spreaders spaced one-fourth (1/4) the length of the A-frame from each end. Cross bracing shall cross between the two (2) spreaders. Bracing material shall be not less than two thirds (2/3) of the rated strength of the A-frame timbers. Tie rods (stay bolts) of not less than one and one-half (1 1/2) the diameter of the main A-frame timbers shall be used. Tie rods shall be placed directly above the upper

spreader and directly below the lower spreader. Ends of bolts shall be secured at each end with malleable washers and nuts. The base of the A-frame shall be securely anchored. Elevating type A-frames shall be set in pinion-type sockets. Pinion bases shall be securely anchored. Guy lines shall be of sufficient strength to carry the load imposed upon them and shall be securely fastened in place. ()

22. Helicopter Hoisting Operations. ()

a. Helicopter operations shall comply with all applicable regulations of the Federal Aviation Administration. ()

b. Prior to each day's operation, a briefing shall be conducted. This briefing shall set forth the plan of operation for the pilot and ground personnel. Sufficient ground personnel shall be provided when required for safe helicopter loading and unloading operations. ()

c. The load shall be properly slung. Tag lines shall be of a length that will not permit their being drawn up into rotors. Pressed sleeve, swedged eyes, or equivalent means shall be used for all freely suspended loads to prevent hand splices from spinning open or cable clamps from loosening. Hoist ropes or other gear, except for pulling lines or conductors that are allowed to pay out from a container or roll off a reel, shall not be attached to any fixed ground structure, or allowed to foul on any fixed structure. ()

d. All electrically operated cargo hooks shall have the electrical activating device so designed and installed as to prevent inadvertent operation. In addition, these cargo hooks shall be equipped with an emergency mechanical control for releasing the load. The hooks shall be tested prior to each day's operation to determine that the release functions properly, both electrically and mechanically. ()

e. Personal protective equipment for employees receiving the load shall consist of complete eye protection and hard hats secured by chin straps. Loose-fitting clothing likely to flap in the down-wash and thus be snagged on hoist line shall not be worn. ()

f. Every practical precaution shall be taken to provide for the protection of the employees from flying objects in the rotor down-wash. All loose gear within one hundred (100) feet of the place of lifting the load, depositing the load, and all other areas susceptible to rotor down-wash shall be secured or removed. Good housekeeping shall be maintained in all helicopter loading and unloading areas. ()

g. The helicopter operator shall be responsible for size, weight, and manner in which loads are connected to the helicopter. The weight of an external load shall not exceed the manufacturer's rating. If, for any reason, the helicopter operator believes the lift can not be made safely, the lift shall not be made. ()

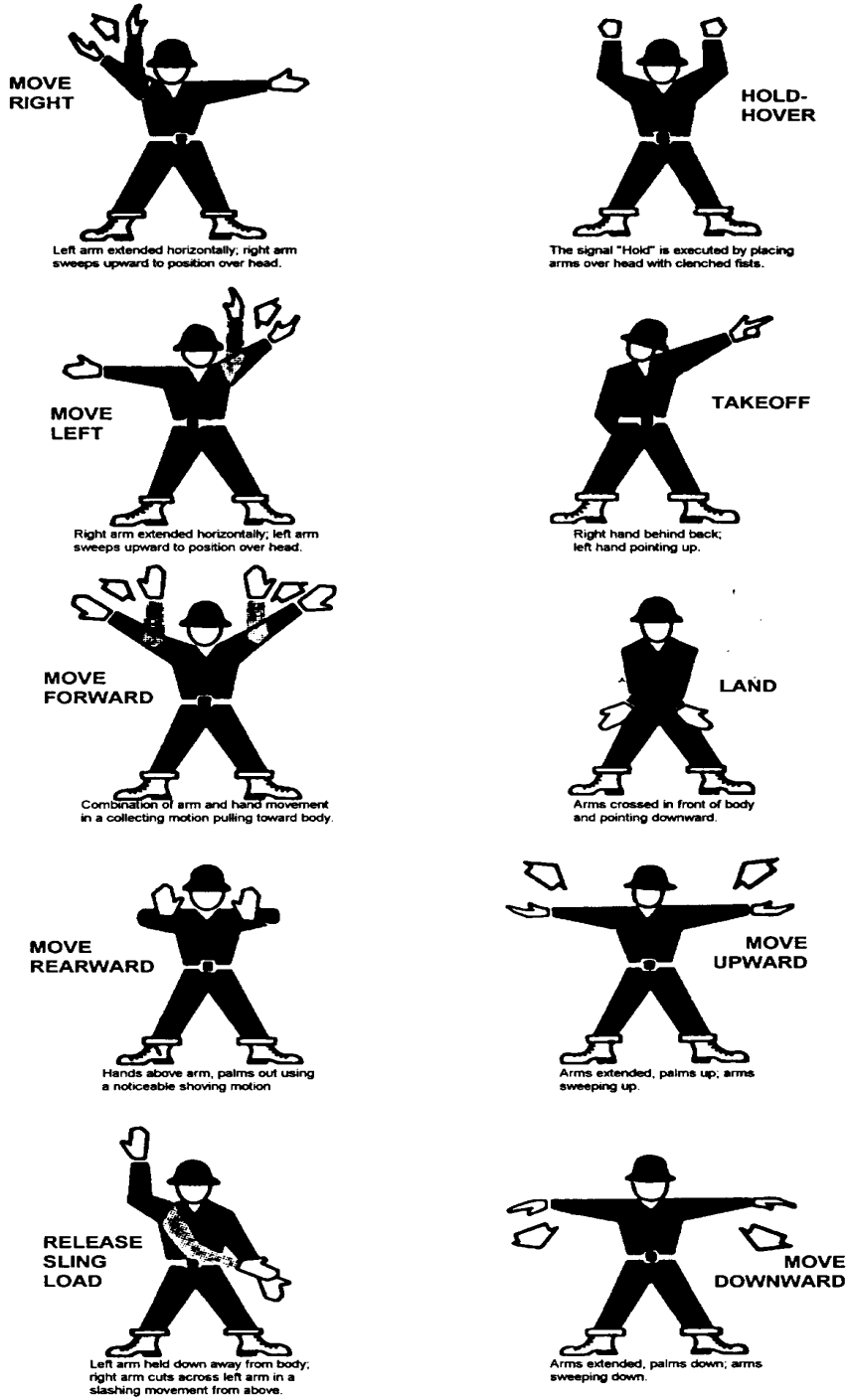
h. Employees shall not perform work under hovering craft except for that limited period of time necessary to guide, secure and unhook loads, or to hook loads. Regardless of whether the hooking or unhooking of a load takes place on the ground or a flat roof, or other location in an elevated work position in structural members, a safe means of access and egress, to include an unprogrammed emergency escape route or routes, shall be provided for the employees who are hooking or unhooking loads. ()

i. Static charge on the suspended load shall be dissipated with a grounding device before ground personnel touch the suspended load, or protective rubber gloves shall be worn by all ground personnel touching the suspended load. ()

j. When visibility is reduced by dust or other conditions, ground personnel shall exercise special caution to keep clear of main and stabilizing rotors. Precautions shall also be taken by the employer to eliminate as far as practical reduced visibility. ()

k. There shall be constant reliable communication between the pilot, and a designated employee of the ground crew who acts as a signalman during the period of loading and unloading. This signalman shall be distinctly recognizable from other ground personnel. Signal systems between aircrew and ground personnel shall be understood and checked in advance of hoisting the load. This applies to either radio or hand signal systems. Hand signals shall be as shown in Figure 280.22-A. ()

FIGURE 280.22-A



l. No unauthorized person shall be allowed to approach within fifty (50) feet of the helicopter when the rotor blades are turning. Whenever approaching or leaving a helicopter with blades rotating, all employees shall remain in full view of the pilot and keep in a crouched position. Employees shall avoid the area from the cockpit or cabin rearward unless authorized by the helicopter operator to work there. ()

m. Open fires shall not be permitted in an area that could result in such fires being spread by the rotor down-wash. ()

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