Occupational Safety and Health Standards for the Oil and Gas Industry

Participant Manual

Texas Engineering Extension Service (TEEX)
Professional and Regulatory Training (PRT)

A Member of The Texas A&M University System

PRT 512

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OSHA TRAINING INSTITUTE

Southwest Education Center

The Texas Engineering Extension Service (TEEX), a member of The Texas A&M University System, is a recognized leader in championing worker safety and health through unparalleled occupational, industrial and construction safety training programs.

The Occupational Safety and Health Administration (OSHA) Training Institute's Southwest Education Center at TEEX serves Texas, Louisiana, New Mexico, Oklahoma and Arkansas. However, TEEX's impact on safety and health extends nationwide. TEEX operated the top OSHA center yet again in 2005, setting a national record for participants trained. Twenty-nine OSHA courses are conducted at the agency's 32,000-square-foot Mesquite, Texas, facility and at locations throughout Region VI.

The TEEX Certified Safety and Health Official (CSHO) professional certificate program is proving beneficial to the hundreds who have completed the required courses and earned CSHO status. This program, originally offered exclusively for safety and health professionals in construction and general industry, has been expanded to include career tracks for oil & gas and petrochemical, aviation and emergency response personnel. This professional certificate program is now recognized by the Council on Certification of Health, Environmental and Safety Technologists (CCHEST) and the International Association for Continuing Education and Training (IACET).

Following the disasters of Hurricanes Katrina, Rita and Wilma, TEEX expertise and resources were tapped by OSHA to target health and safety training for reconstruction workers and organizations. TEEX has conducted numerous courses in the disaster-stricken areas, including: Disaster Site Hazard Awareness, the OSHA 10-Hour Construction and Disaster Site Worker Course, plus a Train-the-Trainer Disaster Site Course.

TEEX leads the nation in offering OSHA safety classes in Spanish and training bilingual instructors who reach out to Spanish-speaking workers and small business owners. All training emphasizes safe work practices, personal protective equipment, regulatory compliance and environmental safety.

OSHA TRAINING INSTITUTE SOUTHWEST EDUCATION CENTER

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TEXAS A&M SYSTEM

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Participant Manual

The Texas A&M University System

Texas Engineering Extension Service (TEEX)

Professional and Regulatory Training Division (PRT)

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Module 1

Introduction and Orientation

About This Course

Course Goal

Upon the successful completion of this course, participants will be able to identify the most common hazards associated with oil and gas exploration and production activities, locate applicable OSHA standards and requirements, and recommend abatement methods for these hazards and violations of these standards.

Course Overview

This course presents occupational safety and health standards that apply to the oil and gas industry, with an emphasis on drilling and well servicing activities. Standards addressed in this class come primarily from 29 CFR 1910, the OSHA general industry regulations, along with selected OSHA construction regulations from 29 CFR 1926. The course is based heavily on the OSHA 511 general industry standards course and is designed to fulfill the training prerequisite for the OSHA 501 general industry trainer course.

Target Audience

This course was built to support a Department of Labor training grant for members of the oil and gas field service industry, SIC 138. The course is designed for employees, management and owners of businesses associated with oil and gas extraction operations. It will help to be familiar with oil and gas extraction processes, since not all oil and gas terms are described fully. Participants who are unfamiliar with the oil and gas industry may want to consider taking the OSHA 510 or 511 courses instead of this course or taking an Introduction to Oil and Gas course first.

Delivery Methods

Course delivery consists of lectures, small group discussions, and team and individual exercises. Participants will spend much of their time finding and interpreting standards in the Code of Federal Regulations.

Course Prerequisites

No prerequisites, but familiarity with the oil and gas exploration and production industry will be invaluable.

Course Length

4 days, or 31 hours

Registration and Attendance

TEEX-PRT attendance policy requires all students to fully attend enrolled classes. You must attend the entire class to receive a certificate of completion. We realize that extenuating circumstances may arise that would take you out of class and use the following policy to handle those situations.

- You are expected to attend 100% of the course in which you are enrolled.
- If an extenuating circumstance requires you to attend less than 100% of class, you must complete a Student Absentee Request form and submit it to the instructor for approval before leaving. If the extenuating circumstance arises during non-class hours, you must complete the Student Absentee Request form immediately upon return to the classroom and submit it to the instructor for approval.
- With an approved absence for extenuating circumstances you may have options for make-up work. See your instructor.
- Unexcused absences will require you to make up time missed by attending the same course offered at another time.
- You must enroll through TEEX-PRT Registrars to attend the make-up course.

In order to receive a certificate of completion, each participant must:

- complete a registration form at the beginning of the course;
- sign the attendance roster for each day of the course, and;
- complete the evaluation at the end of the course.

If this is a grant funded class, you must fill out the affirmation of eligibility form and agree to provide feedback after the course.

Class Schedule

Day One

Morning

- Module 1: Introduction and Orientation
- Module 2: Why Safety?
- Module 3: Introduction to OSHA

Afternoon

- Module 4: Introduction to OSHA Standards
- Module 5: Inspections, Citations, and Penalties
- Module 6: Multi-Employer Workplaces

Day Two

Morning

- Module 7: Safety and Health Programs
- Module 8: Recordkeeping
- Module 9: Walking and Working Surfaces and Fall Protection

Afternoon

- Module 10: Electrical Standards
- Module 11: Hazard Communication
- Module 12: Introduction to Industrial Hygiene

Day Three

Morning

- Module 13: Personal Protective Equipment
- Module 14: Hazardous Materials
- Module 15: Permit-Required Confined Space Entry

Afternoon

- Module 16: Welding
- Module 17: Egress and Fire Protection
- Module 18: Materials Handling

Day Four

Morning

- Module 19: Machine Guarding
- Module 20: Lockout/Tagout
- Module 21: Construction Hazards and Standards

Afternoon

- Module 21: Construction Hazards and Standards (continued)
- Module 22: Oil and Gas Industry Guidelines
- Module 23: Review, Assessment and Course Closing

Breaks will be provided as necessary.

Participant Evaluation Strategy

Participants must demonstrate active involvement in the course and will be evaluated through discussion responses and classroom activities. Participants will participate in group and individual exercises and may be tested at the end of the course to evaluate comprehension.

Participants will receive a certificate and if they meet the attendance requirements and participate substantially in class activities.

Administrative Instructions

Instructors will use this portion of course time to familiarize you with facility safety and convenience features, as well as any additional resources or equipment available to you.

Instructor Role

To provide the most interactive learning experience possible, the instructor will serve as a facilitator of content and not as a mere lecturer. As a facilitator, the instructor will focus on guiding participant interaction and therefore will require the willing participation of all students.

Participant Role

During classroom discussion, you may not agree with the opinions or assumptions of your fellow classmates; however, please be respectful and courteous in your disagreement.

Module 2

Why Safety?

Terminal Objective

Upon the successful completion of this module, participants will be able to describe the effects of workplace injuries and illnesses.

Enabling Objectives

1. Discuss prevalence and frequent causes of fatalities and injuries in general industry and in the oil and gas exploration and production industry.
2. Describe important reasons for injury reduction and compliance with regulations.

Why Safety?

Why is safety important?

A good health and safety program can reduce injuries. In the U.S. an injury occurs about every 8.3 seconds.

More About the Injuries

4,365,200 injuries resulted in:

- lost work time;
- medical treatment (other than 1st aid);
- loss of consciousness;
- restriction of work or motion; or
- transfer to another job.

More than 2.2 million injuries were serious enough to require recuperation away from work or to restrict duties at work or both.

Nationwide, injury rates generally are higher for companies with 50-249 workers than for smaller or larger companies

Highest injury occupations

- Truck drivers
- Laborers, non-construction
- Nursing aides, orderlies
- Laborers, construction
- Janitors & cleaners
- Electricians
- Metal/plastic workers
- Roofers
- Logging workers
- Pilots
- Assemblers
- Carpenters
- Cooks
- Stock handlers & baggers
- Welders and cutters
- Fork lift drivers

- Steel workers
- Commercial fishing

1/4th of the 2.2 million cases involving days away from work resulted in 21 days or more away from work.

Carpal tunnel syndrome cases had more median days away (28) than amputations (25).

Musculoskeletal disorders (MSDs) account for 32% of all cases.

A Good Health and Safety Program Can Stop the Slaughter...

A workplace death occurs about every hour and a half in the United States.

Oil and Gas Fatalities: SIC 138, FY 2006

Provided by Marianne McGee, Compliance Assistance Specialist, OSHA, Corpus Christi, TX

60 fatalities in SIC 1381 nationwide; 33 in Region VI (Texas, Oklahoma, Arkansas, Louisiana, New Mexico

Summary

Struck-by: 18

Pressure Release/Explosion: 5

Electrocution: 4

Fall from elevation: 2

Heart attack: 2

Caught-in: 1

Asphyxiation: 1

Struck-By

Employee was walking across the site to visually inspect drill pipe when he was struck by a truck.

The crown sheave shaft came out of one of its mounts releasing the sheaves, the drilling line, 165,000 pound drilling string, and the blocks fell to the drilling floor.

An employee was traversing a steep incline on an ATV when the vehicle turned over, striking the employee.

Employee was struck on the head by a falling A-Frame leg of a drilling derrick. The employee was in the process of guiding the brace of the A-Frame leg into place.

An employee was working on / near the line heater when the end blew off. The employee had been engaged in changing out the o-ring. Shut in the line heater by closing a valve upstream at / near the well head and closing a valve downstream in front of the separator. The valve upstream had been opened but the valve downstream had not been opened.

Employee was struck by pressurized mud and gas when he attempted to remove the bolt from the rotating head rubber gasket.

Explosion took place, which severed the flow lines connected to the Christmas Tree. One of the lines struck the employee, fatally injuring him.

Employee was run over by a crawler crane being used to move equipment.

Employees closed and bled line, then removed seat in choke valve. Company man activated switch which remotely activated valve releasing (4000 psi) causing a wrench to strike employee in the face.

23,000 pound traveling block and attached 180,000 pound drill string fell uncontrollably to the drilling floor.

While underneath the crane boom, employee struck retaining pin. The mid-section collapsed directly on employee.

Employee was struck by counter weights of pumping unit.

Employee jumped on to the back end of a traveling bobcat. The auger bit on the bobcat got stuck into the ground. Operator of bobcat stopped, backed up the bobcat, and raised the auger bit up; when doing this the hydraulic arms of the bobcat crushed his face and neck.

A large rock was kicked up by the rear tire of a truck which struck a worker in the head.

An employee assisting in servicing a duplex mud pump was fatally injured when a 36-inch pipe wrench situated on the rotating shaft (bull wheel) of the diesel engine struck the worker when the clutch was engaged.

Horizontal discharge piping on a trailer foam unit was left loose and not secured. When the bleed valve was opened, the back pressure whipped the discharge pipe around, striking employee.

2 incidents have no additional information at this time.

Caught - in

While lubricating rotary the employee's raincoat was caught by the near-by rotating kelly.

Pressure Release / Explosion

Employee was examining the hatch of a pressurized vessel for a suspected leak when the hatch exploded, striking the employee.

While performing gas well servicing hydrocarbon vapors escaped from the well and were ignited by the engine on the work-over rig.

While operating a reverse circulation unit, oil and natural gas came up from the well and the gas entered the intake of the swivel engine causing an explosion.

Explosion occurred while employees were sleeping.

Employee was attempting to clean out the coils from the hot oiler truck by pushing hot water through with the burners lit on the truck. Without uncoiling the hose, employee began pumping out he crude oil into the wash pit in the yard. The hot water caused a volatile steam cloud to form which was blown into the burners causing a flash fire.

Fall from Elevation

The derrickman fell while holding onto the elevator after attempting to latch a drill pipe from the fingers of the board. He had his harness on but was not tied off.

Fall from derrick board: Employee grabbed the elevator and held on for a few minutes but then let go, grasping a 4.5" vertical pipe. Employee slid partially down the pipe joint until he reached the pipe collar from where he free fell approximately 65 ft.

Electrocution

Repairing cables that had been damaged by a truck, employee was holding cable while another employee energized line (incorrect line).

Pump jack, being moved with a gin pole truck, came into contact with or came near an electrical line.

Employee detected water leak and went to turn valve off. Valve was energized.

Employee drove the forklift into the overhead power lines.

Heart attack

Climbing a stairway on a drilling rig, employee collapsed.

Employee fell to the ground suddenly and was unconscious.

Asphyxiation

Employee opened a cover at the top of a oil storage tank in order to gage the amount of water in the tank and was overcome by H2S gas.

Fatality Causes:

Hazards that cause fatalities are the most likely to cause injuries and raise cost. OSHA concentrates on the most common causes of injury and fatality.

A good health and safety program can save money...

The average direct cost of a lost time claim is over $28,000.

$afety Pays

This OSHA program is available to help you calculate costs of injuries. It is available on the Web at *http://www.osha.gov/dts/osta/oshasoft/safetwb.html*.

A good health and safety program can save more money:

- Lower Insurance Cost
- Increase Company’s Ability to Grow
- Increased Profit Margin

A good health and safety program can increase morale...

If workers are being injured, they will not feel good about their job or the company that condones unsafe working conditions and unsafe work practices.

A good health and safety program can improve efficiency...

A safe, healthy and happy workforce produces good quality output.

A good health and safety program can improve productivity...

Safety, quality, and productivity go hand in hand.

A good health & safety program provides regulatory compliance...

Compliance with regulatory standards alone does not qualify as a "good Safety and Health program."

Why NOT Safety?

Is there a defensible answer?

4 Reasons to Make Safety Important:

- Responsibility to self
- Responsibility to family
- Responsibility to not endanger co-workers
- Productivity and health of the company

BADGES WE WEAR

Your role in safety is **selling** it.

To get people to buy into safety you need to understand the badges we all wear.

Badge # 1 W.I.I.F.M.

What's In It For Me!

Badge # 2 M.M.F.I.

Make Me Feel Important!

Communication

People have to believe you truly care about their **safety**.

Module

3

Introduction to OSHA

Terminal Objective

Upon the successful completion of this module, participants will be able to explain the history and development of United States safety and health regulations, laws, and agencies.

Enabling Objectives

1. Summarize history and organization of OSHA.
2. Explain the history and development of safety and health regulations.
3. Describe major sections of the Occupational Safety and Health Act of 1970, Public Law - 91-596.
4. Discuss other federal agencies covered under The OSH Act.

Introduction to OSHA and the Act

The Need for Legislation

- Workplace injuries and illnesses increasing throughout the 1960s
- Need for more comprehensive and uniform protection of nation's workers
- Size of national workforce increasing
- Congressional hearings on worker safety were held

In 1970, Congress considered these figures:

- 14,000 worker deaths
- 2.5 million workers disabled
- 300,000 new occupational disease cases

Public Law 91-596 Enacted

Occupational Safety and Health Act signed by President Nixon on December 29th 1970; effective April 29, 1971

Occupational Safety and Health Act of 1970, also called:

- OSHA Act
- OSH Act

34 sections

Amended

- 1990
- 1998
- 2001

Purpose of the Act

". . . to assure so far as possible every working man and woman in the Nation safe and healthful working conditions and to preserve our human resources."

Three Agencies Established

- Occupational Safety and Health Administration (OSHA)
- National Institute for Occupational Safety and Health (NIOSH)

- Occupational Safety and Health Review Commission (OSHRC)

Section 2 - OSHA’S Purpose

- Reduce workplace hazards;
- Implement new or improve existing safety and health programs;
- Provide for research in solving occupational safety and health problems
- Establish employer and employee responsibilities for safety and health conditions.
- Build on employer/employee safety and health initiatives.
- Focus on occupational health to prevent diseases occurring in the work environment.
- Establish training programs to increase the number and competence of occupational safety and health personnel;
- Develop mandatory job safety and health standards and enforce them effectively;
- Develop recordkeeping and reporting requirements;
- Provide for the development, analysis, evaluation and approval of state occupational safety and health programs.

Section 3 - Definitions

As defined by the Act, an employer is any "person engaged in a business affecting commerce who has employees, but does not include the United States or any State or political subdivision of a State."

Section 4 - The Act’s Coverage

Coverage of the Act extends to all 50 states, and the District of Columbia

Includes all territories under Federal jurisdiction

Coverage provided either directly by federal OSHA or through an OSHA-approved state program.

Replaces some previously established federal laws.

- Manufacturing
- Construction
- Longshoring
- Agriculture

Not Covered

- Self-employed persons (incl. homeowners);
- Farms on which only immediate members of the farm employer's family are employed;
- Working conditions regulated by other federal agencies under other federal statutes: If they have safety and health rules and execute authority over their rules.

Federal Agency Coverage-Examples

- Federal Railroad Administration (FRA):
  - OSHA covers facilities
  - FRA covers tracks, trains, etc..
- Federal Aviation Administration (FAA):
  - OSHA covers to the tarmac
  - FAA covers past the tarmac

Section 5 - Duties

(a) Each employer -

(1) shall furnish to each of his employees employment and a place of employment which are free from recognized hazards that are likely to cause death or serious physical harm to his employees

(2) shall comply with occupational safety and health standards promulgated under this Act.

5(a)(1) Known as General Duty Clause

General Duty Clause

Applies where OSHA has not passed specific standards.

Employer must protect employees from recognized hazards likely to cause death or serious harm:

- Industry and consensus standards
- Common safe practices
- Hazards recognized by similar employers
- Manufacturer requirements or manuals

(b)

Each **employee** shall comply with occupational safety and health standards and all rules, regulations, and orders issued pursuant to the Act which are applicable to his own actions and conduct.

Provisions for Federal Employees

Federal agency heads responsible for providing safe and healthful working conditions for their employees.

Act requires agencies to comply with standards consistent with those OSHA issues.

No OSHA $$$ penalties levied against another federal agency for failure to comply with OSHA standards (Exception: U.S. Postal Service; enacted 1998).

Compliance issues at federal agencies are resolved internally to that agency.

Federal agency safety responsibilities are described in Section 19 of the Act.

Provisions for State & Local Governments

OSHA provisions do not apply to state and local governments.

States desiring to gain OSHA approval for a private sector occupational safety and health program must provide a program that also covers state and local government workers.

State plans may also cover only public sector employees (city, municipal, state).

Twenty-three states and territories operate plans covering both the public and private sectors. State plan states include AK, AZ, CA, CT, HI, IN, IA, KY, MD, MI, MN, NV, NJ, NM, NY, NC, OR, PR, SC, TN, UT, VT, VI, VA, WA, and WY.

Three states – CT, NJ, and NY - operate public employee only plans.

Section 6 - Occupational Safety and Health Standards

Secretary of Labor, for first two years after Act's promulgation, could adopt any established Federal or consensus standard which would result in improved employee safety and health.

It is the responsibility of the employer to become familiar with standards that apply to their establishments.

(6)(a) OSHA given authority to promulgate start-up standards without rulemaking

(6)(b) Rulemaking procedure

(6)(c) Emergency temporary standards

(6)(d) Variances

Section 7 - Advisory Committees; Administration

7(a)(1) Establishes National Advisory Committee on Occupational Safety and Health

"The Committee shall advise, consult with, and make recommendations to the Secretary…"

NACOSH meets at least twice per year.

Section 8 - Inspections, Investigations & Recordkeeping

8(a) OSHA representatives are authorized to:

(1) enter without delay

(2) inspect during regular working hours and at reasonable times and to question privately employers and employees

8(b) OSHA has subpoena power

8(c) OSHA requires recordkeeping

8(f) Employees right of complaint

Section 9 - Citations

9(a) If an employer violates Section 5 of Act or any standard, rule or order related to Section 6, a citation may be issued. Each citation will:

- Be in writing
- Describe the particular violation
- Set a reasonable abatement period

9(b) Posting of citations

9(c) Time limit - 6 months to issue citation

Section 10 - Enforcement

10(a) Employer's right of contest

Citations can be contested up to the Occupational Safety and Health Review Commission (OSHRC), an independent quasi-judicial branch of the Department of Labor

10(c) Employee's right of contest of abatement dates

Section 11 - Judicial Review

11(a) Appeals & review of Commission order

11(c) Prohibits discrimination against employees filing complaints under OSHA, or for disclosing safety and health issues concerning the workplace

Section 12 - Occupational Safety & Health Review Commission

Establishes membership and terms of Review Commission (OSHRC)

OSHRC acts independently of OSHA.

http://www.oshrc.gov

Section 13 - Procedures to Counteract Imminent Dangers

Allows OSHA to petition for (obtain) a restraining order in cases of Imminent Danger.

- U.S. District Court issues
- Area Director requests through Solicitor of Labor

OSHA will:

- Advise employer of imminent danger
- Advise employees of rights
- Petition District Court for relief

Section 17 - Penalties

Penalties were increased in 1990.

- Willful & repeated violations to a maximum of $ 70,000
- Minimum $ 5,000 willful
- Serious & other than serious to $ 7,000
- Failure to abate to a maximum of $ 7,000 for each day violation continues (up to 30 day max.)

Section 18 - State Plans

States may regulate anything OSHA does not.

State plans must be approved by OSHA to regulate anything OSHA does.

Must be at least as effective as federal standards.

Approved state plans can receive funding up to 90% of budget.

Penalty proceeds collected via state programs remain in that state.

Section 19 - Federal Agency Programs & Responsibilities

Federal agencies (exception: Post Office) are required to establish their own safety and health programs consistent with OSHA.

- Require the use of safety equipment & PPE as necessary to protect employees
- Keep accident and illness records
- Establish rules consistent with OSHA

Executive Order 12196 further defines the responsibilities of Federal Agencies.

Section 20 - Research and Related Activities

Most OSHA research is carried out by the National Institute for Occupational Safety and Health (NIOSH), under Department of Health and Human Services (HHS).

Secretary of HHS confers with Secretary of Labor and conducts research on occupational safety and health problems.

Section 21 - Training and Employee Education

Training and education responsibilities are shared by the Department of Labor (DOL) and HHS

Training is authorized directly or through grants

Section 22 - National Institute for Occupational Safety and Health

Establishes NIOSH as a part of HHS

Section 24 - Statistics

DOL is authorized to collect and analyze statistics of occupational fatalities, injuries, and illnesses.

Data is collected and compiled by the Bureau of Labor Statistics (BLS).

Section 27 - NCSWCL

Establishment of the National Commission on State Workman's Compensation Laws to ensure adequate worker protection in the event of disabling work-related injuries and illnesses

Historic Progress

A total of 5,915 fatal work injuries were recorded in 2000, which is a decline of about 58% percent from 1970, according to the Census of Fatal Occupational Injuries, conducted by the Bureau of Labor Statistics, U.S. Department of Labor.

Module 4

Introduction to OSHA Standards

Terminal Objective

Upon the successful completion of this module, participants will be able to describe the organization, origin and codification of OSHA standards.

Enabling Objectives

1. Describe the system of organization for the Code of Federal Regulations.
2. Identify major parts within Title 29 Labor.
3. Discuss the origin of OSHA standards.
4. Explain the codification system for general industry standards.
5. Identify tasks for which general industry standards or construction standards apply.
6. Recognize types of consensus or proprietary standards that may be legally binding because they are incorporated by reference or commonly used in the industry.
7. Explain the purpose, location and type of information found in a preamble to a regulation.
8. Identify the purpose, location and type of information found in OSHA Directives, including Enforcement and Compliance Directives (CPL).
9. Identify the purpose, location and type of information found in letters of interpretation.

Code of Federal Regulations (CFR)

A system of organization for the general and permanent rules published in the Federal Register by the Executive departments and agencies of the Federal Government

The CFR is divided into 50 titles covering Federal laws passed by different branches of government.

- Regulations first published or revised in the Federal Register
- CFR updated annually with revisions and new regulations
- OSHA regulations updated each July 1st

Examples of what the different titles cover:

- Title 3: The President
- Title 10: Energy
- Title 21: Food and Drugs
- Title 29: Labor
- Title 40: Protection of Environment
- Title 49: Transportation

Title 29-Labor

Titles divided into chapters which bear the name of the issuing agency.

OSHA is designated Title 29-Labor, Chapter XVII.

Each chapter is subdivided into parts covering specific regulatory areas.

Important Parts of 29 CFR:

Part 1903 Inspections, Citations and Proposed Penalties

Part 1904 Recording and Reporting Occupational Injuries and Illnesses

Part 1910 General Industry Standards

Part 1926 Construction Standards

Origin of OSHA Standards

Many OSHA standards were originally developed from three sources:

- Consensus standards
- Proprietary standards
- Federal laws already in effect

Consensus Standards

Developed by industry-wide standard developing organizations, including:

- American National Standards Institute (ANSI)
- National Fire Protection Association (NFPA)

Discussed and substantially agreed upon through member consensus

National in scope

Developed by a committee of experts within a particular field

Often developed through subject subcommittees

Examples of Consensus Standards:

- ANSI Standard B56.1-1969, Standard for Powered Industrial Trucks
- NFPA No. 30-1969, Flammable and Combustible Liquids Code: source for Part 1910 Section 106

Proprietary Standards

Prepared by professional experts within specific industries, professional societies and associations

Determined by straight membership vote, not consensus

Examples of Proprietary Standards:

- Compressed Gas Association, Pamphlet P-1, Safe Handling of Compressed Gasses in Containers
- American Conference of Governmental Industrial Hygienists (ACGIH), Threshold Limit Values (TLVs)
- American Petroleum Institute (API) Recommended Practice (RP) 54, Recommended Practice for Occupational Safety for Oil and Gas Well Drilling and Servicing Operations

Relation of Proprietary and Consensus Standards to OSHA Standards

Not enacted as OSHA standard directly unless incorporated by reference in text

Citation possible under General Duty Clause, 5(a)(1) if:

- Employees were exposed to hazard
- Hazard was recognized

- Hazard caused or was likely to cause death or serious harm
- There was a feasible and useful method to correct the hazard

Pre-Existing Federal Law

Some preexisting federal laws were enforced prior to OSHA including:

- Federal Supply Contracts Act (Walsh-Healey)
- Federal Service Contracts Act (McNamara-O'Hara)

Horizontal and Vertical Standards

Some standards are **horizontal** meaning "general", or "across the board". Horizontal standards could apply to any employer in any industry.

Examples of horizontal standard:

- Hazard Communication Standard
- Walking and Working Surfaces

Vertical standards are specific only to a particular industry:

- Pulp, paper, and paperboard mills (1910.261)
- Textiles (1910.262)
- Sawmills (1910.265)
- Logging operations (1910.266)

No Federal vertical standard exists for oil and gas well drilling or servicing.

Distinction extends within sub-divisions and individual paragraphs of OSHA standard (example: Portable Powered Tools)

Horizontal: Employer responsible for safe condition whether furnished by employer or employee

Vertical: Hand held circular saw shall have a constant pressure on/off switch

OSHA Standards Development

Standard Development Petitions

OSHA can begin standards-setting procedures on its own initiative, or in response to petitions from other parties, including:

- Secretary of Health and Human Services (HHS);
- National Institute for Occupational Safety and Health (NIOSH);
- U.S. Environmental Protection Agency (EPA);
- State and local governments;
- Standards-producing organization;
- Employer or labor representatives, or;
- Any other interested person.

Advisory Committees

If OSHA determines that a specific standard is needed, any of several advisory committees may be called upon to develop specific recommendations.

All advisory committees must have members representing management, labor and state agencies.

Health and Safety professions and the general public also may be represented.

National Advisory Committee on Occupational Safety and Health (NACOSH) : Advises the Secretary of HHS and the Secretary of Labor on matters regarding administration of the Act.

Advisory Committee on Construction Safety and Health : advises the Secretary of Labor on formulation of construction safety and health standards and other regulations.

Standards Adoption

OSHA intentions to propose, amend, or revoke a standard are published in the Federal Register:

- Notice of Proposed Rulemaking
- Request for Information
  - — Provides time for the public to respond
  - — Sets up public hearings

"Advance Notice" or "Request for Information" may be used to solicit information that can be used in drafting a proposed standard

Usually provide 60 days or more for the public to respond

Public hearings then scheduled

After the close of the comment period and any public hearing that is held, OSHA must publish in the Federal Register:

- The full, final text of any standard amended or adopted;
- The date it becomes effective;
- An explanation of the standard and the reasons for implementing it (Preamble).

Preambles provide help with standard interpretation.

Emergency Temporary Standards (ETS)

ETS's take effect immediately!

OSHA must determine that workers are in grave danger due to exposure to toxic substances or agents determined to be toxic or physically harmful or to new hazards.

OSHA publishes ETS in Federal Register.

ETS serves as a proposed permanent standard.

OSHA has had only one ETS in its history.

Appealing a Standard

May file a petition for judicial review within 60 days of the rule's promulgation with the U.S. Court of Appeals for the circuit in which the objector lives or has his or her principal place of business.

Appeals petition will not delay enforcement unless the Court of Appeals specifically orders it.

Reading OSHA Standards

Major Subparts in 29 CFR 1910 and 1926 for Oil and Gas Operations

Found in "Oil and Gas and Petrochemical: The Complete OSHA Guide"

- 1903, 1904, 1910, 1926
- Interpretations and forms also included

Up-to-date versions can be found on *www.osha.gov.*

Organization of a Subpart

Subpart for major chunks of regulation, e.g. 29 CFR 1910 Subpart D - Walking and Working Surfaces

Divided into sections, e.g.:

1910.21 Definitions

1910.22 General Requirements

1910.23 Guarding Floor and Wall Openings and Holes

1910.24 Fixed Industrial Stairs

Part 1910 Major Subparts

Subpart D - Walking and Working Surfaces

Subpart E - Exit Routes, Emergency Action Plans, and Fire Prevention Plans

Subpart F - Powered Platforms

Subpart G - Occupational Health and Environmental Control

Subpart H - Hazardous Materials

Subpart I - Personal Protective Equipment

Subpart J - General Environmental Controls

Subpart K - Medical and First Aid

Subpart L - Fire Protection

Subpart M - Compressed Gas

Subpart N - Materials Handling

Subpart O - Machinery and Machine Guarding

Subpart P - Tools

Subpart Q - Welding, Cutting & Brazing

Subpart R - Special Industries

Subpart S - Electrical

Subpart T - Commercial Diving

Subpart Z - Toxic and Hazardous Substances

Each Subpart is then broken down into Sections:

Subpart D Walking-Working Surfaces

1910.21 Definitions

1910.22 General Requirements

1910.23 Guarding Floor and Wall Openings and Holes

1910.24 Fixed Industrial Stairs

1910.25 Portable Wood Ladders

1910.26 Portable Metal Ladders

1910.27 Fixed Ladders

1910.28 Safety Requirements for Scaffolding

1910.29 Manually Propelled Mobile Ladders and Scaffolds

1910.30 Other Working Surfaces

1910.31 Sources of Standards

1910.32 Standards Organizations

Reading Standards

29 CFR 1910.110(b)(13)(ii)*(b)(7)(iii)*

29 United States Code Title

CFR Code of Federal Regulations

1910 Part - Part 1910 covers General Industry

110 Section Number (Section 110 falls under Subpart H; Hazardous Materials)

(b) Major Topic Paragraph; “Basic Rules”

(13) Paragraph Subsection; “LP-Gas in buildings”.

(ii) Next subdivision: lower case roman numeral

After this the paragraph number sequence begins again as before, but using italics.

(After 1979, fourth set of parentheses uses capital letter instead of lower case italicized.)

Color coding may be useful for standards without formatting.

Hazard / Violation Workshop

This type of workshop will be used throughout the course.

1. Find any safety or health hazards.
2. Find any standards applicable to the situation.
3. Find any violations of standards.

Example: An exit door is blocked from the outside. What are the hazards, standards, and violations?

Applicability of OSHA Standards

Which standard applies?

- Depends on activity or industry
- 1903 and 1904 always apply
- 1926 applies for construction operations
  - — Site preparation, grading
  - — Rig up / rig down
- 1910 applies for most other operations
- When in doubt, apply the most stringent standard

Which non-OSHA standards apply?

Standards incorporated by reference in an OSHA standard:

API-ASME Code for Unfired Pressure Vessels for Petroleum Liquids and Gases, 1951 edition with 1954 Addenda, in 29 CFR 1910.110(b)(3)(iii)

ANSI Z89.1-1986, head protection, in 29 CFR 1910.135(b)(1)

Many others

- Legally binding
- May refer to a specific year of a consensus standard
- OSHA may update/remove references to outdated standards

Under 5(a)(1):

- API RP 54, RP 4G, and other relevant standards that demonstrate recognition of a hazard
- Manufacturer recommendations / manuals
- Standards protecting against commonly recognized hazards
- Employer's own documents

Interpreting OSHA Standards

OSHA Tools for Interpreting Standards

- Letters of Interpretation
- Preambles (Federal Register)
- Directives (CPL and DIR)

Letters of Interpretation

- Can contact OSHA for interpretation of a standard
- Answers based heavily on preambles to regulations
- Can be superseded by later letters
- Responses posted on www.osha.gov

Preambles (Federal Register)

- Explanation of intent behind regulations
- Published with final rules in Federal Register
- Never expire until rule is updated
- Available on www.osha.gov

Directives

Policy or procedure for OSHA

Examples:

- Enforcement and Compliance Directives (CPL)
- Standards (STD)

- Training and Education (TED)
- Available on *www.osha.gov*

Module 5

Inspections, Citations, and Penalties

Terminal Objective

Upon the successful completion of this module, participants will be able to describe the process and rules for OSHA inspections, citations and penalties.

Enabling Objectives

1. Discuss the legal basis of inspections, citations and penalties in the OSH Act.
2. Describe the major sections of Part 1903.
3. Describe the inspection process.
4. Recognize OSHA inspection priorities.
5. Indicate the various types of OSHA violations.
6. Describe the post-inspection process.
7. Identify the most frequently cited standards in the oil and gas exploration and production industry.
8. Identify consensus standards commonly cited under section 5(a)(1) for the oil and gas exploration and production industry.
9. Discuss the use of the Oil & Gas Rig Inspection Checklist for Drilling & Well Servicing Operations.

Basis in the Act

- Sections 8-10 and 13 of OSH Act authorize DOL to inspect and issue citations
- Sections 11 and 12 authorizes review of citations
- Section 17 authorizes civil and criminal penalties

In Section 8(a), OSHA representatives are authorized to:

- Enter without delay, at reasonable times
- Inspect during regular working hours and at reasonable times
- Question privately employers and employees

Regulations

29 CFR 1903

Your CFR book contains the text of 29 CFR 1903, which spells out the regulations for inspections, citations and penalties. You are encouraged to use your CFR book to follow the discussion. This Participant Manual will only contain information not found in the standards.

Inspection Priorities

Imminent Danger = top priority

- Employees notify employer of imminent danger
- If no action taken, notify OSHA

Catastrophes and Fatal Accidents = second priority

Employee Complaints = third priority

- Referrals from employees & outside agencies of unsafe or unhealthful conditions
- Informal review for situations not inspected
- Confidentiality is maintained on request

Programmed High-Hazard Inspections = fourth priority

- Aimed at high hazard industries, occupations, or health substances
- Selection criteria examples:

— Death
— Lost workday case rates
— Exposure to toxic substances

Follow-up Inspections = fifth priority

Determine whether previously cited violations have been corrected.

"Notification of Failure to Abate"

OSHA Inspection Process

Pre-Inspection Preparation

Compliance Safety and Health Officer (CSHO) becomes familiar with facility

- History
- Nature of business
- Relevant standards
- Industrial hygiene equipment selection

Inspection Process: Arrival

CSHO arrives at facility and displays credentials

Employers should always verify the identity of the CSHO

- United States Department of Labor ID including photo and serial number
- Verify by phoning OSHA

Opening Conference

CSHO explains:

- Why facility was selected
- Purpose of visit, inspection scope and applicable standards

Complaint copies distributed (if applicable)

Employee representative may be summoned

Inspection Tour

- CSHO determines route and duration

- Consults with employees
- Photos
- Instrument readings
- Examines records
- CHSO points out unsafe conditions
- Points out possible corrective action if employer requests
- Some may be corrected immediately
- May still result in citation

Closing Conference

Discussion of problems, questions and answers

Discussion of recommended citations

Time needed for abatement

Only Area Director issues citations and assesses penalty amounts

Types of Violations

Serious Violation

High probability of death or serious harm

Mandatory fine, up to $7,000

Adjusted downward:

- Good faith
- Gravity of alleged violation
- Violation history
- Size of business

Willful Violation

Employer knowingly commits with plain indifference to the law

Either knows action is a violation or is aware of hazardous condition, with no effort to eliminate

Up to $70,000 for each

Minimum of $5,000

If convicted of willful violation that has resulted in death:

- court imposed fine,
- up to six months in jail, or both
- Criminal conviction, up to $250,000 for individual; and years in jail
- $500,000 for corporation
- Corporate officers may be imprisoned

Repeat Violation

Same or substantially similar

Up to $70,000 for each violation

Failure to Abate

Up to $7000/day for each violation not abated

Maximum of 30 days

Other Than Serious Violation

Normally would not cause death or serious injury

Normally no fines

Fines levied may be lowered up to 95%

- Factors:
- Good faith
- History of violations
- Size of business

De Minimis Violation

No direct relationship to safety or health

No fines

Falsifying records

Up to $10,000, six months in jail, or both

Violations of posting requirements

Civil fine up to $7,000

Assaulting, interfering with, intimidating a CSHO while performing their duties

Up to three years prison and $5,000 fine

Reduction of Penalties

Some contested penalties are reduced:

- Up to 60% for small employers
- Up to 25% for "good faith"
  - Written safety and health program
  - Only incidental deficiencies
- Up to 10% for citation history

Increase of Penalties

Multiplied if previously cited; factor varies by employer size

Multiplied for willful violations

Citation Questions

Who - if anyone - goes to prison?

Employer = entire chain of supervision

Attempts to identify the person most reasonably considered at fault

Where does the money go?

National Treasury

Not ear-marked for OSHA

More Information Available

Field Inspection Reference Manual, CPL 2.103 (FIRM): *http://www.osha.gov/Firm_osha_data/100008.html*

Small Entity Compliance Guide for OSHA's Abatement Verification Regulation: *http://www.osha.gov/Publications/Abate/abate.html*

Discussion

1. How would your organization respond to an inspection?
   a. Immediately
   b. Afterward

2. Any effects of citation?
   a. Civil liability for injuries or illnesses
   b. Risk of repeat violations
   c. Wider hazard awareness

Most Frequently Cited Standards

Can be found on *www.osha.gov*

Following statistics from SIC 1300-1399, Oil and Gas Extraction (which includes Oil and Gas Field Services), October 2005 - September 2006

- 189 inspections, 872 citations
- $1,177,376 in penalties

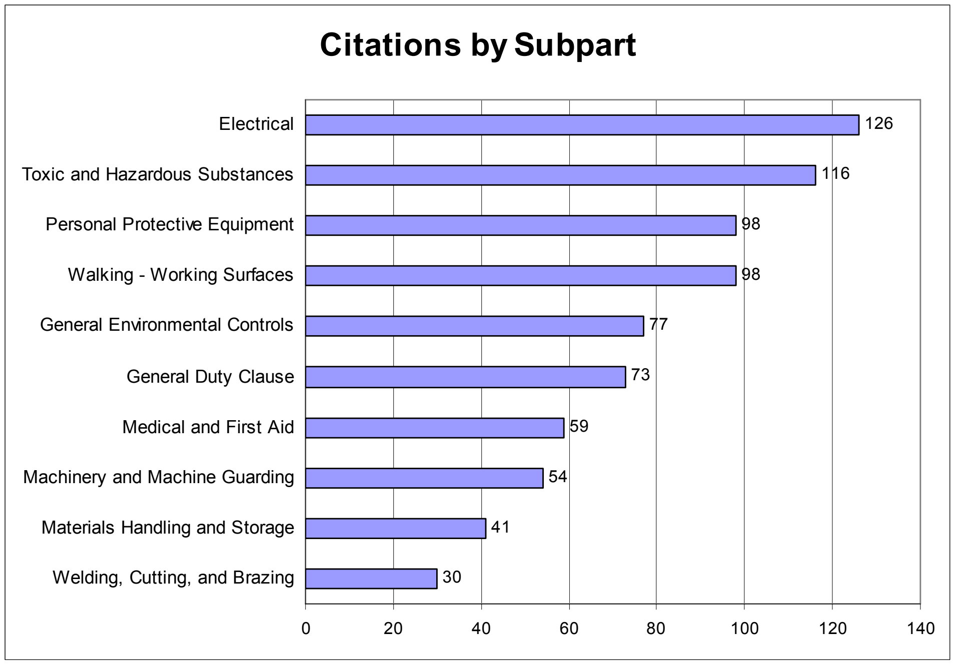

Figure 5.1: Number of citations issued by OSHA for SIC 1300 during FY06

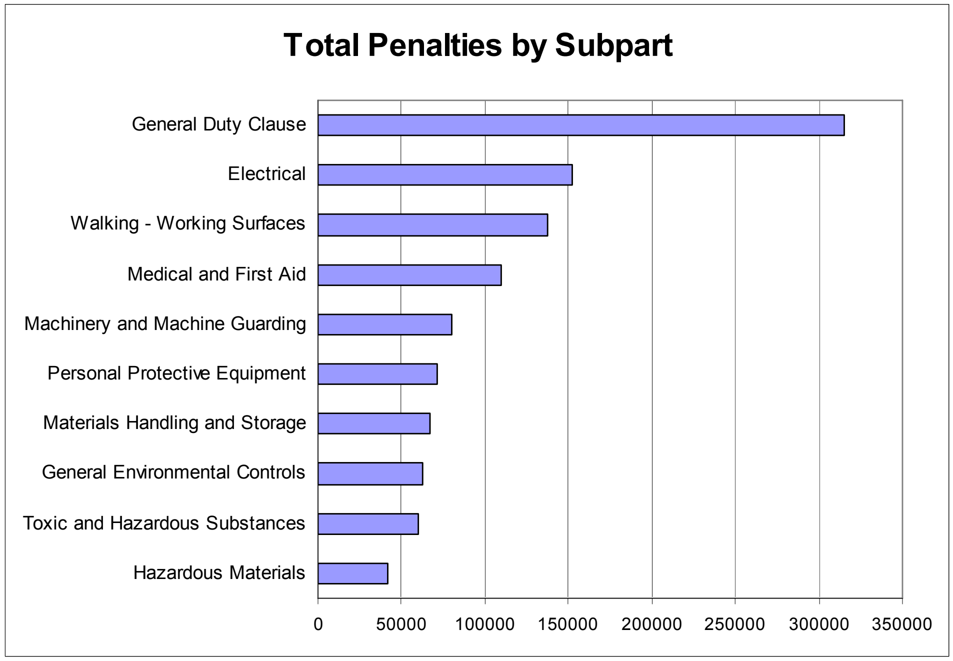

Figure 5.2: Total penalties associated with citations issued by OSHA for SIC 1300 during FY06

General Duty Clause Violations in Oil and Gas extraction

Categories between 10/1/05 and 3/6/07:

Struck by – 32

Crushing – 11

Falling – 10

Operating Procedures - 10

Equipment – 8

Burns – 6

Explosion - 5

Lifting – 5

Unclassified – 5

Chemical – 2

Guarding – 2

Lockout – 1

Most common industry standards referenced:

- — API RP 54
- — API RP 4G
- — ANSI B30
- — Operator’s manuals for equipment
- — Employer safety manuals and practices

Standards Recognized by OSHA

A list of oil and gas related industry standards is available on the OSHA web page at *http://www.osha.gov/SLTC/oilgaswelldrilling/industry.html.*

A Rig Inspection Checklist was developed for Region VI Regional Emphasis Program (REP) based on:

- 29 CFR 1910, API RP 54, other API RPs and ANSI standards and
- Checklists from IADC and AESC

It is updated by OSHA’s Baton Rouge Area Office, and you will receive a copy as a handout.

Module 6

Multi-Employer Workplaces

Terminal Objective

Upon the successful completion of this module, participants will be able to discuss the responsibilities and liabilities of each type of employer on a multi-employer workplace.

Enabling Objectives

1. Explain what makes an employer an exposing, creating, correcting or controlling employer.
2. Discuss the responsibilities and liabilities of each type of employer.

Multiple Employer Worksites

How many contractors typically work on one well site?

Who is liable if someone is hurt?

Who is cited if a standard is violated?

OSHA Multi-Employer Citation Policy

CPL 2-0.124

- Clarifies responsibilities of employers
- More than one employer may be citable
- Two-step process to determine

The full text of the multi-employer citation policy is in Appendix A of this manual. You can follow this presentation there, complete with examples.

OSHA Regulations with Rules for Multiple Employers

Specific rules in:

- Hazard communication 1910.1200
- Lockout/tagout 1910.147
- Permit-required confined spaces 1910.146
- Process safety management 1910.119

Citation policy applicable to all hazards

Civil Liability

Worker's compensation only covers employee-employer relationship.

Subcontractor employees may sue a general contractor.

Prevention:

- Reasonable care to prevent/correct hazard
- Coordination with other employers
- Contract terms / practices with contractors

Module 7

Safety and Health Programs

Terminal Objective

Upon the successful completion of this module, participants will be able to describe elements, guidelines and OSHA programs relating to safety and health programs.

Enabling Objectives

1. Recognize the importance and basic structure of safety programs.
2. Explain safety and health program guidelines.
3. Describe major elements of an effective safety program.
4. Explain the terms; alliances, strategic partnerships, and voluntary protection programs (VPP).

Effective Safety and Health Programs

Brainstorm:

What makes a good safety and health program?

What does a good program do for you?

Benefits of Effective Safety and Health Programs

- Reduce injuries & illnesses
- Improve morale & productivity
- Reduce workers' compensation costs
- Show good faith efforts

Exemplary Workplaces:

- Assign responsibility to managers, supervisors, and workers
- Inspect regularly to control hazards
- Train employees to recognize and avoid hazards
- Provide systematic policies, procedures and practices

Safety and Health Program Guidelines

- Systematic policies and procedures
- Recognize hazards
- Protect employees
- Address all hazards
- Beyond law
- Including hazards caused by change
- More important to be effective than written
- Guidelines available from OSHA

Major Elements

- Management commitment & employee involvement
- Worksite analysis
- Hazard prevention & control
- Safety and health training

The OSHA Safety & Health Program Management Guidelines are in Appendix B of this manual. You can follow along with the presentation there. The rest of this section will include only what is not included in the guidelines in Appendix B.

Safety & Health Program Resources

Resources Available

OSHA Safety & Health Management Guidelines (Appendix B)

Small Business Handbook

Sample safety & health programs (one available at *http://www.osha.gov/SLTC/etools/safetyhealth/mod2_sample_sh_program.html*)

- — Compliance Assistance Quick Start
- — Customize and apply to your situation!

OSHA Consultation (OSHCON)

Related OSHA Programs

- — Alliances
- — Strategic Partnerships
- — VPP
- — OSHA Consultation
- — SHARP

Alliances

Organizations committed to workplace safety and health

Collaborate with OSHA to prevent injuries and illnesses in the workplace

Reach out to, educate, and lead the nation's employers and their employees in improving and advancing workplace safety and health.

Benefits of an Alliance

Build trusting, cooperative relationships with OSHA

Network with others committed to workplace safety and health

Leverage resources to maximize worker safety and health protection

Gain recognition as proactive leaders in safety and health

How Alliances Work

OSHA and organization define, implement and meet short and long-term goals from three categories:

- Training and education
- Outreach and communication
- Promote the National Dialogue on Workplace Safety and Health

Getting Started with Alliances

National alliances: Office of Outreach Services and Alliances (202)693-2340

Regional or local alliances: OSHA regional office

Region VI contacts: *http://www.osha.gov/dcsp/alliances/regional/regional_alliance_contacts.html*

State plan alliances also exist.

OSHA Strategic Partnerships(OSPP)

Extended, voluntary, cooperative relationship

Groups of employers, employees, and employee representatives

May have 1 business or many stakeholders

- Common goal
- Plans for achieving goal
- Cooperation in implementation

Most are small businesses <50 workers

Many focus on Strategic Plan areas of concern

- Areas of Emphasis, including Oil and Gas Field Services
- Targeted Areas and High Incident/Severity Areas - industry profiles available at *http://www.osha.gov/dep/industry_profiles/index.html*
  - Landscape and Horticultural Services

- — Oil and Gas Well Drilling and Servicing
- — Preserved Fruits and Vegetables
- — Primary Metals and Basic Steel Products
- — Ship and Boat Building and Repair
- — Public Warehousing and Storage
- — Concrete and Concrete Products

Elements of Partnerships

Must either implement effective workplace safety and health management system or address a specific hazard

Core elements required include

- Goals, strategies, performance measures
- Evaluation and OSHA verification

Getting Started with Partnerships

Contact OSHA: National or regional contact information available at *http://www.osha.gov/dcsp/partnerships/contacts.html*

Identify goals, strategies, measures

Identify partners

Draft and submit application

Voluntary Protection Program (VPP)

Recognizes exemplary safety and health programs

- Cooperation: management, labor, OSHA
- Site with comprehensive safety and health management system implemented

Removes routine inspections

13 VPP Star sites in SIC 13

VPP Process

Application and S&H program review

Written program and onsite implementation

Review by OSHA and SGE

Levels available

Star – exemplary, self-sufficient, safer than average; evaluations every 3-5 years

Merit – potential to meet Star within 3 years; evaluations every 18-24 months

Star Demonstration – worksites with VPP-quality safety and health protection that want to test alternatives to current eligibility and performance requirements

VPP Innovations

Special Government Employees (SGE): Volunteers from other VPP sites work with OSHA on onsite evaluations

Mentoring: matching current and potential VPP sites

Safety and Health Management course

OSHA Consultation

Separate from compliance inspectors

Free, confidential services:

- Recognition of potential hazards
- Suggest methods and resources for solutions
- Help with safety and health program
- Written report
- Training/education

Operated by states

Obligation: commitment to correcting serious hazards

- Plan / schedule to control serious hazards

Benefit: possible one-year exclusion from programmed inspections

No results reported to inspectors

Safety and Health Achievement Recognition Program (SHARP)

Operated by Consultation

Small employers with exemplary safety and health management systems

Exemption from programmed inspections for 1 year

Renewable for 1-2 years with evaluations

Getting Started with SHARP

Request a consultation visit and survey

Involve employees

Correct hazards identified

Maintain safety and health program meeting 1989 guidelines

Lower injury/illness and lost workday rates below national average

Notify consultation office before changes

Module

8

Recordkeeping

Terminal Objective

Upon the successful completion of this module, participants will be able to describe the OSHA recordkeeping requirements for injuries and illnesses.

Enabling Objectives

1. Discuss the recordkeeping requirements in 29 CFR 1904.
2. Explain the use of OSHA forms 300, 300A and 301.
3. Discuss the criteria for recordability of illnesses or injuries.

Recordkeeping Resources

OSHA Recordkeeping Page, *http://www.osha.gov/recordkeeping/index.html*

OSHA Recordkeeping forms, *http://www.osha.gov/recordkeeping/RKforms.html*

OSHA Recordkeeping Handbook, *http://www.osha.gov/recordkeeping/handbook/index.html*

OSHA 7845 course, available from TEEX or any other OSHA Training Institute Education Center

29 CFR 1904

The regulation on which this section is based is in your CFR book. This section of this manual will only contain items not in the regulation.

The OSHA recordkeeping forms are also in the back of your CFR book.

Module 9

Walking and Working Surfaces and Fall Protection

Terminal Objective

Upon the successful completion of this module, participants will be able to locate and describe applicable standards relating to walking and working surfaces or fall protection.

Enabling Objectives

1. Explain the definitions of essential terms used in 29 CFR 1910 Subpart D.
2. Describe 29 CFR 1910 Subpart D general requirements.
3. Identify the applicability of 29 CFR 1926 Subpart M.
4. Explain the requirements for guarding floor openings and holes.
5. Describe the requirements for stairways and railings.
6. Identify applicable standards relating to ladders.
7. Locate standards for hazard violation workshop violative conditions.

OSHA Regulations

29 CFR 1910 and 29 CFR 1926

Construction work = construction, alteration, and/or repair

1910 Subpart D = Walking-Working Surfaces

1926 Subpart M = Fall Protection for construction

Protect against recognized hazards

29 CFR 1910 Subpart D and 29 CFR 1926 Subpart M are located in your CFR book. API RP 54 provisions mentioned in the standard are excerpted in more detail in Module 22.

Module 10

Electrical Standards

Terminal Objective

Upon the successful completion of this module, participants will be able to discuss hazards and standards related to electricity.

Enabling Objectives

1. Discuss the applicability of electric standards from OSHA and other organizations.
2. Describe the general requirements for electrical installations.
3. Identify different types of conductors.
4. Discuss equipment grounding.
5. Discuss safety-related work practices for work near electricity.
6. Identify hazards and violations associated with electricity.

Electrical Hazards and Standards

Statistics

Electrocution: Among most frequent causes of occupational injury death in US

295 fatalities/year; 4309 lost time

1992-2002: 9% decrease

Most frequent cause: Overhead power lines

Factors in Fatal Electrocutions

- Safe work practices implemented and followed?
- Adequate/required PPE provided and worn?
- Lockout/tagout procedures implemented and followed?
- OSHA, NEC, NESC compliance?
- Worker and supervisor training adequate?

(from NIOSH)

Types of Electrical Injuries

- Electrocution (death due to electrical shock)
- Electrical shock
- Burns (ugly pictures here)
- Falls

Hazard Recognition

How can you sense electrical danger?

Cannot always see, smell, taste, or hear danger

Can recognize unsafe conditions

Electrical Terminology

Current – movement of electrical charge

Resistance – opposition to current flow

Voltage – measure of electrical force

Conductors – substances with little resistance to electricity (such as metals)

Insulators – substances with high resistance to electricity (such as wood, rubber, glass, & bakelite)

Grounding – a conductive connection to the earth (which acts as a protective measure)

Electrical Shock

Received when current passes through body

Severity depends on:

- Path of current through body
- Amount of current flowing through body
- Length of time body is in circuit
- Also: voltage, moisture, heart cycle, health

Low voltage is NOT low hazard!

Dangers of Electrical Shock

Currents >75 mA can cause ventricular fibrillation (rapid, ineffective heartbeat)

- (mA = milliampere = 1/1,000 of an ampere)
- Death within minutes unless a defibrillator is used
- 75 mA is not much current (a small power drill uses 30 times as much)

Effects of Current on Body

1 mA: Perception level, slight tingling.

5 mA: Slight shock; not painful.

- Can usually let go.
- Involuntary reactions can cause injuries.

6-30 mA: Painful shock

- Muscular control lost
- Freezing current or “let-go” range

50-150 mA: Extreme pain

- Respiratory arrest; cannot let go
- Death possible

1000-4300 mA: Ventricular fibrillation

- Muscular contraction; nerve damage
- Death likely

10000 mA: Cardiac arrest

- Severe burns, probable death

How Shock Happens

Connection between:

- 2 wires of energized circuit
- 1 wire of energized circuit and ground
- Metallic part in contact with energized wire and ground

Inadequate Wiring Hazards

What happens when a wire is too small to carry the current safely?

- Overheating
- Risk of fire or short circuit
- Fuse acts as sacrificial weak link
- Fuse too strong? Other parts of the system break first

OSHA Regulations

29 CFR 1910 and 29 CFR 1926

1910 Subpart S = Electrical: Revised 2/14/2007; effective in 180 days

1910 Subpart I = PPE

1910.137 Electrical Protective Devices

1926 Subpart K = Electrical

Protect against recognized hazards

Other Standards

NFPA 70E enacted to help meet CFR

Revised Subpart S based heavily on 2000 version

2004 version now published

OSHA chose which provisions of 70E to adopt

29 CFR 1910 Subpart S

Electrical standards for general industry

§ 302-308 and 399 updated: PM App. C

5 main groups of standards:

- Design safety standards § 302-330
- Safety-related work practices § 331-360
- Reserved: maintenance, special equipment
- Definitions: § 399

The revised portion of 29 CFR 1910 Subpart S is in Appendix C of this manual. The remainder of 29 CFR 1910 Subpart S is in the CFR book. Please follow along with the presentation using those resources.

Relevant Standards Outside 29 CFR 1910

29 CFR 1926 Subpart K: construction

API RP 54

- Section 9.14 Generators, Motors, and Lighting
- Section 10: Drilling and Well Servicing Rig Electrical Systems

API RP 14F for offshore wiring

API RP 500 and 505: area classification

Clues that Electrical Hazards Exist

Tripped circuit breakers or blown fuses

Warm tools, wires, cords, connections, or junction boxes

GFCI that shuts off a circuit

Worn or frayed insulation around wire or connection

OSHA Resources

Publication 3075, Controlling Electrical Hazards, at *http://www.osha.gov/Publications/osha3075.pdf*

Small Business Handbook section, at *http://www.osha.gov/dcsp/smallbusiness/small-business.html#electrical*

Inspection Procedures: Electrical Safety-Related Work Practices -- Inspection Procedures and Interpretation Guidelines, at *http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=DIRECTIVES&p_id=1750*

Interpretations:

The following interpretations can be found on the OSHA web site.

- Training requirements for employees who perform non-electrical work on electrical equipment
- Qualifications for resetting circuits or replacing fuses; electrical enclosures must be approved
- Use of compressed air above 30 p.s.i. for cleaning purposes; nonmetallic-sheathed cable for temporary wiring

Module

11

Hazard Communication

Terminal Objective

Upon the successful completion of this module, participants will be able to discuss the purpose and requirements of the hazard communication standard.

Enabling Objectives

1. Explain the purpose of the hazard communication standard.
2. Describe the requirements for a written program.
3. Discuss chemical labeling requirements.
4. Discuss the major sections of a material safety data sheet.
5. List common target organ effects.

Hazard Communication

The standard on which this module is based is 29 CFR 1900.1200 and is available in your CFR book.

Purpose of OSHA's Hazard Communication Standard

"…ensure that employers and employees know about work hazards and how to protect themselves so that the incidence of illnesses and injuries due to hazardous chemicals is reduced."

Why should chemical hazards be communicated?

- Exposure Risk: About 32 million workers potentially exposed to chemical hazards
- Profusion of Chemicals: About 650,000 chemical products exist; hundreds of new ones introduced annually
- Health Effects: May include heart ailments, central nervous system damage, kidney and lung damage, sterility, cancer, burns, and rashes
- Safety Hazards: Potential to cause fires, explosions, or other serious accidents

Concept of regulation:

Employees have both a need and a right to know the hazards and identities of the chemicals they are exposed to when working.

They also need to know what protective measures are available to prevent adverse effects from occurring.

Who is covered?

General industry, shipyard, marine terminals, longshoring, and construction employers

Chemical manufacturers, importers, employers, and employees exposed to chemical hazards

Employer Responsibilities

A significant portion of the standard pertains only to chemical manufactures, importers, and distributors

Employers who do not produce chemicals only have to focus onestablishing a workplace program and communicating information to their workers.

Appendix E provides guidelines.

- Inventory: Identify and list hazardous chemicals in workplaces
- MSDS & Labeling: Obtain Material Safety Data Sheets and labels for each hazardous chemical, if not provided by the manufacturer, importer, or distributor
- Written Program: Implement a written HazCom program, including labels, MSDS, and employee training
- Communication & Training: Communicate hazard information to employees through labels, MSDSs, and formal training programs

Labeling Exemptions

Other federal agencies control labeling requirements for the following substances:

- Pesticides
- Chemicals covered under the Toxic Substance Control Act
- Foods or food additives
- Distilled spirits, tobacco
- Consumer products, lumber, cosmetics
- Hazardous wastes

How can workplace hazards be minimized?

Hazard Assessment: The first step in minimizing workplace hazards is to perform a thorough hazard assessment

Manufacturer Evaluations: Employers can rely on the manufacturers' or importers' evaluations of the hazards of the chemicals they use (from MSDS)

Why is a written program required?

Employer: Program ensures that all employers receive the information they need to inform and train their employees

Employee: Program provides necessary hazard information to employees

Employer Requirements-Written Program

Must cover at least:

- Labels and other forms of warnings
- Material Safety Data Sheets
- Employee Information and Training
- List of chemicals present and MSDS for each
- Methods used to inform employees of hazards of non-routine tasks
- Hazards of chemicals in unlabeled pipes

Multi-Employer Workplaces

When other employers have employees onsite that may be exposed, program must include:

- Methods to provide contractor employees with on-site access to MSDS
- Methods used to inform other employers of precautionary measures for normal and emergency situations
- The employer's chemical labeling system

Consumer Products Exemption

Any consumer product as defined in the Consumer Product Safety Act where:

- Used in the workplace for the purpose intended
- Exposure within the range that could reasonably be experienced by consumers when used for intended purpose

Written Program Availability

Written program available on request to employees and their representatives

Program may be kept at main location.

How must chemicals be labeled?

Containers of hazardous chemicals entering workplace must be labeled with:

- Identity of chemical
- Appropriate hazard warnings
- Message, picture or symbol

- Hazards of chemical
- Target organs affected
- Legible in English, may have other languages
- Name and address of responsible party

Container Labeling Exemptions

No new labels necessary if existing labels convey required information

Labeling not required for portable containers if:

- Transferred from labeled containers and
- Intended for immediate use by employee performing transfer

Material Safety Data Sheets

Prepared by chemical manufacturer or importer, describing:

- Physical hazards, such as fire and explosion
- Health hazards, such as signs of exposure
- Routes of exposure
- Precautions for safe handling and use
- Emergency and first-aid procedures
- Control measures

Must be in English and include specific chemical identity and common names.

Must provide information about:

- Physical and chemical characteristics
- Health effects
- Exposure limits
- Carcinogenicity (cancer-causing)
- Identification (name, address, and telephone number) of the organization responsible for preparing the sheet

Must be readily accessible to employees in their work area

No prescribed format

If no MSDS received for a chemical:

- Contact supplier, manufacturer or importer
- Maintain record of the contact

May be kept in any form including operating procedures

Addressing hazards of process may make more sense than individual chemicals

Employee Information and Training

- Employees must be provided information and training on hazardous chemicals in their work area:
- At the time of their initial assignment
- Whenever a new physical or health hazard is introduced into their work area
- May cover categories of hazards or individual chemicals

Employee Information

Employers must inform employees of:

- Training requirements of this section
- Operations in their work area where hazardous chemicals are present;
- Location and availability of the written hazard communication program

What must employee training contain?

- Program: Explanation of the HazCom program, including information on labels, MSDSs, and how to obtain and use available hazard information
- Physical and health hazards of chemicals
- Protection: Protective measures such as engineering controls, work practices, and the use of PPE
- Detection: How to detect the presence or release of a hazardous chemical (using monitoring devices, observation, or smell)

Health Hazard Definitions

Acute: rapid effects, as a result of short-term exposures, of short duration

Chronic: effects as a result of long-term exposure, of long duration

Corrosive: Visible destruction or irreversible damage to body tissue, including acids and caustics (bases)

Definitions in 1910.1200 Appendix A

Target Organ Effects

Hepatotoxins: liver damage

Nephrotoxins: kidney damage

Neurotoxins: nervous system effects

Agents which act on the blood or hematopoietic system: deprive body tissues of oxygen

Agents which damage the lungs

Reproductive toxins, including teratogens (damage fetuses) and mutagens (damage DNA)

Cutaneous hazards: skin damage

Eye hazards

Setting up a program

The Hazard Communication Standard covers both:

- Physical hazards (such as flammability), and
- Health hazards (such as irritation, lung damage, and cancer)

Most chemicals used in the workplace have some hazard potential, and thus will be covered by the rule.

This rule is more performance-oriented than many other OSHA regulations.

You have flexibility to adapt the rule to the needs of your workplace, rather than having to follow specific, rigid requirements.

Setting up a program:

- Make a list of all chemicals in the workplace that are potentially hazardous
- Survey the workplace to make a comprehensive list
- Identify chemicals in containers, including pipes
- Establish purchasing procedures so that MSDSs are received before a material is used in the workplace
- Identify hazardous chemicals in the workplace
- Compile a complete list of the potentially hazardous chemicals in the workplace
- Determine if you have received material safety data sheets for all of them
- If any are missing, contact your supplier and request one

- Do not allow employees to use any chemicals for which you have not received an MSDS

Preparing and implementing a hazard communication program

All workplaces where employees are exposed to hazardous chemicals must have a written plan

The plan does not have to be lengthy or complicated

Employee Training

You may want to discuss each chemical individually if there are only a few chemicals in the workplace

You may want to train generally:

- Based on the hazard categories (e.g., flammable liquids, corrosive materials, carcinogens),
- Where there are large numbers of chemicals; or
- Where the chemicals change frequently.

Training Documentation

The rule does not require employers to maintain records of employee training, but many employers choose to do so.

This may help you monitor your own program to ensure that all employees are appropriately trained.

Module 12

Introduction to Industrial Hygiene

Terminal Objective

Upon the successful completion of this module, participants will be able to discuss hazards, protective measures and standards associated with exposure to chemical, biological and physical hazards.

Enabling Objectives

1. Identify chemical exposures common in oil and gas operations.
2. Describe exposure routes and toxicity of common chemicals used or encountered in oil and gas operations.
3. Explain the applicability of 29 CFR 1910 Subpart Z.
4. Discuss the meaning and use of Tables Z-1, Z-2, and Z-3.
5. Describe the application of the General Duty Clause and standards from organizations other than OSHA to chemical exposures.
6. Describe biological hazards found in oil and gas operations and requirements associated with them.
7. Describe physical and radiological hazards found in oil and gas operations and requirements associated with them.
8. Describe protective measures that may be used for chemical exposures common in oil and gas operations.

Introduction to Indust?rial Hygiene

What is Industrial Hygiene

Industrial hygiene is the science of anticipating, recognizing, evaluating, and controlling workplace conditions that may cause workers' injury or illness.

Key factors:

Employee exposure to hazards

Control for hazards to protect workers

Steps to Protect Employees

Anticipate potential hazards

Recognize potential hazards

Evaluate exposure and risk

Control exposure and risk

(Not just for health hazards)

Hierarchy of Controls

Engineering controls: Remove hazard

- Process change, Chemical substitution
- Ventilation, Shielding, Guarding
- Requires little or no employee action

Administrative controls: Manage exposure

- Worker rotation, Procedures, Training
- Trench shoring, Controlled access areas
- Requires employee action

Personal protective equipment (PPE)

- Respirators, Gloves, Boots, Clothing
- Fall protection equipment, Hard hats
- Requires individual employee action
- Last line of defense, behind engineering and administrative controls

Addressed in 29 CFR 1910 Subpart I

Chemical exposures in oil and gas operations

What chemicals are used in oil and gas operations?

How can employees be exposed?

What toxic effects do these chemicals have?

How can employees be protected from these effects?

29 CFR Subpart Z Toxic and Hazardous Substances

1910.1000 Air Contaminants:

- Includes Z tables: worker exposure limits for specific listed substances
- Employee exposure cannot exceed limits
- Tables Z-1, Z-2, Z-3 each have their own requirements
- PEL = Permissible Exposure Limit

29 CFR 1910.1001-1096:

Specific regulations for individual substances including:

- asbestos (1910.1001);
- lead (1910.1025);
- bloodborne pathogens (1910.1030), and others

1910.1200 Hazard Communication

1910.1000(a) - Table Z-1

Derived from 1968 ACGIH TLVs

American Conference of Governmental Industrial Hygienists

Threshold Limit Values

Levels thought to cause no significant adverse health effects in the majority of the community

Lists common workplace chemicals

Two types of limits:

- 8-hour Time Weighted Average (TWA) or
- Ceiling (C) limits

Employee exposure shall at no time exceed a ceiling (C) exposure limit.

8-hour Time Weighted Averages (TWA)

Employee exposure shall not exceed 8-hour TWA in any 8-hour work shift of a 40-hour work week

Calculations illustrated in (d)

Units:

- Parts per million (ppm)
- Milligrams per cubic meter (mg/m3)

1910.1000(b) - Table Z-2

Adopted from ANSI standards (American National Standards Institute)

Expanded standards developed for some of the substances found in Z-2, including:

Benzene 1910.1028

Cadmium 1910.1027

Formaldehyde 1910.1048

Methylene chloride 1910.1052

Table Z-2 expresses exposure limits as:

- 8-hour TWA
- Ceiling
- Peak

If a substance has both ceiling and peak limits: peak = level never to be exceeded

Exposure levels over the ceiling but under the peak must comply with margin notes in table

TWA must still not be exceeded.

1910.1000(c) - Table Z-3

8-hour TWA limits for forms of silica

Adopted from ACGIH TLVs

SiO2 : basic component of sand, granite

Quartz: 2nd most common mineral

Quartz sand (crystalline silica) used to fracture rock formations in wells

Silica in barite, lignite, and bentonite mud additives

Health Effects of Silica:

Silicosis

- Irreversible but preventable
- Most commonly associated with silica dust

Other possible effects:

- Lung cancer
- Some auto-immune diseases

1910.1000(d) – Computation formulae

Time Weighted Average

$E = (C_1T_1 + C_2T_2 + \ldots)$/total time

Total time used = 8 hours

Example in § 1910.1000(d)(1)(ii)

- What about different work schedules?
- Varies by chemical
- Most chemicals: Worst 8 hours of shift
- Lead: adjusted by hours worked
- Interpretation – Foulke letter, 1997, available at *http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=INTERPRETATIONS&p_id=22333*

Exposure to Chemical Mixtures

$E_m = (C_1/L_1) + (C_2/L_2) + \ldots + (C_n/L_n)$

If $E_m > 1$, employee is overexposed

Assumptions:

- Chemicals' effects are additive
- Dose is proportional to C x T

1910.1000(e) – To achieve compliance

Administrative or engineering controls first wherever feasible

When those are not feasible for full compliance: protective equipment or other protective measures

Equipment or technical measures must be approved by competent industrial hygienist or qualified person

Respirators: 1910.134

Chemical-Specific Standards

1910.1001 Asbestos

1910.1018 Inorganic Arsenic

1910.1025 Lead

1910.1026 Chromium (VI) (revised 2006)

1910.1027 Cadmium

1910.1028 Benzene: Oil and gas drilling, production, servicing exempt

1910.1029 Formaldehyde

1910.1020 Access to employee exposure and medical records

Employees, representatives, and OSHA have right of access

Preserved for 30 years, with exceptions

Employee consent for medical records

OSHA access order posted if identifiable

Trade secrets

Employee information

1910.1030 Bloodborne Pathogens

Occupational exposure:

Reasonably anticipated skin, eye, mucous membrane, or parenteral contact

With blood or other potentially infectious materials (OPIM) e.g. certain body fluids, tissues

1910.1096 Ionizing radiation

OSHA standards cover NORM and TENORM

Exposures must be kept within limits even if sources are natural

1910.1201 Retention of DOT markings, placards and labels

Retain markings on packages received until clean enough to remove hazard

Freight container or vehicle retains placards until materials removed enough

Readily visible

Non-bulk packages not to be reshipped: Hazard Communication labels OK

1910.1450 Hazardous chemicals in laboratories

For laboratory use only

Supersedes other standards in Subpart Z – except:

- PELs
- Prohibition of eye and skin contact
- Exposure monitoring and medical surveillance for those over action levels

Other Standards and Protective Measures

General Duty Clause

Recognized hazards may be cited

If there is no PEL:

- Consensus or proprietary standards
  - ANSI, ACGIH, AIHA
- Industry Best Practices
- Manufacturer Recommendations (MSDS)

Biological Hazards

Potentially infectious material exposure

Contagious diseases e.g. influenza

Vector-borne diseases e.g. Malaria, Lyme disease

Fungi e.g. mold, spores

Toxins e.g. endotoxin

Allergens / sensitizers e.g. pollen, red cedar

Physical and Radiological Hazards

Heat or cold (General Duty Clause)

Vibration (General Duty Clause)

Noise (1910 Subpart G)

Non-ionizing radiation (electromagnetic, light) (1910 Subpart G)

Ionizing radiation

Other Standards

29 CFR 1926 Subpart D: Occupational Health and Environmental Controls: Construction operations only

API RP 54

- Noise rules allow for 12 hour shifts
- Handling drilling fluid chemicals and additives

Protective Measures

How are exposures to health hazards evaluated on your site?

How are they controlled?

Module

13

Personal Protective Equipment

Terminal Objective

Upon the successful completion of this module, participants will be able to explain the requirements for personal protective equipment.

Enabling Objectives

1. Identify the personal protective equipment necessary for common tasks in the oil and gas industry.
2. Explain the general requirements for personal protective equipment.
3. Identify appropriate eye protective measures.
4. Describe the requirements for respiratory protective equipment.
5. Explain the requirements for head, hand, and foot protection.
6. Describe the hazard of noise exposure and requirements for hearing protection.

Introduction

Protective equipment = tools to do the job.

Nearly 2 million disabling work-related injuries expected this year.

More than ¼ will involve head, eyes, hands, feet

Personal Protective Equipment (PPE) Statistics

From Bureau of Labor Statistics (BLS):

Hard hats were worn by only 16% of those workers who sustained head injuries

Only 1% of approx 770 workers suffering face injuries were wearing face protection

Only 23% of the workers with foot injuries wore safety shoes or boots

About 40% of the workers with eye injuries wore eye protection

Personal Protective Equipment in Oil and Gas

What PPE is used in oil and gas?

What injuries or illnesses does it protect against?

Does it always succeed in protecting against these injuries or illnesses?

Why or why not?

29 CFR 1910 Subpart I

This section follows the regulation, which can be found in your CFR book.

29 CFR 1910.95

This section follows the regulation, which can be found in your CFR book.

Other Regulations

29 CFR 1926 Subpart E: Personal Protective and Life Saving Equipment

Construction operations only

If employees supply their own, employer assures adequacy and maintenance

Includes safety belts, lifelines, lanyards

API RP 54 section 5

Includes fall protection

Hearing protection includes 12-hour shift

No loose or poorly fitted clothing

Do not work in clothing saturated in hazardous substance – wash and/or treat skin and change clothes

Module 14

Hazardous Materials

Terminal Objective

Upon the successful completion of this module, participants will be able to describe the hazards and requirements of working with hazardous materials.

Enabling Objectives

1. Describe the hazards and requirements for compressed gas cylinders.
2. Identify safe work practices for the use of compressed gases.
3. Describe the hazards and requirements for working around flammable and combustible liquids.
4. Explain basic concepts associated with explosive safety.
5. Explain basic concepts associated with process safety management.

Compressed Gases

29 CFR 1910.101-103 are included in your CFR book. This section includes parts of those regulations and parts of the CGA Pamphlets that are referenced in the CFR.

1910.101(a) Compressed gases

Inspection of all compressed gas cylinders:

Visual and other inspections

DOT 49 CFR Parts 171-179 and 14 CFR Part 103 if applicable

Otherwise, Compressed Gas Association Pamphlets C-6-1968 and C-8-1962 - applicable to suppliers & distributors filling compressed gas cylinders

Cylinder Types: High pressure, low pressure, acetylene, cryogenic

Gas suppliers advise users to:

- Check cylinders as they are received
- Verify labels, tags and shipping papers
- Reject and return cylinders with obvious damage
- Determine required caps & plugs in place

CGA C-6 1968

3.2.6 - Bulges:

Cylinders are manufactured with reasonably symmetrical shape

Cylinders which have definite bulges shall be removed from service

5.3.7 - Fire Damage:

Cylinders shall be carefully inspected for evidence of exposure to fire

Evidence includes:

Charring or burning of paint

Burning or scarfing of the metal

Distortion of the cylinder

Burning or melting of a valve

1910.101(b) Compressed gases

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

CGA P-1 1965 Section 3.1; General

3.1.14 Never tamper with the safety relief devices in valves or cylinders

3.1.15 Never attempt to repair or to alter cylinders, valves, or safety relief devices

3.1.16 Never use cylinders as rollers, supports, or for any other purpose than to contain the contents as received

3.1.17 Keep cylinder valve closed at all times, except when cylinder is in active use

3.1.18 Notify cylinder owner if any condition might have permitted any foreign substance to enter the cylinder or valve:

- Provide details of incident
- Provide the cylinder serial number

3.1.19 Do not place cylinders where they might become part of an electric circuit

When cylinders are used in conjunction with electric welding, precautions must be taken against accidentally grounding cylinders and allowing them to be burned by electric welding arc

P-1 Section 3.2 Moving cylinders

3.2.2 Do not lift cylinders by the cap

3.2.3 Never drop cylinders nor permit them to strike against each other or against other surfaces violently

3.2.4 Never handle a cylinder with a lifting magnet

3.2.5 Avoid dragging or sliding cylinders

3.2.6 Use suitable hand truck, fork truck, roll platform or similar device with cylinder firmly secured for transporting and unloading

P-1 3.3 Storing cylinders

3.3.6 Do not store cylinders near highly flammable substances such as oil, gasoline or combustible waste

3.3.8 Do not store cylinders near elevators or gangways, or in locations where heavy moving objects may strike or fall on them

P-1 3.4 Withdrawing cylinder content

3.4.2 If cylinder content is not identified by marking, return cylinder to the supplier without using

3.4.4 Before using a cylinder, be sure it is properly supported to prevent it from being knocked over

3.4.5 Suitable pressure regulating devices must be used

3.4.6 Never force connections

3.4.7 Where compressed gas cylinders are connected to a manifold, all related equipment, such as regulators, must be of proper design

3.4.8 Do not mix regulators, gages, hoses and other appliances provided for use with a particular gas or group of gases with incompatible materials/gases

3.4.9 Safe work practices

Open cylinder slowly

Point valve opening away from yourself & others

Never use wrenches or tools except those provided by the supplier or approved by the gas manufacturer

Avoid the use of a wrench on a valve equipped with a handwheel

Never hammer on the valve wheel

For frozen, corroded valves, contact the supplier

Use check valves if cylinder is apt to be contaminated by feedback of materials

Before removing a regulator, close the cylinder valve and release all the pressure from the regulator

P-1 3.5 Flammable gases

Indoor cylinder storage

- Well protected
- Well insulated
- Dry
- Twenty feet from flammable or combustible materials

3.5.1 Do not store cylinders near highly flammable solvents, combustible waste material and similar substances, or near unprotected electrical connections, gas flames or other sources of ignition

3.5.2 Never use a flame to detect flammable gas leaks; use soapy water

P-1 Section 3.6 Poison Gases

3.6.1 Personnel handling and using poison gases should have available for immediate use gas masks or self-contained breathing apparatus approved by U.S. Bureau of Mines* for the particular service desired

*NOTE: This approval for respirators has been up-dated to the requirements of NIOSH (CGA P-1 2000)

1910.102 Acetylene

Cylinders: In-plant transfer, handling, storage, and utilization of acetylene in cylinders shall be in accordance with Compressed Gas Association Pamphlet G-1-1966

Case report

"A fitter with a work van left an E size Oxygen and Acetylene cylinder on the back seat of a Toyota dual cab over the weekend. The Acetylene cylinder must not have fully closed and a small leak occurred. Over the weekend the Acetylene had accumulated in the van.

"On the Monday morning the fitter approached the van and opened the door, a large explosion took place. We believe the ignition could have been caused by either the internal light, the automatic door control or by a mobile phone which was on the front seat of the van.

"The fellow was also a smoker. He has damage to his ear drums and facial damage. As you can see by the attached photos he was very lucky.

Why was this dangerous?

Flammability limits: Lower: 2.5% Upper: 100% – an extremely wide range.

Use or store only in a well-ventilated area. (Inside of the truck is not well ventilated.)

NFPA RATINGS: Health 1; Flammability 4; Reactivity 3

1910.103 (b) Gaseous hydrogen systems

(1)(i)(c) Each portable container shall be legibly marked with the name "Hydrogen" in accordance with ANSI Z48.1-1954

(1)(iv)(b)Installation of hydrogen systems shall be supervised by personnel familiar with proper practices with reference to their construction and use.

"Marking." The hydrogen storage location shall be permanently placarded as follows: “HYDROGEN – FLAMMABLE GAS – NO SMOKING – NO OPEN FLAMES” or equivalent

29 CFR 1910.106 Flammable & Combustible Liquids

29 CFR 1910.106 and 1910.110 are included in your CFR book. You may follow along there with anything not included in this section of this manual.

Purpose of Standard

This standard applies to the handling, storage, and use of flammable and combustible liquids with a flash point (FP) below 200°F

Primary hazards associated with flammable and combustible liquids: explosion and fire

To prevent these hazards, this standard addresses the primary concerns:

- Design and construction,
- Ventilation,
- Ignition sources, and
- Storage.

Definitions

Flash Point

The minimum temperature at which a liquid gives off vapor within a test vessel in sufficient concentration to form an ignitable mixture with air near the surface of the liquid

Flash point is normally an indication of susceptibility to ignition.

Combustible Liquid

Any liquid having a flash point (FP) at or above 100°F (37.8°C)

Divided into two classes:

Class II liquids: FP between 100°F and 140°F (60°C)

Class III liquids: FP at or above 140°F

Class IIIA: FP between 140°F and 200°F (93.3°C)

Class IIIB: FP at or above 200°F

Flammable Liquid

Any liquid having a flash point below 100°F

Also known as Class I liquids

Class IA: FP <73°F, BP <100°F

Class IB: FP <73°F, BP >100°F

Class IC: FP between 73°F and <100°F

Safety Can

An approved container:

- 5 gallons or less
- With a spring-closing lid
- With a spout cover
- Designed to safely relieve internal pressure when subjected to fire exposure

Ventilation

As specified in this section: for the prevention of fire and explosion

Considered adequate if it is sufficient to prevent accumulation of significant quantities of vapor-air mixtures in concentration over 1/4 of the lower flammable limit

Flammable (Explosive) Limits

When vapors of a flammable or combustible liquid are mixed with air in the proper proportions in the presence of a source of ignition, rapid combustion or an explosion can occur.

The proper proportion is called the flammable range or explosive range.

Flammable range includes all concentrations of flammable vapor or gas in air in which a flash will occur or a flame will travel if the mixture is ignited.

General Principles

Control evaporation, particularly in closed spaces.

Prepare to dispose of spills quickly and safely.

Prevent the ignition of flammable vapors.

Ground and bond containers to prevent against static electricity discharge.

Sources of ignition

- Open flames
- Lightning
- Smoking
- Cutting and welding
- Hot surfaces, frictional heat
- Sparks (static, electrical, and mechanical)
- Spontaneous ignition
- Chemical and physical-chemical reactions
- Radiant heat

29 CFR 1910.109 Explosives and Blasting Agents

29 CFR 1910.109 is included in your CFR book. You may follow along there with anything not included in this section of this manual.

General Principles

No flames, fires or firearms nearby

Competent person in charge of enforcement of safety precautions

Authorized persons take precautions to protect others

Care in storage and handling

Blasting only in daylight hours

Notify utilities before blasting

Loud warning before blast

Perforating Safety

Electric blasting caps set off by current:

- Electrical storms
- Dust storms
- Power lines
- Radio or radar

Recommendations

Keep non-essential personnel out of immediate area.

Post warning signs and prohibit the use of radios, telephones, or navigational systems.

Shut down non-essential electrical systems during gun-arming operations.

Notice of Proposed Rulemaking

April 13, 2007 Federal Register

Comments invited until June 13, 2007

Press release available at *http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=NEWS_RELEASES&p_id=14100*

29 CFR 1910.119 Process Safety Management

29 CFR 1910.119 is included in your CFR book. You may follow along there with the presentation.

29 CFR 1910.120 HAZWOPER

29 CFR 1910.120 is included in your CFR book. You may follow along there with the presentation.

Module 15

Permit-Required Confined Space Entry

Terminal Objective

Upon the successful completion of this module, participants will be able to identify the hazards, precautions and requirements associated with confined spaces.

Enabling Objectives

1. Identify the hazards of confined spaces found on oil and gas sites.
2. Identify conditions that constitute permit-required confined spaces.
3. Explain procedures and requirements for entry of permit-required confined spaces.

Confined Spaces

What confined spaces exist on oil and gas well sites?

What hazards may exist in these confined spaces?

Identifying Confined Spaces

Large Enough to Enter and Work

Limited Openings for Entry and Exit

Not Designed for Continuous Worker Occupancy

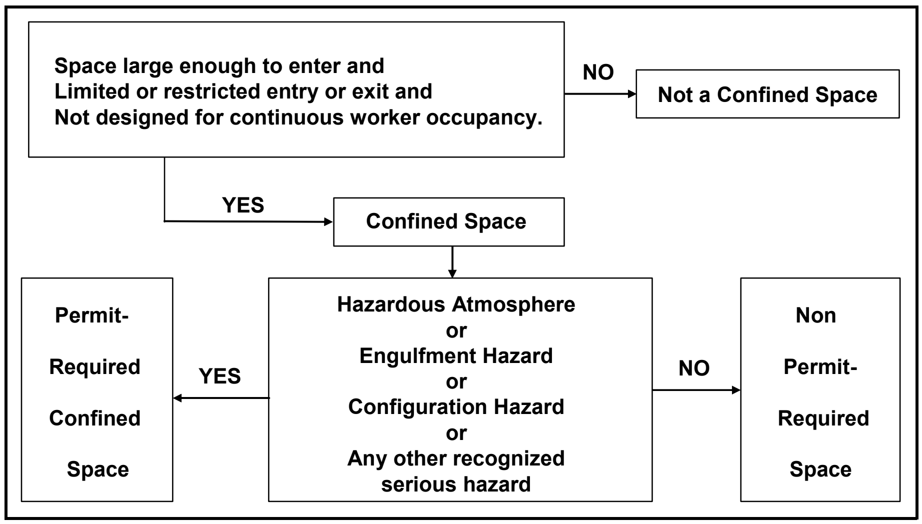

Figure 15.1: Categorizing work space as confined space and/or permit-required confined spaces

Applicable regulations

The full text of 29 CFR 1910.146 is available in your CFR book. Much of this presentation follows the standard, and you may follow along there.

General industry only – does not apply to construction operations

(b) Definitions

Entry

Passing through opening (any part of entrant's body breaks its plane)

Includes ensuing work activities

Hazardous Atmosphere

Flammable gas, vapor, or mist in excess of 10% of its LFL

Airborne dust at a concentration that meets or exceeds its LFL (Rule of thumb: vision at <5')

Oxygen <19.5% or >23.5

Atmospheric concentrations of substances above PEL

Other atmospheric conditions: IDLH.

Engulfment

The surrounding & effective capture of a person by a liquid or finely divided (flammable) solid substance that can:

- Be aspirated to cause death by filling or plugging the respiratory system
- Exert enough force on the body to cause death by strangulation, constriction, or crushing.

Engulfment Hazards

Loose, granular materials stored in bins and hoppers - grain, sand, coal, etc.

Crusting and bridging below a worker

Flooding of confined space

Water or sewage flow

Configuration Hazard

Has an internal configuration such that an entrant could be trapped or asphyxiated

- By inwardly converging walls, or
- By a floor which slopes downward & tapers to a smaller cross-section

Hazards of Confined Spaces

Oxygen Deficient Atmospheres

Oxygen Enriched Atmospheres

Flammable Atmospheres

Toxic Atmospheres

Temperature Extremes

Engulfment Hazards

Equipment (machinery, electrical)

Noise

- Amplified due to acoustics within the space
- Damages hearing; affects communication.

Slick / Wet Surfaces

- Slips and falls
- Increased chance of electric shock

Falling Objects

- Topside openings expose workers inside confined space to falling objects.

Oxygen Deficient Atmospheres

19.5 %: Minimum acceptable oxygen level.

15 - 19%: Decreased ability to work strenuously. Impaired coordination. Early symptoms.

12-14%: Respiration increases. Poor judgment.

10-12%: Respiration increases. Lips blue.

8-10%: Mental failure. Fainting. Nausea. Unconsciousness. Vomiting.

6-8%: 8 minutes - fatal; 6 minutes - 50% fatal; 4-5 minutes - possible recovery

4-6%: Coma in 40 seconds. Death.

Oxygen Enriched Atmospheres

Oxygen level above 23.5%

Causes flammable and combustible materials to burn violently when ignited

Hair, clothing, materials, etc.

Oil soaked clothing and materials

Never use pure oxygen to ventilate

Never store or place compressed tanks in a confined space

Flammable Atmospheres

Critical Factors:

- Oxygen content in the air
- Presence of a flammable gas, or vapor
- Presence of dust (visibility of 5’ or less)

Proper air/gas mixture can lead to explosion

Typical Ignition Sources:

- Sparking or electric tool
- Welding / cutting operations
- Smoking

Toxic Atmospheres

Product stored in a confined space:

- Gases released when cleaning
- Materials absorbed into walls of confined space
- Decomposition of materials in the confined space
- Work performed in a confined space:
- Welding, cutting, brazing, soldering
- Painting, scraping, sanding, degreasing
- Sealing, bonding, melting

Areas adjacent to a confined space

Hydrogen Sulfide

Decomposition of materials, human waste

Naturally present in some oil/gas reservoirs

Rotten egg odor at low concentrations

Possibly no warning at high concentrations

Table 15.1: Hydrogen Sulfide concentrations and effects

PPM	Effect	Time
10	Permissible Exposure Level	8 hours
50 - 100	Mild Irritation - eyes, throat	1 hour
200 - 300	Significant Irritation	1 hour
500 - 700	Unconsciousness, Death	1/2 - 1 hour
>1000	Unconsciousness, Death	Minutes

Carbon Monoxide

Odorless, colorless gas

Combustion by-product

Quickly collapse at high concentrations

Table 15.2: Carbon Monoxide concentrations and effects

PPM	Effect	Time
50	Permissible Exposure Level	8 hours
200	Slight headache, discomfort	8 hours
600	Headache, discomfort	1 hour
1000-2000	Tendency to stagger	1 1/2 hours
1000-2000	Slight heart palpitation	30 minutes
2000-2500	Unconsciousness	30 minutes

Temperature Extremes

Extreme heat & cold

Steam cleaning

Humidity factors

Extremely cold liquids

Work processes inside the confined space can increase temperature extremes

Personal protective equipment

Air Testing

Always test the air at various levels to be sure that the entire space is safe. Good air near the opening does NOT mean there is good air at the bottom!

Order of Testing

First---Oxygen Presence And Amounts

Second---Flammables

Third---Toxics

Others

Module 16

Welding

Terminal Objective

Upon the successful completion of this module, participants will be able to discuss requirements and safe work practices for welding operations.

Enabling Objectives

1. Discuss the general requirements for welding, including fire protection.
2. Discuss the selection of eye protection for welding operations.
3. Discuss operating procedures for welding cylinder use.

Welding Safety Principles

Hazards of Welding Operations

Fire hazards

Metal splatter

Electric shock

Explosion hazards

Released gases

Radiant energy

Where would these hazards be found on oil and gas well sites?

Three Basic Types of Welding

Gas – Slower and easier to control than electric arc. Uses gas flame over metals until molten puddle is formed. Most popular fuels used with oxygen include acetylene, mapp gas, and hydrogen.

Arc – Two metals are joined by generating an electric arc between a covered metal electrode and the base metal.

Oxygen and Arc Cutting – Metal cutting in welding is the severing or removal of metal by a flame or arc.

Oxygen and arc cutting

Most common cutting processes :

Oxygen Cutting: Metal is heated by gas flame and an oxygen jet does the cutting.

Arc Cutting: Intense heat of electric arc melts away the metal.

Regulations

29 CFR 1910 Subpart Q: General Industry

29 CFR 1926 Subpart J: Construction

API RP 54 Section 20: Hotwork, Welding, and Flame Cutting Operations

29 CFR 1910 Subpart Q

29 CFR Subpart Q can be found in your CFR book, where you can follow along with the presentation.

Fire Prevention Safeguards

Fire Hazards should be removed if the welded object cannot be readily moved.

Guards should be used if removing fire hazards is not possible.

Restrictions apply (no cutting or welding allowed) if none of the above is possible.

Special Precautions

Protect nearby combustible materials from sparks that might escape through openings in floors or walls.

Fire Extinguishers must be ready for instant use.

Fire Watch lasting at least 30 min after welding or cutting operations is required if more than a minor fire might develop and if certain combustible materials are present.

Authorization: A responsible individual must inspect the area and designate precautions, preferably by written permit.

Floors: Combustible materials must be swept 35 feet away; combustible floors must be wetted or protected (while preventing arc welding shock)

Prohibited areas for welding:

- Unauthorized by management
- Where sprinklers are impaired
- Explosive atmospheres
- Near storage of large quantities of readily ignitable materials

Relocation of Combustibles: Combustibles shall be moved 35 feet away or properly protected or shielded.

Ducts: Ducts & conveyor systems that might carry sparks must be shut down.

Combustible walls must be shielded or guarded.

Noncombustible walls, partitions or ceilings (when welded) require opposite-side moving of combustibles or a fire watch.

Combustible cover: No welding on certain metal building components having combustible covers or layers.

Pipes (or any metal) close enough to combustibles to cause ignition by conduction may not be cut or welded.

Management responsibilities:

- Establish proper areas and procedures
- Designate responsible individual
- Ensure training
- Advise contractors of hazards

Supervisor responsibilities:

- Safety of equipment & procedures
- Determine combustibles & hazardous areas
- Protect combustibles from ignition through moving, shielding and scheduling
- Secure authorizations
- Give go-ahead to cutter or welder
- Ensure fire protection
- Ensure fire watches if required

Welding or Cutting Containers

Used containers must be cleaned of flammable materials or other materials that could release toxic of flammable vapors when heated.

Venting & purging is required for hollow spaces or cavities.

Confined Spaces

Precautions must be taken during long* pauses in arc welding to prevent accidental contact of electrodes or torch valve gas leaks in gas welding.

*Long = During lunch or overnight

Protection of Personnel

Railing or other suitable fall protection must be provided as required.

Welding cable and other equipment must be kept clear of passageways, ladders and stairways.

Eye protection and protective equipment of specific appropriate types must be worn. Nearby workers must be protected from arc welding rays.

Work in confined spaces requires consideration of:

- Ventilation
- Securing cylinders and machinery
- Lifelines
- Electrode removal (arc welding)
- Gas cylinder shutoff (gas welding & cutting)
- Warning signs for hot metal

Health Protection & Ventilation

General requirements for protecting welders are based on 3 factors:

- Dimensions of space (especially ceiling height) in which welding is to be done
- Number of welders
- Possible evolution of hazardous fumes, gases, or dust according to the metals involved.

Natural and Mechanical Ventilation

- Must not be restricted by screens
- Sufficient to keep concentrations <PEL

Mechanical ventilation required for:

- Metals not described here
- Spaces <10,000 feet per welder
- Rooms with ceilings lower than 16 feet
- Confined spaces or areas with barriers to natural cross ventilation

Dilution Ventilation

- Contaminant should travel away from breathing zone.
- Local exhaust ventilation may be more effective.

Ventilation

- Confined space: ventilation first; respirators if ventilation impossible
- Specific rules for specific chemicals
- Outdoors: Just stay below PEL

Transmission pipeline

Special rules in 1910.252(d)(1)

Special electric shock protection for wet conditions

Pressure testing: Worker and public protection against blowing out or loose dirt

Construction: API Std. 1104-1968

Flammable substance lines: API Std. PSD No. 2201-1963

X-ray inspection: ANSI Z54.1-1963

Oxygen-Fuel Gas Welding & Cutting

General Requirements

Flammable mixtures of fuel gases and air or oxygen must be guarded against.

Maximum pressures of 15 psi for acetylene must be observed (with certain rare exceptions).

Approved apparatus.

Competent personnel in charge of supply equipment

Cylinders & Containers

Approval & Marking:

- DOT compliant
- Legibly marked
- ANSI compliant connections
- Valve protection

Storage

Away from heat sources (such as radiators)

When inside buildings:

- Well-protected, ventilated, dry location at least 20 ft from combustibles
- Assigned storage spaces, protected from damage & tampering

When empty: closed valves

When not in use: hand-tight valve protection caps

Oxygen Storage

Protect oxygen cylinders from fire hazards such as acetylene:

Distance: at least20 ft from fuel-gas cylinders or combustibles, or

Barrier: at least 5 ft high noncombustible partition with half-hour fire-resistance rating

Arc Welding & Cutting

Use compliant equipment

Special design for exposure to weather, flammable gases, marine conditions…

Workmen who operate or maintain arc welding equipment shall be acquainted with the requirements of 1910.254 and 1910.252

Electrode holders when not in use must be kept from shocking people and objects.

Protect against electric shock:

- Never use cables with splices within 10 feet (3 m) of the holder
- The welder should not coil or loop welding electrode cable around parts of his body

Maintenance must ensure safety:

- Damaged cables & equipment must be replaced.
- Work and cables must be joined properly and have adequate insulation.

Operating procedures

Cylinders, cylinder valves, couplings, regulators, hose, and apparatus kept free from oily or greasy substances

Oxygen cylinders shall not be handled with oily hands or gloves

A jet of oxygen must never be permitted to strike an oily surface, greasy clothes, or enter a fuel oil or other storage tank

When transporting cylinders by a crane:

- Use a cradle or suitable platform
- Never use slings or electric magnets
- Valve-protection caps always in place

Never use valve-protection caps to lift cylinders from one vertical position to another

Never use bars under valves or valve-protection caps to pry cylinders loose; may use warm (not boiling) water

Before cylinders are moved:

- Regulators shall be removed
- Valve-protection caps, when provided for, shall be put in place
- Unless cylinders are secured on a special truck

Cylinders without fixed hand wheels shall have keys, handles, or nonadjustable wrenches on valve stems while cylinders are in service

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

Before connecting a regulator to a cylinder valve: Open the valve slightly; close immediately

Open the valve while standing to one side of the outlet; never in front of it

Never crack a fuel-gas cylinder valve near other welding work or near sparks, flame, or other possible sources of ignition

Always open the cylinder valve slowly

Never open an acetylene cylinder valve more than 1.5 turns of the spindle, and preferably no more than 3/4 of a turn

Hose and hose connections

Replace hose with leaks, burns, worn places, defects

When parallel lengths of oxygen and fuel hose are taped together, not more than 4 of 12 inches covered by tape

Module

17

Egress and Fire Protection

Terminal Objective

Upon the successful completion of this module, participants will be able to describe methods and requirements for emergency exit and fire protection planning.

Enabling Objectives

1. Describe the requirements for exits in places of employment and the application of these requirements on oil and gas exploration and production sites.
2. Explain the requirements of an emergency action plan.
3. Explain the requirements of a fire prevention plan.
4. Describe types of fires and requirements for the use of fire extinguishers.
5. Discuss special hazards and prevention and control methods for oil and gas sites.

Egress and Fire Protection

What could make employees need to escape quickly?

What are the typical escape routes?

What precautions are taken for fire protection and prevention?

Regulations

29 CFR 1910 Subparts E and L

29 CFR 1926 Subpart F – construction

API RP 54

- Section 7: Fire Protection and Prevention
- 6.10: Auxiliary Escape
- 9.3.10: At least 2 stairways on a drilling rig

29 CFR 1910 Subparts E and L

29 CFR 1910.34 can be found in Appendix D of this manual. The rest of 29 CFR 1910 Subparts E and L can be found in your CFR book. You can follow along with this presentation by following these regulations.

Fire Protection on Oil and Gas Well Sites

API RP 54 Requirements

Drilling rigs: at least 4 20-pound capacity, Class BC rated fire extinguishers

Well servicing rigs: at least 2 20-pound capacity, Class BC rated fire extinguishers

Available near all welding

Firefighting equipment also includes water hoses and drilling fluid guns

Module

18

Materials Handling

Terminal Objective

Upon the successful completion of this module, participants will be able to describe the hazards and requirements related to materials handling and hoisting operations.

Enabling Objectives

1. Describe the requirements for secure storage of materials.
2. Explain the requirements for operating powered industrial trucks.
3. Indicate the requirements for operation of cranes.
4. Discuss special hazards and safe work practices for oil and gas operations.

Materials Handling Regulations

The regulations listed below can be found in your CFR book, where you can follow along with them.

Materials Handling and Storage

29 CFR 1910 Subpart N

Powered Industrial Trucks

29 CFR 1910.178

Overhead and Gantry Cranes

29 CFR 1910.179

Crawler, Locomotive, and Truck Cranes

29 CFR 1910.180

Derricks

29 CFR 1910.181

Slings

29 CFR 1910.184

Construction Standards

29 CFR 1926 Subparts H and N

API Standards for Oil Derricks

API RP 54, RP4G, and RP9B have provisions for material handling and hoisting on rigs.

Module 19

Machine Guarding

Terminal Objective

Upon the successful completion of this module, participants will be able to describe the hazards and precautions associated with machinery and the requirements for guarding moving parts of machinery.

Enabling Objectives

1. Explain the general requirements for guarding the hazards of machines.
2. List fundamental requirements for abrasive wheel machinery.
3. Identify hazards and requirements associated with machinery found on oil and gas sites.
4. Identify the hazards and requirements associated with hand and portable power tools.

Machine Guarding and Hazards

What hazards exist?

Crushed by or drawn into equipment

Struck by moving parts

Struck by failed components or particles

Key parts of machines

Point of operation: where work is performed on the material, such as cutting, shaping, boring, or forming of stock.

Power Transmission Device: transmits energy to the part of the machine performing the work

- Includes flywheels, pulleys, belts, connecting rods, couplings, cams, spindles, chains, cranks, and gears.

Operation Controls: Control mechanisms

Other moving parts: can include reciprocating, rotating, and transverse moving parts, feed mechanisms, and auxiliary parts of the machine

Hazards to be Guarded

Things to guard include

- In-running nip points
- Rotating equipment
- Flying chips or sparks
- Belts or gears
- Parts that impact or shear

Rotating Parts

Can grip hair or clothing

Can force the body into a dangerous position

Projecting pieces increase risk

In-Running Nip Points

Between 2 rotating parts

Between rotating and tangential parts

Between rotating and fixed parts which shear, crush, or abrade

Reciprocating Parts

Risk of being struck between stationary and moving part

Transverse motion

Continuous straight line motion

Worker struck or caught in pinch or shear point

Cutting action

Direct injury from cutting action

Flying chips or sparks

Saws, drills, lathes, mills

Punching action

Ram stamps materials

Danger at point of operation

Shearing action

Powered blade that shears materials

Hazard at point of operation

Bending action

Power applied to a slide to stamp/shape materials

Hazard at point of operation

Guarding Principles

Prevent contact between hazardous moving parts and body or clothing

Secure guard: not easily removed

Protect from objects falling into machinery

No new hazards: sharp/rough edges

No interference with job/comfort/speed

Allow safe lubrication: without removing guards if possible

Guarding Methods

Location / distance

Guards

- Fixed
- Interlocked
- Adjustable
- Self-adjusting

Devices

- Presence sensing
- Pullback
- Restraint
- Safety controls (tripwire cable, two-hand control, etc.)
- Gates

Feeding & ejection methods: Automatic and/or semi-automatic feed and ejection

Robots

Miscellaneous aids

- Awareness barriers
- Protective shields
- Hand-feeding tools

Fixed Guard

Barrier is a permanent part of machine

Preferable over other types

Interlocked Guard

Stops motion when guard is opened or removed

Adjustable Guard

Barrier may be adjusted for variable operations

What are the drawbacks?

Self-Adjusting Guard

Adjusts according to size/position of material

Pullback Device

Cables attached to operator’s hands or wrists

Removes hands from point of operation during danger period

What are the drawbacks?

Restraint Device

Cables attached to fixed point and wrists or hands

Adjustable to let hands travel in predetermined area

May be accompanied by hand-feeding tools

Safety Tripwire Cable

Device located around the perimeter of or near the danger area

Operator must be able to reach the cable to stop the machine

Two-Hand Control

Requires constant pressure on both pads to activate the machine

Hands on controls at safe distance while machine is in dangerous cycle

Gate

Must close fully to protect user before cycle will start

Safeguarding by Location/Distance

Location of hazardous parts that is inaccessible or not a hazard during normal operation

Must maintain safe distance

Training, warning, communication necessary

Protective Shields

Protection from flying particles or splashing fluids

Do not protectcompletely frommachine hazards

What regulations apply?

29 CFR 1910 Subpart O

29 CFR 1910 Subpart P for hand and portable power tools

API RP 54 6.8 Machinery and Tools

29 CFR 1910 Subparts O and P are in your CFR book, and you can follow along with most of the presentation there. The exception is 29 CFR 1910.219, which is in Appendix E of this manual. The remainder of this manual section will contain only parts not found in the CFR book.

Hazards on Oil and Gas Sites

Parts Requiring Guarding

Drive belts and shafts – mud pumps and tank area

Pony rods

Rotating parts

Shale shaker

Agitator shafts & couplings

Moving generator parts

Air compressors

Crown sheaves

Kelly bushing – or other controls (Note Alternative Abatement: STD 1-12.28 CH-1, which may be found at *http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=DIRECTIVES&p_id=1735*)

Rotary chain drive

Air hoist line

Drawworks

Bench grinder wheels

Belts, drive chains, gears and drives on power and hand tools

Traveling blocks

Sheaves

Cathead?

Safety Responsibilities

Management

Ensure all machinery is properly guarded

Supervisors

Train employees on specific guard rules in their areas

Ensure machine guards remain in place and are functional

Immediately correct machine guard deficiencies

Employees

Do not remove guards unless machine is locked and tagged

Report machine guard problems to supervisors immediately

Do not operate equipment unless guards are in place

Training

Operators/affected employees should receive training on:

- Hazards associated with particular machines
- How the safeguards provide protection and the hazards for which they are intended
- How and why to use the safeguards
- How and when safeguards can be removed and by whom
- What to do if a safeguard is damaged, missing, or unable to provide adequate protection

Module

20

Lockout/Tagout

Terminal Objective

Upon the successful completion of this module, participants will be able to describe the reasons and requirements for the control of hazardous energy.

Enabling Objectives

1. Identify hazards caused by stored energy that could be prevented by lockout/tagout practices.
2. Describe appropriate energy control procedures.
3. Explain the requirements for the control of hazardous energy.

29 CFR 1910.147 The control of hazardous energy (lockout/tagout)

This standard can be found in your CFR book, where you can follow along with the presentation.

Module 21

Construction Hazards and Standards

Terminal Objective

Upon the successful completion of this module, participants will be able to identify standards in 29 CFR 1926 that are applicable during certain types of oil and gas operations.

Enabling Objectives

1. Discuss activities that fall under the construction standards.
2. Explain the hazards of site clearing, grading, and excavation.
3. Identify the requirements associated with site clearing, grading and excavation operations.
4. Explain the hazards associated with motor vehicles and heavy equipment.
5. Identify the requirements associated with motor vehicles and heavy equipment.
6. Identify the applicability of scaffold standards.

Construction vs. General Industry

"Construction, alteration and/or repair, including painting and decorating" is under 29 CFR 1926 – 29 CFR 1910.12

Repair of existing facilities; replacement of structures and their components

Interpretation on Construction vs. Maintenance is available at *http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=INTERPRETATIONS&p_id=21569*

29 CFR 1926 Organization

A. General

B. General Interpretations

C. General Safety and Health Provisions

D. Occupational Health and Environmental Controls

E. Personal Protective and Life Saving Equipment

F. Fire Protection and Prevention

G. Signs, Signals, and Barricades

H. Materials Handling, Storage, Use, and Disposal

I. Tools – Hand and Power

J. Welding and Cutting

K. Electrical

L. Scaffolds

M. Fall Protection

N. Cranes, Derricks, Hoists, Elevators, and Conveyors

O. Motor Vehicles, Mechanized Equipment, and Marine Operations

P. Excavations

Q. Concrete and Masonry Construction

R. Steel Erection

S. Underground Construction, Caissons, Cofferdams, and Compressed Air

T. Demolition

U. Blasting and the Use of Explosives

V. Power Transmission and Distribution

W. Rollover Protective Structures; Overhead Protection

X. Ladders

Y. Commercial Diving Operations

Z. Toxic and Hazardous Substances

Hazards and Standards

What hazards are employees exposed to:

- When they set up a drilling site?
- When they grade land or excavate?
- When they clear a site for use?

Regulations in 29 CFR 1926:

- Subpart P – Excavations
- Subpart O – Motor Vehicles, Mechanized Equipment, and Marine Operations
- If blasting: Subpart O

29 CFR 1926 Subpart P: Excavations

This standard can be found in your CFR book, where you can follow along with the presentation. This manual will contain material not found in the standard.

Excavating is recognized as one of the most hazardous construction operations

Fatality rate for excavations is twice that of construction as a whole

Cave-ins: More likely to result in fatalities than other excavation hazards

Hazards of Excavation Work

Cave-ins

Underground utilities

Materials/equipment falling into excavation sites

Asphyxiation

Explosion

Falls

Drowning

Soil Mechanics

Unit weight of soils:

Varies with type and moisture content

1 cubic foot can weigh 100 to >140 lbs

1 cubic meter can weigh >3000 lbs

Types of excavation collapse

Tension crack

Sliding

Bulge

Toppling

Heaving

Boiling

Definitions

Excavation: any man-made cut, cavity, trench, or depression in an earth surface, formed by earth removal.

Trench (Trench excavation): a narrow excavation (in relation to its length) made below the surface of the ground.

- Depth>width; width <15 feet
- <15 feet between structure and side

Competent Person: Training, experience, and knowledge of:

- Soil analysis
- Use of protective systems
- Requirements of 29 CFR Part 1926 Subpart P

Ability to detect:

- Conditions that could result in cave-ins
- Failures in protective systems
- Hazardous atmospheres

- Other hazards including those associated with confined spaces

Authority to take prompt corrective measures to eliminate existing and predictable hazards and to stop work when required

Soil Testing

Visual tests

Clumping

Cracks or spalling

Existing utilities/previously disturbed soil

Layers and slope

Water in surface, seeping, water table

Vibration sources

Manual tests

Plasticity

Dry strength

Thumb penetration

Pocket penetrometer or shearvane

Drying test

29 CFR 1926 Subpart O: Motor Vehicles, Mechanized Equipment, and Marine Operations

This standard can be found in Appendix F of this manual. You can follow along with the presentation using that appendix.

1926 Subpart W: Rollover Protective Structures (ROPS)

This construction equipment must have ROPS meeting minimum performance standards:

- Rubber-tired, self-propelled scrapers
- Rubber-tired front-end loaders
- Rubber-tired dozers
- Wheel-type agricultural and industrial tractors
- Crawler tractors
- Crawler-type loaders
- Motor graders, with or without attachments
- NOT sideboom pipe laying tractors

Rollover Protective Structures

Purpose: Prevent complete overturn; minimize possibility of crushed operator

Driver could still be crushed if not wearing a seatbelt!

Also in subpart W:

- Testing provisions
- Rule for overhead protection

29 CFR 1926 Subpart L: Scaffolds

This standard can be found in your CFR book. You will need to use it in class discussion to answer these and any other questions.

Application of Scaffold Regulations

What is a scaffold?

What is covered by 29 CFR 1926 Subpart L?

Where are scaffolds used in oil and gas?

Module

22

Oil and Gas Industry Guidelines

Terminal Objective

Upon the successful completion of this module, participants will be able to identify requirements in oil and gas industry guidelines.

Enabling Objectives

1. Recognize the enforceability of API standards for oil and gas operations.
2. Identify sections of industry standards recently cited by OSHA compliance officers.
3. Recognize the major sections of API RP 54.
4. Recognize the applicability of OSHA Technical Manual Section IV, Chapter 1: “Oil Well Derrick Stability: Guywire Anchor Systems”.

Oil and Gas Industry Guidelines

What standards are enforceable?

OSHA standards

- By industry and type of operation
- Take precedence over industry standards

Standards incorporated by reference

- Only the parts concerning health and safety
- Recognized hazards
- Generally accepted industry standards
- OSHA guidance documents can interpret ambiguities

Elements Required to Prove Violation of General Duty Clause

- The employer failed to keep the workplace free of a hazard to which employees of that employer were exposed
- The hazard was recognized
- The hazard was causing or was likely to cause death or serious physical harm
- There was a feasible and useful method to correct the hazard

Reference: FIRM Chapter III (C)(2)(c)

- Not the lack of a particular abatement method
- Not a particular accident

SIC 1300 Standards Cited by OSHA Compliance Officers under 5(a)(1)

October 2005 through September 2006

- API RP 54: 19 different sections, some multiple times
- API RP 4G: 5 citations
- ASME/ANSI B30 series: 3 citations
- API 9B: 1 citation
- NEC: 1 citation
- Company safety practices: 3 citations
- Operating manuals: 5 citations

API RP 54: Recommended Practice for Occupational Safety for Oil and Gas Well Drilling and Servicing Operation

1 General

1.1 Purpose:

Recommend practices and procedures for promotion and maintenance of safe working conditions for personnel engaged in drilling operations and well servicing operations, including special services

1.2 Scope:

Rotary drilling rigs, well servicing rigs, special services

- Operations on location
- Not seismic or water well drilling
- Not site preparation or site abandonment

1.3 Responsibility:

- Each employer trains own employees
- Operator and contractor share information
- Immediate supervision of authorized person with authority to commence, modify, cease or improve

2 References

- API standards
- ACGIH TLVs
- ANSI standards
- ASME Boiler and Pressure Vessel Code
- NFPA standards
- Incorporated for special topics

3 Definitions

3.1.88 shall:

Recommended practice has universal application to specific activity

3.1.89 should:

Recommended practice

- Safe comparable alternative available
- May be impractical or unnecessary under certain circumstances

4 Injuries and First Aid

4.1 General

Immediate reporting and treatment; follow-up reporting; cause investigation and prevention

4.2 Medical services

Information available and arrangements made

4.3 First aid

CPR trained individual and first aid kit at worksite

4.4 Emergency eye or body wash stations

where exposed to injurious materials

5 Personal Protective Equipment (PPE)

5.1 General

Wear PPE when there is reasonable potential for prevention of harm

PPE only used when engineering or administrative controls impractical

5.2 Wearing Apparel

Hard hat: each person

Eye protection where probable injury

Safety-toe footwear; Alternative practice for extreme cold

Gloves, apron, boots, other appropriate PPE for chemical handling

No loose or poorly fitted clothing

Never work in clothing saturated with flammable, hazardous, or irritating substances

Never wear jewelry that could be snagged or hung

Keep hair contained if long enough to cause hazards

Hair/beard must not interfere with PPE

5.3 Hearing protection

5.4 Respiratory protection

5.5 Fall protection

For work 10 feet above rig floor or other working surface

Guardrail, net, or PFAS

Alternative fall protection plan if infeasible

6 Operations

6.1 General

Well control maintained at all times

Rig floor attended by person qualified in well control

“Horseplay and careless acts” not permitted

Training and safety program

Unsafe conditions reported to supervisor and relayed between shifts

Pipe threads cleaned with brush to prevent finger wounds

Hazardous substances properly labeled; users trained

Blowout prevention where necessary; well control drills

No field welding on tongs, elevators, bails, or heat treated rig equipment

Vehicles not involved in operations: at least 100 feet or derrick height away from wellbore, or other safety measures if not possible

Ground rig substructure, derrick, mast, and other equipment as appropriate

6.2 Over Water Operations

Instruction in abandonment procedures, emergency signals, water entry

At least 2 emergency escape means to water

Personal flotation devices & ring buoys

At least 2 life floats or alternatives

Cold water attire

Basket stretcher or litter, and instruction

Rules for crane transport of personnel

API RP 2D for offshore pedestal cranes

No crane operation during helicopter takeoff or landing

Personal flotation devices for crane or swingrope transfer to/from boats

Tag lines to steady all loads

6.3 Preliminary Rig-Up Operations

Review planned arrangement to avoid hazardous conditions

- Pipelines
- Utility lines

Rig up safely before commencing well operations

Locate change rooms and outbuildings far enough from boilers and fuel tanks

Check well for pressure, and remove it or operate safely under pressure

All personnel out of derrick or mast and cellar and stand clear when

- Subsurface pump is being unseated or
- Initial pull on tubing is made

6.4 Blowout Prevention Equipment

Blowout prevention equipment installed and tested where well might flow

Install, operate, maintain: API RP 53

Rig personnel must understand and be able to operate blowout preventer

- Discuss in pre-job meeting
- Drills under variety of conditions

Anchor choke and kill lines – prevent whipping

6.5 Housekeeping

Clean work areas; remove trip hazards

Avoid / clean up wet floors (from leaks, spills, or pulling wet pipe)

Keep cellar clear of fluids or loose equipment/material

Keep egress routes unblocked

Store tools & equipment to avoid falling

Keep fire fighting equipment accessible

6.6 Hydrogen Sulfide Environment

Safety guidelines referenced

- API RP 49, 55, 68

Protect personnel and general public

6.7 Confined Space, Excavations, or Hazardous Environments

Where unusually hazardous gases present, advise employees, contractors, and service company supervisors of hazards

Fill the cellar if it is not needed

Definition of confined space

Testing, permit system before entry

Declassification of confined spaces

6.7.5 Excavations

If deeper than 4 feet and may contain a hazardous atmosphere: Test for oxygen, flammable gases/vapors, toxic air contaminants

Evaluate whether excavation is a confined space, and permit if necessary

Precautions to prevent exposures

Emergency response procedures

6.8 Machinery and Tools

Personnel only operate machinery on which they are qualified

Belts, drive chains, gears, and drives must have guards installed - except rotary table, catheads, kelly

Guards in place and properly maintaned for operation

Maintenance: report to rig supervisor

Moving parts guarded or stopped before cleaning, lubrication, or repair

Maintain tools in safe condition

Double insulate or ground tools; Use GFCI

Electric or pneumatic tools: deadman switch or starting switch that cannot be locked in

Secure materials to body when carrying them up a ladder

6.9 Lockout/Tagout

Locks/tags identify equipment or circuits being worked on

- Critical systems: include identity of worker

Train and discipline personnel

Lock/tag removed by person who installed it, or authorized replacement

- If neither available, supervisor may remove after ensuring no hazard created

6.10 Auxiliary Escape

Land rigs: derrick or mast must have auxiliary means of escape before work in the derrick

- Securely anchored escape line attached to derrick or mast for escape from derrickman's platform (Geronimo line)
- Wire rope with safety buggy with braking or controlled descent device
- Safety buggy releases when weight is applied

6.10 Auxiliary Escape

Tension on escape line:

- Periodically checked and adjusted
- 6-12 feet of sag in middle
- Ground anchor point distance at least 2x height
- Ground anchor point should withstand 3000 lb pull

Alternate fast escape if line is infeasible

Training on use

Never ride except in emergency

6.11 Personnel Lifting Systems

Never ride the elevators.

- Except in extreme emergency, as determined by supervisor, with full fall protection and no pipe or other equipment

Bosun’s chair attached to traveling block or tugger line for inaccessible location

Hydraulic or air winch lines allowable under certain conditions

6.12 Racking Tubulars and Drill Collars

Secure rods, tubulars, drill pipe, drill collars when racked or hung in derrick or mast to keep from falling

Safety clamps removed before hoisting continues

Use stops, pins, or chocks to keep round equipment from rolling off storage rack

Prevent/remove ice plugs in tubulars

6.13 Handling Drilling Fluid Chemicals and Additives

Never use asbestos as additive

Instruct personnel handling fluid and additives in handling, disposal, and PPE

7 Fire Prevention and Protection

7.1 Fire Prevention

Store combustible and flammable materials safely

Prevent rubbish accumulation

No smoking, or source of ignition, near operations that could cause fire hazard – signs necessary

Change rooms in safe areas for smoking

Potential ignition sources located at safe distance from wellhead or flammable storage areas

Only safety-designed heaters near rig floor, substructure, or cellar

Do not allow oil and gas accumulations

Store oily waste in covered metal containers

Never use natural gas or LPG to operate spray guns or pneumatic tools

Cleaning solutions: flash point at least100°F

Conductive containers (e.g. metal) to handle, store, or transport flammable liquids

- Ground and bond any plastic containers
- NFPA 77 and API Publication 2003

7.2 Fire Protection

Fire fighting equipment not tampered with or removed

Fire fighting water system may be used for wash down if capacity is not compromised

Equipment accessible, plainly labeled

Equipment inspected & maintained

Crew familiar with location & use

Drilling rigs: at least 4 20-pound BC extinguishers, depending on operation

Well servicing rigs: at least 2 20-pound BC extinguishers, depending on operation

Fire fighting equipment near all welding

Fire watch for welding/cutting outside designated welding area

8 Flammable Liquids

Approved portable containers

Tanks and Drums properly labeled

Refueling operations:

- Procedures for over water transfers
- Shut down engines while refueling unless shutdown causes greater hazard
- Assign a person to monitor filling tank to prevent spillage
- Ground during refueling

8.3 Liquefied Petroleum Gas (LPG)

Follow NFPA 58

Ignition source control

Protective caps on cylinders

Usual cylinder precautions

No temperatures >125°F, no direct heat

Protective gloves for refilling or replacing bottles: freeze burns

8.4 Flammable Liquid Storage

Storage area requirements: ventilation, exits, housekeeping, warning, extinguishers, classification

On land:

- Not within 50 feet of wellbore, or equivalent safety measures
- LPG tanks >250 gallons at least 150 ft from and parallel to closest side of rig; labeled

Offshore: appropriate precautions

9 Drilling and Well Servicing Rig Equipment

9.1 General

Openings in rotary table kept covered when not occupied

Rathole and mousehole openings kept covered when not occupied with equipment

9.2 Derricks and Masts

Substantial, well designed & maintained

Permanent name plate:

- Manufacturer
- Model and serial number
- Rating including static hook load capacity with number of lines
- Recommended guying pattern if applicable
- If not noted, guy according to API 4G

Raising and lowering masts:

- Not moved while raised
- Visual inspection of raising/lowering mechanism before use
- Tools and unsecured materials removed from mast before raising/lowering
- Base level and positioned before raising, lowering or telescoping, or tightening guylines
- Qualified person in charge of raising/lowering
- Bolts, nuts and pins secured
- No extra personnel in/under mast unless fully raised or lowered

Guylines tensioned before load applied

During unusual loading:

- Only essential personnel on rig floor
- No one in derrick, mast, or cellar

Platforms above rig floor maintained and secured to support stresses

Materials not kept above rig floor unless in use and secured against falling

No one on rig floor during overhead repair unless their help is needed

No unguarded openings big enough for person to fall except ladder opening between supports of crown block

Bumper blocks:

- Safety cable or strap along full length
- Prevent wood fragment falling with screen

Counterweights:

- Safety line anchored to derrick/mast if not encased or in permanent guides
- Travel of tong counterweights limited to elevations needed for tongs

Safety devices for jacks

9.3 Ladders, Stairways, and Platforms

Fixed ladder from rig floor to crown block and to each intermediate platform

Ladders securely attached by manufacturer specifications

Ladders must not lean back from vertical

Minimum clearances for ladders

Side rails extend at least42 inches past landing

Cages and platforms not required if PFAS is used

Platforms wherever ladders are offset, if PFAS is not used

Open stairways >4 risers:

- Securely fastened
- Handrails and midrails over entire length
- Uniform, level stair treads

At least 2 stairway exits on drilling rigs from rig floor to ground level

Rig floor, ramps, stairways, ladders, platforms kept free of slip/trip hazards

Derrick platforms:

- Inside mast, except stabbing board, must completely cover space from edge to legs
- Secured to protect against dislodging

Well servicing rigs:

- Work not at ground level is on a working platform large enough for 2 people
- Safety fasteners when folded for storage

Finger board fingers bolted, welded, hinged-and-pinned, or equivalent, to beam

Guardrails at outer edge at least 4 ft. above ground or other working level

- 42 inch top rail, intermediate rail, posts, except for
  - Personnel exits and entrances
  - Catwalk and V-door opening when being used
  - Work station used to rack tubulars
  - Alternate arrangements with equivalent safety

4 inch toe boards to prevent falling items

Floor and deck openings not left open

Floor holes people may walk into: securely covered with no more than 1 inch opening

9.4 Drawworks

Visual inspection once per day

Guard remains in place and in good condition during operation

Do not lubricate during operation

Do not leave brake without securing, unless equipped with automatic driller

Shut down switches at drum control console

Brake systems inspected and maintained per manufacturer recommendations

Drilling rigs:

- Double (auxiliary) braking system
- Safety device to keep traveling block from striking crown block
  - — Tested before each trip and after drill-line slipping or cutting operation

9.5 Catheads and Lines Powered by the Cathead

Shaft head covered by a thimble a rope cannot wind around

Rope guide for manually operated rope

Check for grooves >1/4 inch; rebuild and turn to avoid fouling

Keep lines from being entangled with cathead line

No rope or line on unattended cathead

Drawworks control attended while manual cathead is in use

No rope splices on cathead friction surface, except properly spliced endless rope

Headache post or guard for drawworks control personnel when line is near operator

Training required before operation of cathead or lines

Maintain lines and automatic catheads in safe working condition

When lifting tubulars, use slings that will not slip off.

9.6 Hoisting lines and other wire rope

Visually inspect at least once per day; detailed inspection once per month

Remove when too many broken wires

Consider removal for corrosion

Remove lines with corroded, cracked, bent, worn, improper end connections

Remove for kinking, crushing, birdcaging, cutting, cold working

Hoisting line: End securely fastened; enough extra line on drum to avoid fastener strain

Anchors at least as strong as line

Ton-mile limits; see API RP 9B

Moving hoisting line not to come in contact with anything stationary except crown block sheaves and traveling block sheaves

Hoisting line not removed from drum until traveling block rests on rig floor or is suspended separately

Slings should be identified by size, grade, rated capacity, reach

9.7 Hoisting Tools, Hooks, Bails, Elevators, and Related Equipment

Good engineering practice; maintained safe. See API Spec 8A, 8B, 8C

Never exceed design load

Safety latch on hoisting hook to prevent accidental release

Traveling blocks guarded properly

Crown blocks secured to keep sheaves from jumping out of bearings

Traveling blocks not moved while crown block is being lubricated

Fasten pump end of rotary hose to derrick/mast by cable or chain

Fasten swivel end of rotary hose to swivel with similar cable or chain

Inspect elevators, latches, latch locks, pins, springs; replace if worn/damaged

9.8 Rotary

Only engage power when rotary table is clear of all people and materials

Do not use rotary table for initial breakout of tool joints – only spinning out after initial breakout

Use smooth kelly bushings to prevent catching of people, clothes or material

9.9 Drill String Handling Equipment

Manual drill pipe slip handles:

Use manufacturer's original or equivalent

Short enough to not project beyond master bushing

Lubricate tapered side of drill pipe slips

Do not kick slips into place

Attach tongs to fixed structure using wire rope or stiff arm

Maintain tongs properly

Tong safety lines: long enough to use breakout cathead, but short enough to prevent complete rotation of tongs

Power tongs:

Pressure systems: safety relief valve

Power input pressure line disconnected to work on tongs

9.10 Weight Indicators

Used for all rigs that manipulate tubulars

Maintained to register within 5%

Checked periodically for calibration

Gauge visible to operator

Protected from falling

9.11 Drilling Fluid Tanks

On land: Pits and tanks used to circulate flammables located at least 100 feet from well, or equivalent

Drilling fluid tanks treated as confined spaces

Ventilation, ventilation alarms, gas detectors

Blowers with appropriate electrical classification

9.12 Pipe Racks and Pipe Tubs

Pipe handled at the ends while loading, unloading, or transferring

Keep people out of the way during transfer or loading/unloading

Prevent pipe from rolling off: Load and unload by layers, with each layer blocked at all 4 corners.

Temporary supports to skid or roll pipe

9.13 Pressure Equipment

Pressure relief valve discharges located to prevent hazard with sudden discharge or piping movement

Lines and hoses secured to prevent unsafe movement

Never operate above rated pressure

Hammer unions must be the same thread – some look alike but will fail

Pressure relief devices to discharge at or below rated pressure of components

Automatic air pressure controls for cleaning, sandblasting, etc.

Pump houses with 2 exit doors in different directions to outside

Shear-pin relief valves enclosed to prevent flying pins

9.14 Generators, Motors, and Lighting

Generators at least 100 feet upwind of wellhead or equivalent

Overload safety device to protect from shorting and burnout

Adequate illumination, by safe portable lights if necessary. Headlights are not sufficient.

Extension cords insulated; plugs in good condition

Lighting and fixtures of appropriate electrical classification (RP 500 & 505)

- Enclosed and gasketed if not covered by 500/505

ANSI/IES RP7 1988: Industrial Lighting

Class I, Division I safeguards for shale shaker motor and area within 5 feet

Lockout/tagout before repairing electrical equipment

Ground motors, generators, control panels

9.15 Internal Combustion Engines

Diesel engines require emergency shut-down devices to shut off air

Actuation check the rig power emergency shut down devices 1x/week

Check all other internal combustion engine shutdown devices 1x/30 days

Spark arrestors or equivalent within 100 feet of wellbore

9.16 Inspection of Critical Equipment

Periodically inspected by manufacturer recommendation or good engineering practice

Certified inspectors use recognized methods for nondestructive testing

Qualified personnel for other inspection types

10 Drilling and Well Servicing Rig Electrical Systems

10.1 Work in Proximity to Exposed Energized Power Sources

Minimum clearances to power lines:

- Operating rig: 10 ft + 4 in/10 kV over 50 kV
- Lowered mast: 4 ft + 4 in/10 kV over 50 kV
- Individual designated as observer
- Consider lines live unless owner report or test by qualified person says non-energized

10.2 Rig Electrical Systems Equipment

Designed for use in hazardous locations if used there

Maintain: manufacturer recommendation

Flexible cord, resistant to dampness and petroleum

Protect wiring from damage; replace or properly repair when insulation damaged

Offshore: API RP 14F

10.3 Classification of Areas

See API RP 500 and 505 and NFPA 30

Adequate ventilation defined

- <10% of lower explosive limit (LEL)
- Enclosed areas: 1 cubic foot/minute per square foot, but at least 6 air changes per hour
- Natural or mechanical

11 Pumping Units

11.1 Well Pumping Units

Electric power deenergized during well servicing and, if necessary, during rig moves and rig-up or rig-down

For well servicing:

- Pumping unit turned off
- Brake set
- Power source locked/tagged out

Prevent unintended counterweight movement

Use strong enough sling to handle horsehead

- Installation: bolt or latch as recommended

Maintain brake systems in safe working order

Reinstall guards before startup

12 Special Services

General

Equipment

Communications

Discharge Line (Temporary Treating or Cementing Lines)

Lubricator operations

13 Wireline Service

General

Placement and Handling of Wireline Service Units

Gin Poles (Telescoping and Single Poles)

Rope Falls (Block and Tackle)

Wellheads, Wellhead Connections, and Adapters

Lubricators and Wireline Blowout Preventer Equipment

Wireline Operations

Perforating

Swabbing

Bailing

14 Stripping and Snubbing

General

Operations

15 Drill Stem Testing

General

Preliminary to Drill Stem Test

Performing the Drill Stem Test

16 Acidizing, Fracturing, and Hot Oil Operations

General

Pumping Operations

17 Cementing Operations

General

Pumping Operations

18 Gas, Air, or Mist Drilling Operations

General (All other requirements apply)

Training

Equipment

Procedures

Minimizing Sources of Ignition

19 Hot Tapping and Freezing Operations

General

Hot Tapping Operations

Freezing Operations

20 Hotwork, Welding, and Flame Cutting Operations

General

- Written safety work permit system
- Avoid being a source of ignition
- Certified welders for equipment whose primary function is to contain hydrocarbons

Personal Protective Equipment (PPE)

Fire Protection

Equipment

Welding Fumes and Ventilation

Appendix A

Multi-Employer Citation Policy

This appendix contains OSHA's multi-employer citation policy. The policy is OSHA directive CPL 2-0.124 and can be found online at *http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=DIRECTIVES&p_id=2024*.

CPL 2-0.124

OSHA INSTRUCTION

U.S. DEPARTMENT OF LABOR — Occupational Safety and Health Administration

DIRECTIVE NUMBER: CPL 2-0.124

EFFECTIVE DATE: December 10, 1999

SUBJECT: Multi-Employer Citation Policy

ABSTRACT

Purpose: To Clarify the Agency's multi-employer citation policy

Scope: OSHA-wide

References: OSHA Instruction CPL 2.103 (the FIRM)

Suspensions: Chapter III, Paragraph C. 6. of the FIRM is suspended and replaced by this directive

State Impact: This Instruction describes a Federal Program Change. Notification of State intent is required, but adoption is not.

Action Offices: National, Regional, and Area Offices

Originating Office: Directorate of Compliance Programs

Contact: Carl Sall (202) 693-2345
Directorate of Construction
N3468 FPB

200 Constitution Ave., NW
Washington, DC 20210

By and Under the Authority of
R. Davis Layne
Deputy Assistant Secretary, OSHA

I. Purpose. This Directive clarifies the Agency's multi-employer citation policy and suspends Chapter III. C. 6. of OSHA's Field Inspection Reference Manual (FIRM).

II. Scope. OSHA-Wide

III. Suspension. Chapter III. Paragraph C. 6. of the FIRM (CPL 2.103) is suspended and replaced by this Directive.

IV. References. OSHA Instructions:

- CPL 02-00.103; OSHA Field Inspection Reference Manual (FIRM), September 26, 1994.
- ADM 08-0.1C, OSHA Electronic Directive System, December 19,1997.

V. Action Information

A. Responsible Office. Directorate of Construction.

B. Action Offices. National, Regional and Area Offices

C. Information Offices. State Plan Offices, Consultation Project Offices

VI. Federal Program Change. This Directive describes a Federal Program Change for which State adoption is not required. However, the States shall respond via the two-way memorandum to the Regional Office as soon as the State's intent regarding the multi-employer citation policy is known, but no later than 60 calendar days after the date of transmittal from the Directorate of Federal-State Operations.

VII. Force and Effect of Revised Policy. The revised policy provided in this Directive is in full force and effect from the date of its issuance. It is an official Agency policy to be implemented OSHA-wide.

VIII. Changes in Web Version of FIRM. A note will be included at appropriate places in the FIRM as it appears on the Web indicating the suspension of Chapter III paragraph 6. C. and its replacement by this Directive, and a hypertext link will be provided connecting viewers with this Directive.

IX. Background. OSHA's Field Inspection Reference Manual (FIRM) of September 26, 1994 (CPL 2.103), states at Chapter III, paragraph 6. C., the Agency's citation policy for multi-employer worksites. The Agency has determined that this policy needs clarification. This directive describes the revised policy.

A. Continuation of Basic Policy. This revision continues OSHA's existing policy for issuing citations on multi-employer worksites. However, it gives clearer and more detailed guidance than did the earlier description of the policy in the FIRM, including new examples explaining when citations should and should not be issued to exposing, creating, correcting, and controlling employers. These examples, which address common situations and provide general policy guidance, are not intended to be exclusive. In all cases, the decision on whether to issue citations should be based on all of the relevant facts revealed by the inspection or investigation.

B. No Changes in Employer Duties. This revision neither imposes new duties on employers nor detracts from their existing duties under the OSH Act. Those duties continue to arise from the employers' statutory duty to comply with OSHA standards and their duty to exercise reasonable diligence to determine whether violations of those standards exist.

X. Multi-employer Worksite Policy. The following is the multi-employer citation policy:

A. Multi-employer Worksites. On multi-employer worksites (in all industry sectors), more than one employer may be citable for a hazardous condition that violates an OSHA standard. A two-step process must be followed in determining whether more than one employer is to be cited.

1. Step One. The first step is to determine whether the employer is a creating, exposing, correcting, or controlling employer. The definitions in paragraphs (B) - (E) below explain and give examples of each. Remember that an employer may have multiple roles (see paragraph H). Once you determine the role of the employer, go to Step Two to determine if a citation is appropriate (NOTE: only exposing employers can be cited for General Duty Clause violations).

2. Step Two. If the employer falls into one of these categories, it has obligations with respect to OSHA requirements. Step Two is to determine if the employer's actions were sufficient

to meet those obligations. The extent of the actions required of employers varies based on which category applies. Note that the extent of the measures that a controlling employer must take to satisfy its duty to exercise reasonable care to prevent and detect violations is less than what is required of an employer with respect to protecting its own employees.

B. The Creating Employer

1. Step 1: Definition: The employer that caused a hazardous condition that violates an OSHA standard.

2. Step 2: Actions Taken: Employers must not create violative conditions. An employer that does so is citable even if the only employees exposed are those of other employers at the site.

   a) **Example 1:** Employer Host operates a factory. It contracts with Company S to service machinery. Host fails to cover drums of a chemical despite S's repeated requests that it do so. This results in airborne levels of the chemical that exceed the Permissible Exposure Limit.

      Analysis: Step 1: Host is a creating employer because it caused employees of S to be exposed to the air contaminant above the PEL. Step 2: Host failed to implement measures to prevent the accumulation of the air contaminant. It could have met its OSHA obligation by implementing the simple engineering control of covering the drums. Having failed to implement a feasible engineering control to meet the PEL, Host is citable for the hazard.

   b) **Example 2:** Employer M hoists materials onto Floor 8, damaging perimeter guardrails. Neither its own employees nor employees of other employers are exposed to the hazard. It takes effective steps to keep all employees, including those of other employers, away from the unprotected edge and informs the controlling employer of the problem. Employer M lacks authority to fix the guardrails itself.

      Analysis: Step 1: Employer M is a creating employer because it caused a hazardous condition by damaging the guardrails. Step 2: While it lacked the authority to fix the guardrails, it took immediate and effective steps to keep all employees away from the hazard and notified the controlling employer of the hazard. Employer M is not citable since it took effective measures to prevent employee exposure to the fall hazard.

C. The Exposing Employer

1. Step 1: Definition: An employer whose own employees are exposed to the hazard. See Chapter III, section (C)(1)(b) for a discussion of what constitutes exposure.

2. Step 2: Actions taken: If the exposing employer created the violation, it is citable for the violation as a creating employer. If the violation was created by another employer, the exposing employer is citable if it (1) knew of the hazardous condition or failed to exercise reasonable diligence to discover the condition, and (2) failed to take steps consistent with its authority to protect is employees. If the exposing employer has authority to correct the hazard, it must do so. If the exposing employer lacks the authority to correct the hazard, it is citable if it fails to do each of the following: (1) ask the creating and/or controlling employer to correct the hazard; (2) inform its employees of the hazard; and (3) take reasonable alternative protective measures. In extreme circumstances (e.g., imminent danger situations), the exposing employer is citable for failing to remove its employees from the job to avoid the hazard.

   a) **Example 3:** Employer Sub S is responsible for inspecting and cleaning a work area in Plant P around a large, permanent hole at the end of each day. An OSHA standard requires guardrails. There are no guardrails around the hole and Sub S employees do not use personal fall protection, although it would be feasible to do so. Sub S has no authority to install guardrails. However, it did ask Employer P, which operates the plant, to install them. P refused to install guardrails.

   Analysis: Step 1: Sub S is an exposing employer because its employees are exposed to the fall hazard. Step 2: While Sub S has no authority to install guardrails, it is required to comply with OSHA requirements to the extent feasible. It must take steps to protect its employees and ask the employer that controls the hazard - Employer P - to correct it. Although Sub S asked for guardrails, since the hazard was not corrected, Sub S was responsible for taking reasonable alternative protective steps, such as providing personal fall protection. Because that was not done, Sub S is citable for the violation.

b) **Example 4:** Unprotected rebar on either side of an access ramp presents an impalement hazard. Sub E, an electrical subcontractor, does not have the authority to cover the rebar. However, several times Sub E asked the general contractor, Employer GC, to cover the rebar. In the meantime, Sub E instructed its employees to use a different access route that avoided most of the uncovered rebar and required them to keep as far from the rebar as possible.

Analysis: Step 1: Since Sub E employees were still exposed to some unprotected rebar, Sub E is an exposing employer. Step 2: Sub E made a good faith effort to get the general contractor to correct the hazard and took feasible measures within its control to protect its employees. Sub E is not citable for the rebar hazard.

D. <u>The Correcting Employer</u>

1. <u>Step 1: Definition:</u> An employer who is engaged in a common undertaking, on the same worksite, as the exposing employer and is responsible for correcting a hazard. This usually occurs where an employer is given the responsibility of installing and/or maintaining particular safety/health equipment or devices.

2. <u>Step 2: Actions taken:</u> The correcting employer must exercise reasonable care in preventing and discovering violations and meet its obligations of correcting the hazard.

a) **Example 5:** Employer C, a carpentry contractor, is hired to erect and maintain guardrails throughout a large, 15-story project. Work is proceeding on all floors. C inspects all floors in the morning and again in the afternoon each day. It also inspects areas where material is delivered to the perimeter once the material vendor is finished delivering material to that area. Other subcontractors are required to report damaged/missing guardrails to the general contractor, who forwards those reports to C. C repairs damaged guardrails immediately after finding them and immediately after they are reported. On this project few instances of damaged guardrails have occurred other than where material has been delivered. Shortly after the afternoon inspection of Floor 6, workers moving equipment accidentally damage a guardrail in one area. No one tells C of the damage and C has not seen it. An OSHA inspection occurs at the beginning of the next day, prior to the morning inspection of Floor 6. None of C's own employees are exposed to the hazard, but other employees are exposed.

Analysis: Step 1: C is a correcting employer since it is responsible for erecting and maintaining fall protection equipment. Step 2: The steps C implemented to discover and correct damaged guardrails were reasonable in light of the amount of activity and size of the project. It exercised reasonable care in preventing and discovering violations; it is not citable for the damaged guardrail since it could not reasonably have known of the violation.

E. The Controlling Employer

1. Step 1: Definition: An employer who has general supervisory authority over the worksite, including the power to correct safety and health violations itself or require others to correct them. Control can be established by contract or, in the absence of explicit contractual provisions, by the exercise of control in practice. Descriptions and examples of different kinds of controlling employers are given below.

2. Step 2: Actions Taken: A controlling employer must exercise reasonable care to prevent and detect violations on the site. The extent of the measures that a controlling employer must implement to satisfy this duty of reasonable care is less than what is required of an employer with respect to protecting its own employees. This means that the controlling employer is not normally required to inspect for hazards as frequently or to have the same level of knowledge of the applicable standards or of trade expertise as the employer it has hired.

3. Factors Relating to Reasonable Care Standard. Factors that affect how frequently and closely a controlling employer must inspect to meet its standard of reasonable care include:

   a) The scale of the project;

   b) The nature and pace of the work, including the frequency with which the number or types of hazards change as the work progresses;

   c) How much the controlling employer knows both about the safety history and safety practices of the employer it controls and about that employer's level of expertise.

d) More frequent inspections are normally needed if the controlling employer knows that the other employer has a history of non-compliance. Greater inspection frequency may also be needed, especially at the beginning of the project, if the controlling employer had never before worked with this other employer and does not know its compliance history.

e) Less frequent inspections may be appropriate where the controlling employer sees strong indications that the other employer has implemented effective safety and health efforts. The most important indicator of an effective safety and health effort by the other employer is a consistently high level of compliance. Other indicators include the use of an effective, graduated system of enforcement for non-compliance with safety and health requirements coupled with regular jobsite safety meetings and safety training.

4. Evaluating Reasonable Care. In evaluating whether a controlling employer has exercised reasonable care in preventing and discovering violations, consider questions such as whether the controlling employer:

   a) Conducted periodic inspections of appropriate frequency (frequency should be based on the factors listed in G.3.);

   b) Implemented an effective system for promptly correcting hazards;

   c) Enforces the other employer's compliance with safety and health requirements with an effective, graduated system of enforcement and follow-up inspections.

5. Types of Controlling Employers

   a) Control Established by Contract. In this case, the Employer Has a Specific Contract Right to Control Safety: To be a controlling employer, the employer must itself be able to prevent or correct a violation or to require another employer to prevent or correct the violation. One source of this ability is explicit contract authority. This can take the form of a specific contract right to require another employer to adhere to safety and health requirements and to correct violations the controlling employer discovers.

      (1) **Example 6:** Employer GH contracts with Employer S to do sandblasting at GH's plant. Some of the work

is regularly scheduled maintenance and so is general industry work; other parts of the project involve new work and are considered construction. Respiratory protection is required. Further, the contract explicitly requires S to comply with safety and health requirements. Under the contract GH has the right to take various actions against S for failing to meet contract requirements, including the right to have non-compliance corrected by using other workers and back-charging for that work. S is one of two employers under contract with GH at the work site, where a total of five employees work. All work is done within an existing building. The number and types of hazards involved in S's work do not significantly change as the work progresses. Further, GH has worked with S over the course of several years. S provides periodic and other safety and health training and uses a graduated system of enforcement of safety and health rules. S has consistently had a high level of compliance at its previous jobs and at this site. GH monitors S by a combination of weekly inspections, telephone discussions and a weekly review of S's own inspection reports. GH has a system of graduated enforcement that it has applied to S for the few safety and health violations that had been committed by S in the past few years. Further, due to respirator equipment problems S violates respiratory protection requirements two days before GH's next scheduled inspection of S. The next day there is an OSHA inspection. There is no notation of the equipment problems in S's inspection reports to GH and S made no mention of it in its telephone discussions.

Analysis: Step 1: GH is a controlling employer because it has general supervisory authority over the worksite, including contractual authority to correct safety and health violations. Step 2: GH has taken reasonable steps to try to make sure that S meets safety and health requirements. Its inspection frequency is appropriate in light of the low number of workers at the site, lack of significant changes in the nature of the work and types of hazards involved, GH's knowledge of S's history of compliance and its effective safety and health efforts on this job. GH has exercised reasonable care and is not citable for this condition.

(2) **<u>Example 7:</u>** Employer GC contracts with Employer P to do painting work. GC has the same contract authority over P as Employer GH had in Example 6. GC has never before worked with P. GC conducts inspections that are sufficiently frequent in light of the factors listed above in (G)(3). Further, during a number of its inspections, GC finds that P has violated fall protection requirements. It points the violations out to P during each inspection but takes no further actions.

Analysis: Step 1: GC is a controlling employer since it has general supervisory authority over the site, including a contractual right of control over P. Step 2: GC took adequate steps to meet its obligation to discover violations. However, it failed to take reasonable steps to require P to correct hazards since it lacked a graduated system of enforcement. A citation to GC for the fall protection violations is appropriate.

(3) **<u>Example 8:</u>** Employer GC contracts with Sub E, an electrical subcontractor. GC has full contract authority over Sub E, as in Example 6. Sub E installs an electric panel box exposed to the weather and implements an assured equipment grounding conductor program, as required under the contract. It fails to connect a grounding wire inside the box to one of the outlets. This incomplete ground is not apparent from a visual inspection. Further, GC inspects the site with a frequency appropriate for the site in light of the factors discussed above in (G)(3). It saw the panel box but did not test the outlets to determine if they were all grounded because Sub E represents that it is doing all of the required tests on all receptacles. GC knows that Sub E has implemented an effective safety and health program. From previous experience it also knows Sub E is familiar with the applicable safety requirements and is technically competent. GC had asked Sub E if the electrical equipment is OK for use and was assured that it is.

Analysis: Step 1: GC is a controlling employer since it has general supervisory authority over the site, including a contractual right of control over Sub E. Step 2: GC exercised reasonable care. It had determined that Sub E had technical expertise, safety knowledge and had implemented safe work practices. It conducted inspections with appropriate frequency. It also made some basic inquiries into the safety of the electrical equipment. Under these circumstances GC was not obligated to test the outlets itself to determine if they were all grounded. It is not citable for the grounding violation.

b) Control Established by a Combination of Other Contract Rights: Where there is no explicit contract provision granting the right to control safety, or where the contract says the employer does not have such a right, an employer may still be a controlling employer. The ability of an employer to control safety in this circumstance can result from a combination of contractual rights that, together, give it broad responsibility at the site involving almost all aspects of the job. Its responsibility is broad enough so that its contractual authority necessarily involves safety. The authority to resolve disputes between subcontractors, set schedules and determine construction sequencing are particularly significant because they are likely to affect safety. (NOTE: citations should only be issued in this type of case after consulting with the Regional Solicitor's office).

(1) **Example 9:** Construction manager M is contractually obligated to: set schedules and construction sequencing, require subcontractors to meet contract specifications, negotiate with trades, resolve disputes between subcontractors, direct work and make purchasing decisions, which affect safety. However, the contract states that M does not have a right to require compliance with safety and health requirements. Further, Subcontractor S asks M to alter the schedule so that S would not have to start work until Subcontractor G has completed installing guardrails. M is contractually responsible for deciding whether to approve S's request.

Analysis: Step 1: Even though its contract states that M does not have authority over safety, the combination of rights actually given in the contract provides broad responsibility over the site and results in the ability of M to direct actions that necessarily affect safety. For example, M's contractual obligation to determine whether to approve S's request to alter the schedule has direct safety implications. M's decision relates directly to whether S's employees will be protected from a fall hazard. M is a controlling employer. Step 2: In this example, if M refused to alter the schedule, it would be citable for the fall hazard violation.

(2) **Example 10:** Employer ML's contractual authority is limited to reporting on subcontractors' contract compliance to owner/developer O and making contract payments. Although it reports on the extent to which the subcontractors are complying with safety and health infractions to O, ML does not exercise any control over safety at the site.

Analysis: Step 1: ML is not a controlling employer because these contractual rights are insufficient to confer control over the subcontractors and ML did not exercise control over safety. Reporting safety and health infractions to another entity does not, by itself (or in combination with these very limited contract rights), constitute an exercise of control over safety. Step 2: Since it is not a controlling employer it had no duty under the OSH Act to exercise reasonable care with respect to enforcing the subcontractors' compliance with safety; there is therefore no need to go to Step 2.

c) Architects and Engineers: Architects, engineers, and other entities are controlling employers only if the breadth of their involvement in a construction project is sufficient to bring them within the parameters discussed above.

(1) **Example 11:** Architect A contracts with owner O to prepare contract drawings and specifications, inspect the work, report to O on contract compliance, and to certify completion of work. A has no authority or means to enforce compliance, no authority to approve/reject work and does not exercise any other authority at the site, although it does call the general contractor's attention to observed hazards noted during its inspections.

Analysis: Step 1: A's responsibilities are very limited in light of the numerous other administrative responsibilities necessary to complete the project. It is little more than a supplier of architectural services and conduit of information to O. Its responsibilities are insufficient to confer control over the subcontractors and it did not exercise control over safety. The responsibilities it does have are insufficient to make it a controlling employer. Merely pointing out safety violations did not make it a controlling employer. NOTE: In a circumstance such as this it is likely that broad control over the project rests with another entity. Step 2: Since A is not a controlling employer it had no duty under the OSH Act to exercise reasonable care with respect to enforcing the subcontractors' compliance with safety; there is therefore no need to go to Step 2.

(2) **<u>Example 12:</u>** Engineering firm E has the same contract authority and functions as in Example 9.

Analysis: Step 1: Under the facts in Example 9, E would be considered a controlling employer. Step 2: The same type of analysis described in Example 9 for Step 2 would apply here to determine if E should be cited.

d) <u>Control Without Explicit Contractual Authority.</u> Even where an employer has no explicit contract rights with respect to safety, an employer can still be a controlling employer if, in actual practice, it exercises broad control over subcontractors at the site (see Example 9). NOTE: Citations should only be issued in this type of case after consulting with the Regional Solicitor's office.

(1) **<u>Example 13:</u>** Construction manager MM does not have explicit contractual authority to require subcontractors to comply with safety requirements, nor does it explicitly have broad contractual authority at the site. However, it exercises control over most aspects of the subcontractors' work anyway, including aspects that relate to safety.

Analysis: Step 1: MM would be considered a controlling employer since it exercises control over most aspects of the subcontractor's work, including safety aspects. Step 2: The same type of analysis on reasonable care described in the examples in

(G)(5)(a) would apply to determine if a citation should be issued to this type of controlling employer.

F. Multiple Roles

1. A creating, correcting or controlling employer will often also be an exposing employer. Consider whether the employer is an exposing employer before evaluating its status with respect to these other roles.

2. Exposing, creating and controlling employers can also be correcting employers if they are authorized to correct the hazard.

Appendix B

OSHA Safety & Health Program Management Guidelines

This appendix contains voluntary guidelines published by OSHA in 1989 to describe the benefits and elements of safety and health programs. The full Federal Register announcement with the public comments and rationale appears on the OSHA web site at *http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=FEDERAL_REGISTER&p_id=12909*.

Safety and Health Management Guidelines

Scope and Application.

(1) This guideline applies to all places of employment which are covered by OSHA standards in 29 CFR Parts 1910, 1915, 1917 and 1918.

(2) This guideline does not apply to places of employment which are covered by OSHA standards found in 29 CFR Part 1926.

Introduction.

The Occupational Safety and Health Administration (OSHA) has concluded that effective management of worker safety and health protection is a decisive factor in reducing the extent and the severity of work-related injuries and illnesses. Effective management addresses all work-related hazards, including those potential hazards which could result from a change in worksite conditions or practices. It addresses hazards whether or not they are regulated by government standards.

OSHA has reached this conclusion in the course of its evaluation of worksites in its enforcement program, its State-operated consultation program, and its Voluntary Protection Programs. These evaluations have revealed a basic relationship between effective management of worker safety and health protection and a low incidence and severity of employee injuries. Such management also correlates with the elimination or adequate control of employee exposure to toxic substances and other unhealthful conditions.

OSHA's experience in the Voluntary Protection Programs has also indicated that effective management of safety and health protection improves employee moral and productivity, as well as significantly reducing workers' compensation costs and other less obvious costs of work-related injuries and illnesses.

Through an analysis of public comment received in response to its request and through an earlier review of literature. OSHA has found that the conclusions it has reached from its own experience are supported by a substantial body of expert and practitioner opinion.

Based on this cumulative evidence that systematic management policies, procedures and practices are fundamental to the reduction of work-related injuries an dillnesses an dtheir attendant economic costs. OSHA offers the following guidelines for effective management of worker safety and health protection. OSHA urges all employers to establish and to maintain programs which meet these guidelines in a manner which addresses the specific operations and conditions of their worksites.

The Guidelines

(a) General.

(1) Employers are advised and encouraged to institute and maintain in their establishments a program which provides systematic policies, procedures, and practices that are adequate to recognize and protect their employees from occupational safety and health hazards.

(2) An effective program includes provisions for the systematic identification, evaluation, and prevention or control of general workplace hazards, specific job hazards, and potential hazards which may arise from foreseeable conditions.

(3) Although compliance with the law, including specific OSHA standards, is an important objective, and effective program looks beyond specific requirements of law to address all hazards. It will seek to prevent injuries and illnesses, whether or not compliance is at issue.

(4) The extent to which the program is described in writing is less important then how effective it is in practice. As the size of a worksite or the complexity of a hazardous operation increases, however, the need for written guidance increases to ensure clear communications of policies and priorities and consistent and fair application of rules.

(b) Major Elements.

An effective occupational safety and health program will include the following four elements. To implement these elements, it will include the actions described in paragraph (c).

(1) **Management commitment and employee involvement** are complementary. Management commitment provides the motivating force and the resources for organizing and controlling activities within an organization. In an effective program, management regards workers safety and health as a fundamental value of the organization and applies its commitment to safety and health protection with as much vigor as to other organizational purposes. Employee involvement provides the means through which workers develop and/or express their own commitment to safety and health protection, for themselves and for their fellow workers.

(2) **Worksite analysis** involves a variety of worksite examinations, to identify not only existing hazards but also conditions and operations in which changes might occur to create hazards. Unawareness of a hazard

which stems from failure to examine the worksite is a sure sign that safety and health policies and/or practices are ineffective. Effective management actively analyzes the work and worksite, to anticipate and prevent harmful occurrences.

(3) **Hazard prevention and controls** are triggered by a determination that a hazard or potential hazard exists. Where feasible, hazards are prevented by effective design of the jobsite or job. Where it is not feasible to eliminate them, they are controlled to prevent unsafe and unhealthful exposure. Elimination or controls is accomplished in a timely manner, once a hazard or potential hazard is recognized.

(4) **Safety and health training** addresses the safety and health responsibilities of all personnel concerned with the site, whether salaried or hourly. If is often most effective when incorporated into other training about performance requirements and job practices. Its complexity depends on the size and complexity of the worksite, and the nature of the hazards and potential hazards at the site.

(c) Recommended Actions

(1) Management Commitment and Employee Involvement.

(i) State clearly a worksite policy on safe and healthful work and working conditions, so that all personnel with responsibility at the site and personnel at other locations with responsibility for the site understand the priority of safety and health protection in relation to other organizational values.

(ii) Establish and communicate a clear goal for the safety and health program and objectives for meeting that goal, so that all members of the organization understand the results desired and the measures planned for achieving them.

(iii) Provide visible top management involvement in implementing the program, so that all will understand that management's commitments is serious.

(iv) Provides for the encourage employee involvement in the structure and operation of the program and in decisions that affect their safety and health, so that they will commit their insight and energy to achieving the safety and health program's goal and objectives.

(v) Assign and communicate responsibility for all aspects of the program so that manages, supervisors, and employees in all parts of the organization know what performance is expected of them.

(vi) Provide adequate authority and resources to responsible parties, so that assigned responsibilities can be met.

(vii) Hold managers, supervisors, and employees accountable for meeting their responsibilities, so that essential tasks will be performed.

(viii) Review program operations at least annually to evaluate their success in meeting the goal and objectives, so that deficiencies can be identified and the program and/or the objectives can be revised when they do not meet the goal of effective safety and health protection.

(2) Worksite Analysis.

(i) So that all hazards are identified:

(A) Conduct comprehensive baseline worksite surveys for safety and health and periodic comprehensive update surveys:

(B) Analyze planned and new facilities, processes, materials, and equipment; and

(C) Perform routine job hazard analyses.

(ii) Provide for regular site safety and health inspection, so that new or previously missed hazards and failures in hazard controls are identified.

(iii) So that employee insight and experience in safety and health protection may be utilized and employee concerns may be addressed, provide a reliable system for employees, without fear of reprisal, to notify management personnel about conditions that appear hazardous and to receive timely and appropriate responses; and encourage employees to use the system.

(iv) Provide for investigation of accidents and "near miss" incidents, so that their causes and means for their prevention are identified.

(v) Analyze injury and illness trends over time, so that patterns with common causes can be identified and prevented.

(3) Hazard Prevention and Control.

(i) So that all current and potential hazards, however detected, are corrected or controlled in a timely manner, established procedures for that purpose, using the following measures:

(A) Engineering techniques where feasible and appropriate:

(B) Procedures for safe work which are understood and followed by all affected parties, as a result of training, positive reinforcement, correction of unsafe performance, and, if necessary, enforcement through a clearly communicated disciplinary system:

(C) Provision of personal protective equipment; and

(D) Administrative controls, such as reducing the duration of exposure.

(ii) Provide for facility and equipment maintenance, so that hazardous breakdown is prevented.

(iii) Plan and prepare for emergencies, and conduct training and drills as needed, so that the response of all parties to emergencies will be "second nature."

(iv) Establish a medical program which includes availability of first aid on site and of physician and emergency medical care nearby, so that harm will be minimized if any injury or illness does occur.

(4) Safety and Health Training.

(i) Ensure that all employees understand the hazards to which they may be exposed and how to prevent harm to themselves and others from exposure to these hazards, so that employees accept and follow established safety and health protections.

(ii) So that supervisors will carry out their safety and health responsibilities effectively, ensure that they understand those responsibilities and the reasons for them, including:

(A) Analyzing the work under their supervision to identify unrecognized potential hazards:

(B) Maintaining physical protections in their work areas; and

(C) Reinforcing employee training on the nature of potential hazards in their work and on needed protective measures, through continual performance feedback and, if necessary, through enforcement of safe work practices.

(iii) Ensure that managers understand their safety and health responsibilities, as described under (c)(1). "Management Commitment and Employee Involvement," so that the managers will effectively carry out those responsibilities.

The Commentary

(Paragraph by Paragraph)

This Commentary indicates the background and rationale for each part of the guidelines. To facilitate its use, each segment of the guidelines except the introduction is repented just before it is discussed. The background of the introduction immediately follows this paragraph.

Introduction

Comment on Introduction. Over the years, OSHA and State enforcement and consultation staff have seen many examples of exemplary workplaces where safety and health programs were well managed and where injury raters were exceptionally low. The common characteristics observed at these sites were the use of organized and systematic methods to assign appropriate responsibility to all managers, supervisors, and employees, to inspect regularly for and control existing and potential hazards, and to orient and train all employees in the ways and means to eliminate or avoid those hazards.

The fundamental importance of such methods has been reflected in decisions of the Occupational Safety and Health Review Commission and the U.S. Courts of Appeal, especially in cases involving an employer claim that a violative workplace condition or action resulted from unpreventable employee misconduct. Such misconduct has been recognized as a defense against citation only when an employer had a work rule prohibiting the conduct, had provided training to ensure that the rule was understood, and had supplied adequate supervision (including regular inspections and work rule enforcement) to ensure that the work rule was followed. These criteria have been applied by the courts in cases involving the citation of OSHA standards as well as the general duty clause. The implication of these cases is that an employer has the duty to establish and maintain such management practices, to the extent that they are necessary to ensure that safe and healthful working conditions are maintained and that safe and healthful work practices are followed.

OSHA has reflected it increasing recognition of the importance of effective safety and health program management by including program management requirements in standards; by recommending safety and health program improvements in conjunction with inspections; by issuing citations under the general duty clause of the Occupational Safety and Health Act of 1970 (Sec. 5(a)(1), 29 U.S.C. 654) which include safety and health management factors; by revising its State-operated consultation program to focus on the promotion of effective safety and health management; and by a range of other promotional efforts.

To further encourage employers and employees to adopt and improve existing safety and health programs, OSHA established on July 2, 1982 (47 FR 29025), the Voluntary Protection Programs (VPP) to recognize worksites with exemplary safety and health management. The participation requirements embodied in the VPP are a distillation of the means, methods, and processes already in use at worksites where safety and health conditions are exceptionally good.

Because VPP participating worksites are officially recognized and are excluded form routine programmed OSHA inspections, the quality of the safety and health programs at these sites must be maintained as models of effectiveness. In 1988, 62 sites were participating in the VPP, and several had been in the program for five or more years. Collectively, during their participation in the VPP, these sites experienced lost-time injuries that were approximately one-fifth to one-third of the average for their industrial classifications. (Unpublished statistics, U.S. Department of Labor, OSHA, 1988).

The fact the VPP participants have injury rates which are so much lower than their industry averages demonstrates that significant reduction is possible. It also strongly indicates that the requirements of the VPP, distilled in the management policies, procedures, and practices described in these recommended guidelines, are major means to achieve the reduction.

In addition, employers at these sites reported improved morale and productivity benefits, as well as significantly reduced workers' compensation and other costs. One plant manager found that the implementation of a single safe work practice at his 44-employee plant during the first three years of participation in the VPP resulted in a greater volume of product and a reduction in rejected project. This change alone saved $265,000 a year. (Proceedings of Public Information Gathering Meeting on Suggested Guidelines for General Safety and Health Programs. U.S. Department of Labor, OSHA, Docket No. C-02. P.77 (October 6, 1988).)

The reduction in workers' compensation and other costs and the improvements in worksite morale and productivity reported by VPP participants reflect significant economic benefits which complement the substantial safety and health benefits of improvement management of worker protection. A Business Roundtable report (Improving Construction Safety Performance (New York, The Business Roundtable. Report A-3. January, 1982). p. 16) concludes that, for construction, the savings from effective administration of safety and health protection is 3.2 times the cost. OSHA has no independent confirmation of this ratio nor of its relevance to industries other than construction. Based on its experience with VPP sites and the conclusions of experienced safety and health professionals, however, OSHA believes that the long-term benefits of effective safety and health management consistently exceed its costs.

To understand this conclusion, it is essential to understand the indirect as well as the direct costs of occupational injuries and illnesses. According to commonly accepted safety management concepts as outlined by Frank E. Bird, Jr. in his Management Guide to Loss Control (Loganville, GA: Institute Press, 1978), for every $1 in medical or insurance compensation costs ("direct costs") for a worker injury, $5-50 more are likely to be spent on "indirect costs" to repair building, tool or equipment damage; to replace damage products or materials; and to make up for losses from production delays and interruptions. An additional $1-3 in indirect costs will be spent for hiring and training replacements and for time to investigate the incident. Mr. Bird's figures do not consider the impact of reduced commitment to work when employees operate in a situation in which injuries are common. Because they frequently involve longer absences, the impact of job-related illnesses can be even greater.

Although economic incentives are secondary to human health and safety as motives for safety and health protection, an employer may find it useful to calculate the total (direct and indirect) costs of injuries and illnesses as a means of determining the economic benefits which might be achieved by preventing the injuries and illnesses. By determining the average cost of an injury and of an illness, the employer can estimate the incremental impact of reducing the rate of injuries and illnesses at the site and therefore the potential economic benefit of such reduction.

Some employers may wish to compare their savings or costs in relation to the nation average for their industries. A method which can be used for that comparison with respect to occupational injuries is described by David R. Bell, a former OSHA employee, in his article, "Gauging Safety Outlays and Objectives," in Occupational Hazards. June, 1987. If the lost workday case rate (LWCR) for a site is below the national average, a formula provided by Bell can be used to calculate how many fewer injuries occurred than would have occurred if the site rate had equalled the national average. (Lost workdays case rates are published annually by the Bureau of Labor Statistics in "Occupational Injuries and Illnesses in the United States by Industry", available from the U.S. Government Printing Office, Washington, DC 20402. The rate for each industry represents the average number of lost workday cases that occurred per 100 employees in the industry).

The number of cases which would have occurred if the site rate had been average Bell calls "expected cases" and the actual cases he calls "injuries avoided." His formula, in which "employment at the site" means the number of equivalent work-years at the site during the year, is as follows:

Industry LWCR = Employment at the site

100 = Expected LW Cases --

Actual LW Cases =

Number of Injuries

Avoided

If the site lost workday case rate is above, the national average, the number of cases by which the site exceeds the national average can be determined by subtracting "expected cases" from "actual cases," once the former number has been calculated.

By multiplying the number of "injuries avoided" or the number of injuries above the average by the average cost of an injury at the site, the employer can estimate the savings or losses which resulted from the quality of its management of safety protection relative to national performance. (Because national data on the incidence of occupational illnesses is incomplete, the formula is less useful in relation to occupational health protection.)

(a) General

"(a) General. (1) Employers are advised and encouraged to institute and maintain in their establishments a program which provides systematic policies, procedures, and practices that are adequate to recognize and protect their employees from occupational safety and health hazards."

Comment: In essence, this paragraph states that the end (protection of employees from occupational safety and health hazards) determines the means. The criterion for determining what is needed in a safety and health program at a particular site is: whatever feasible action it takes to protect the workers from the safety and health hazards at that specific site. The form of the safety and health program elements and implementing actions will vary at each site according to the nature of site organization and the nature of the hazards and potential hazards at the site.

"(2) An effective program includes provisions for the systematic identification, evaluation, and prevention or control of general workplace hazards, specific job hazards and potential hazards, which may arise from foreseeable conditions."

Comment: Provisions for identifying and preventing hazards are systematic. If not, hazards or potential hazards will be missed and/or preventive controls will break down, and the chance of injury or illness will significantly increase.

General workplace hazards include such conditions as tripping hazards in walking areas and poor illumination. Specific job hazards may relate to the specific conditions in a job, such as exposure to a saw blade, or to the inherent hazardousness of an operation required in the job, such as the removal of jammed material from a point of operation. Potential hazards include such situations as the possibility of exposure to toxic chemicals as a result of a rupture of piping from the impact of a forklift.

"(3) Although compliance with the law, including specific OSHA standards, is an important objective, an effective program looks beyond specific requirements of law to address all hazards. It will seek to prevent injuries and illnesses, whether or not compliance is at issue."

Comment: OSHA and other government standards provide important guidance on the identification and control of hazards, but they are not always enough. Although compliance with the law is an important objective of and motive for an effective program. OSHA has found that the most successful programs look beyond government standards and legal requirements. They look for other sources of information about hazards, such as the National Electrical Code (NEC), the American Conference of Government Industrial Hygienists (ACGIH), and the American National Standards Institute (ANSI): and they use their own seasoned analytical abilities to look for and address hazards not covered by government or other standards. Their motive is to prevent injuries and illnesses and the attendant human and economic costs, whether or not compliance with the law is at issue.

This approach is essential in view of the difficulty that regulatory agencies have in moving quickly to set standards for every possible hazard in the workplace and to revise them when new information becomes available.

"(4) The extent to which the program is described in writing is less important than how effective it is in practice. As the size of a worksite or the complexity of a hazardous operation increases, however, the need for written guidance increases to ensure clear communication of policies and priorities and consistent and fair application of rules."

Comment: OSHA recognizes that relatively simple, unwritten policies, practices, and procedures are adequate to address the hazards in many smaller or less hazardous establishments. The more complex and hazardous and operation is, the more formal (written) and complex the program will probably need to be. A written program which is revised regularly can clarify policy, create consistency and continuity in its interpretation, serve as a checkpoint whenever there is a question of priority between safety and production, and support fair and equitable enforcement of safe work rules and practices.

(b) Major Elements

"(b) Major Elements. An effect occupational safety and health program will include the following four elements. To implement these elements, it will include the actions described in paragraph (c).

(1) Management commitment and employee involvement are complementary. Management commitment provides the motivation force and the resources for organizing and controlling activities within an organization. In an effective program, management regards worker safety and health as a fundamental value of the organization and applies its commitment to safety and health protection with as much vigor as to other organizational purposes. Employee involvement provides the means through which workers develop and/or express their own commitment to safety and health protection, for themselves and for their fellow workers.

(2) Worksite analysis involves a variety of worksite examinations, to identify not only existing hazards but also conditions and operations in which changes might occur to create hazards. Unawareness of a hazard which stems from failure to examine the worksite is a sure sign that safety and health policies and/or practices are ineffective. Effective management actively analyzes the work and worksite, to anticipate and prevent harmful occurrences.

(3) Hazard prevention and control are triggered by a determination that a hazard or potential hazard exists. Where feasible, hazards are prevented by effective design of the job site or job. Where it is not feasible to eliminate them, they are controlled to prevent unsafe or unhealthful exposure. Elimination or control is accomplished in a timely manner, once a hazard or potential hazard is recognized.

(4) Safety and health training addresses the safety and health responsibilities of all personnel concerned with the site, whether salaried or hourly. It is often most effective when incorporated into other training about performance requirements and job practices. Its complexity depends on the size and complexity of the worksite, and the nature of the hazards and potential hazards at the site."

Comment: These paragraphs set forth the areas of managerial practice which are essential to effective safety and health protection. These practices, means, and methods are consistent with those used by employers to achieve other organizational objectives, such as cost control, quality, and productivity. Giving safety and health equal organizational priority in relation to these other objectives is fundamental to the protection of individual employees and to the effectiveness of the organization itself.

These elements consist of methods historically used to accomplish organizational objectives. They are generic in that they are generally applicable regardless of unique operations or conditions of particular firms. Only the form which they take varies. Though at points they are expressed in the terms of the "hierarchical" organizations most common in American industry (i.e., by reference to "managers," "supervisors," "employees"), they can easily be adapted to other organizational forms or styles of operation. They relate to essential concerns and activities of any organization. It is on this basis that OSHA considers them applicable in shipyard employment, marine terminals, and longshoring as well as general industry.

(c) Recommended Actions.

(c)(1) Management Commitment and Employee Involvement

Comment: Each action listed in this section represents the application to occupational safety and health of a key means for organizing, motivating and controlling activities within an organization.

"(c)(1)(i) State clearly a worksite policy on safe and healthful work and working conditions, so that all personnel with responsibility at the site and personnel at other locations with responsibility for the site understand the priority of safety and health protection in relation to other organizational values."

Comment: A statement of policy is the foundation of safety and health management. It communicates the value in which safety and health protection is held in the business organization. If it is absorbed by all in the organization, it becomes the basic point of reference for all decisions affecting safety and health. It also becomes the criterion by which the adequacy of protective actions is measured.

"(c)(1)(ii) Establish and communicate a clear goal for the safety and health program and objectives for meeting that goal, so that all members of the organization understand the results desired and the measures planned for achieving them."

Comment: A goal, and implementing objectives, make the safety and health policy more specific. Communicating them ensures that all in the organization understand the direction it is taking.

"(c)(1)(iii) Provide visible top management involvement in implementing the program so that all will understand that management's commitment is serious."

Comment: Actions speak louder than words. If top management gives high priority to safety and health protection in practice, other will see and follow. If not, a written or spoken policy of high priority for safety and health will have little credibility, and others will not follow it. Plant managers who wear required personal protective equipment in work areas, perform periodic "housekeeping" inspections, and personally track performance in safety and health protection demonstrate such involvement.

"(c)(1)(iv) Provide for and encourage employee involvement in the structure and operation of the program and in decisions that affect their safety and health, so that they will commit their insight and energy to achieving the safety and health program's goal and objectives."

Comment: Since an effective program depends on commitment by employees as well as managers, it is important for their concerns to be reflected in it. An effective program includes all personnel in the organization--managers, supervisors, and other--in policy development, planning, and operations.

This does not mean transfer of responsibility to employees. the Occupational Safety and Health Act of 1970 clearly places responsibility for safety and health protection on the employer. However, employees intimate knowledge of the jobs they perform and the special concerns they bring to the job give them a unique perspective which can be used to make the program more effective.

Employee participation may take any or all of a number of forms. For instance, the system for notifying management personnel about conditions that appear hazardous serves as a major means of worksite analysis to identify hazards and is therefore included as paragraph (c)(2)(iii). Such a system is, however, by itself not sufficient to provide for effective employee involvement. Forms of participation which engage employees more fully in systematic prevention include (1) inspecting for hazards and recommending corrections or controls; (2) analyzing jobs to locate potential hazards and develop safe work procedures; (3) developing or revising general rules for safe work; (4) training newly hired employees in safe work procedures and rules, and/or training their co-workers in newly revised safe work procedures; (5) providing programs and presentations for safety meeting; and (6) assisting in accident investigations.

Such functions can be carried out in a number of organizational contexts. Joint labor-management committees are most common. Other means include labor safety committees, safety circle teams, rotational assignment of employees to such functions, and acceptance of employee volunteers for the functions.

Employee involvement is effective only when the employer welcomes it and provides protection from any discrimination, including unofficial harassment, to the employees involved. However, inclusion of employees in one or more of the suggested activities, or in any way that fits the individual worksite and provides an employee role that has impact on decisions about safety and health protection, will strengthen the employer's overall program of safety and health protection.

"(c)(1)(v) Assign and communicate responsibility for all aspects of the program, so that managers, supervisors, and employees in all parts of the organization know that performance is expected of them."

Comment: Assignment of responsibility for safety and health protection to a single staff member, or even a small group, will leave other members feeling that someone else is taking care of safety and health problems. Everyone in an organization has some responsibility for safety and health.

A clear statement of that responsibility, as it relates both to organizational goals and objectives and to the specific functions of individuals, is essential. If all persons in an organization do not know what is expected of them, they are unlikely to perform as desired.

"(c)(1)(vi) Provide adequate authority and resources to responsible parties, so that assigned responsibilities can be met."

Comment: It is unreasonable to assign responsibility without providing adequate authority and resources to get the job done. For example, a person with responsibility for the safety of a piece of machinery need the authority to shut it down and get it repaired. Needed resources may include adequately trained and equipped personnel and adequate operational and capital expenditure funds.

"(c)(1)(vii) Hold managers, supervisors, and employees accountable for meeting their responsibilities, so that essential tasks will be performed."

Comment: Stating expectations of managers, supervisors, and other employees means little if management is not serious enough to track performance, to reward it when it is competent and to correct it when it is not. Holding everyone accountable for meeting their responsibilities is at the heart of effective workers safety and health protection. If management states high expectations for such protection but pays greater attention to productivity or other values, safety and health protection will be neglected.

To be effective, a system of accountability must be applied to everyone, from senior management to hourly employees. If some are held firmly to expected performance and other are not, the system will lose its credibility. Those held to expectations will be resentful; those allowed to neglect expectations may increase their neglect. Consequently, the chance of injury and illness will increase.

"(c)(1)(viii) Review program operations at least annually to evaluate their success in meeting the goal and objectives, so that deficiencies can be identified and the program and/or the objectives can be revised when they do not meet the goal of effective safety and health protection."

Comment: A Comprehensive program audit is essential periodically to evaluate the whole set of safety and health management means, methods, and processes, to ensure that they are adequate to protect against the potential hazards at the specific worksite. The audit determines whether policies and procedures are implemented as planned and whether in practice they have met the objectives set for the program. It also determines whether the objectives provide sufficient challenge to lead the organization to meet the program goal of effective safety and health protection. When either performance or the objectives themselves are found inadequate, revisions are made. Without such a comprehensive review, program flaws and their interrelationship may not be caught and corrected.

(c)(2) Worksite Analysis

Comment: The identification of hazards and potential hazards at a worksite requires an active, on-going examination and analysis of work processes and working conditions. Because many hazards are by nature difficult to recognize, effective examination and analysis will approach the work and working conditions from several perspectives. Each of the activities recommended in this paragraph represents a different perspective.

The recognition of hazards which could result from changes in work practices or conditions requires especially thorough observation and thought, both from those who perform the work and those who are specially trained for that purpose. Since such divergence from the routine and familiar is often the occasion for injuries and health hazard exposures to occur, the anticipation of such changes is critical.

Identification at a worksite of those safety and health hazards which are recognized in its industry is a critical foundation for safety and health protection. It is the general duty of the employer under the Occupational Safety and Health Act of 1970. Successful employers will actively seek the benefit of the experience of others in their industry, through trade associations, equipment manufacturers, and other sources.

An effective program does not stop at this point, however. It continually reviews working conditions and operations to identify hazards which have not previously been recognized in the industry.

Implicit in the provision for the survey, reviews, and analyses recommended in this section is the need for employers to seek competent advice and assistance when they lack needed expertise and to use appropriate means and methods to examine and assess all existing and foreseeable hazards. Personnel who perform comprehensive baseline and update surveys, analysis of new facilities, processes, procedures, and equipment, and job hazard analyses may require greater expertise than those who conduct routine inspections, since the former are conducting a boarder and/or deeper review.

Personnel performing regular inspections should, however, possess a degree of experience and competence adequate to recognize hazards in the areas they review and to identify reasonable means for their correction or control. Such competence should normally be expected of ordinary employees who are capable of safely supervising or performing the operations of the specific workplace. Smaller businesses which need assistance in the development of such competence can receive free assistance from a number of sources, including OSHA and a nationwide network of OSHA-funded, State-operated consultation projects.

"(c)(2)(i) So that all hazards and potential hazards are identified:

(A) conduct comprehensive baseline worksite survey for safety and health and periodic comprehensive update surveys;

(B) analyze planned and new facilities, processes, materials, and equipment; and

(C) perform routine job hazard analyses."

Comment: A comprehensive baseline survey of the work and working conditions at a site permits a systematic recording of those hazards and potential hazards which can be recognized without intensive analysis. This baseline record provides a checklist for the more frequent routine inspections, recommended in paragraph (c)(2)(ii). With those hazards under control, attention can be given to the intensive analysis required to recognized less obvious hazards.

Subsequent comprehensive surveys provide an opportunity to step back from the routine check on control of previously recognized hazards and look for others. With the baseline established, these subsequent reviews are one occasion for focusing more intensive analysis in areas with the highest potential for new or less obvious hazards. The frequency with which comprehensive examinations are needed depends on the complexity, hazardousness, and changeability of the worksite. Many successful worksites conduct such reviews on an annual or biannual basis.

Analysis of new facilities, processes, materials, and equipment in the course of their design and early use (sometimes called "change analysis") provides a check against the introduction of new hazards with them. Effective management ensures the conduct of such analyses during the planning phase, just before their first use, and during the early phases of their use. Numerous specific OSHA standards require inspection of particular equipment, conditions, and activities as a safety precaution prior to operation or use. This guideline makes clear that, in effective safety and health programs, this generally recognized inspection practice is applied more broadly to all conditions and activities.

Job hazard analysis is an important tool for more intensive analysis to identify hazards and potential hazards not previously recognized, and to determine protective measures. Through more careful attention to the work processes in a particular job, analysis can recognize new points at which exposure to hazards may occur or at which foreseeable changes in practice or conditions could result in new hazards.

"(c)(2)(ii) Provide for regular site safety and health inspections, so that new or previously missed hazards and failures in hazard controls are identified."

Comment: Once a comprehensive examination of the workplace has been conducted and hazard controls have been established, routine site safety and health inspections are necessary to ensure that changes in conditions and activities do not create new hazards and that hazard controls remain in place and are effective. Routine industrial hygiene monitoring and sampling are essential components of such inspections in many workplaces.

Personnel conducting these inspections also look out for new or previously unrecognized hazards, but not as thoroughly as those conducting comprehensive surveys.

The frequency and scope of these "routine" inspection depends on the nature and severity of the hazards which could be present and the relative stability and complexity of worksite operations.

"(c)(2)(iii) So that employee insight and experience is safety and health protection may be utilized and employee concerns may be addressed, provide a reliable system for employees, without fear of reprisal, to notify management personnel about conditions that appear hazardous and to receive timely and appropriate responses; and encourage employees to use the system."

Comment: A reliable system for employees to notify management of conditions or practices that appear hazardous and to receive a timely and appropriate response serves a dual purpose. It gives management the benefit of many more points of observations and more experienced insight in recognizing hazards or other symptoms of breakdown in safety and health protection systems. It also gives employees assurance that their investment in safety and health is worthwhile.

A system is reliable only if it ensures employees a credible and timely response. The response will include both timely action to address any problems identified and a timely explanation of why particular actions were or were not taken.

Since the employer benefits from employee notices, effective management will not only guard against reprisals to avoid discouraging them but will take positive steps to encourage their submission.

"(c)(2)(iv) Provide for investigation of accidents and `near miss' incidents, so that their causes and means for preventing repetitions are identified."

Comments: Accidents, and incidents in which employees narrowly escape injury, clearly expose hazards. Analysis to identify their causes permits development of measures to prevent future injury or illness. Although a first look may suggest that "employee error" is a major factor, it is rarely sufficient to stop there. Even when an employee has disobeyed a required work practice, it is critical to ask, "Why?" A thorough analysis will generally reveal a number of deeper factors, which permitted or even encouraged an employee's action. Such factors may include a supervisor's allowing or pressuring the employee to take short cuts in the interest of production, inadequate equipment, or a work practice which is difficult for the employee to carry out safely. An effective analysis will identify actions to address each of the causal factors in an accident or "near miss" incident.

"(c)(2)(v) Analyze injury and illness trends over time, so that patterns will common causes can be identified and prevented."

Comment: A review of injury experience over a period of time may reveal patterns of injury with common causes which can be addressed. Correlation of changes in injury experience with changes in safety and health program operations, personnel, and production processes may help to identify causes.

(c)(3) Hazard Prevention and Control

Comment: Effective management prevents or controls identified hazards and prepares to minimize the harm form job-related injuries and illnesses when they do occur.

"(c)(3)(i) So that all current and potential hazards, however detected, are corrected or controlled in a timely manner, establish procedures for that purpose, using the following measures:

(A) engineering techniques where feasible and appropriate;

(B) procedures for safe work which are understood and followed by all affected parties, as a result of training, positive reinforcement, and, if necessary, endorsement through a clearly communicated disciplinary system;

(C) provision of personal protective equipment; and

(D) administrative controls, such as reducing the duration of exposure."

Comment: Hazards, once recognized, are promptly prevented or controlled. Management action in this respect determines the credibility of its safety and health management policy and the usefulness of it entire program.

An effective program relies on the means for prevention or control which provides the best feasible protection of employee safety and health.

It regards legal requirements as a minimum. When there are alternative ways to address a hazard, effective managers have found that involving employees in discussions of methods can identify useful prevention and control measures, serve as a means for communicating the rational for decisions made, and encourage employee acceptance of the decisions.

When safe work procedures are the means of protection, ensuring that they are followed becomes critical. Ensuring safe work practices involves discipline in both a positive sense and a corrective sense. Every component of effective safety and health management is designed to create a disciplined environment in which all personnel act on the basic that worker safety and health protection is a fundamental value of the organization. Such an environment depends on the credibility of management's involvement in safety and health matters, inclusion of employees in decisions which affect their safety and health, rigorous worksite analysis to identify hazards and potential hazards, stringent prevention and control measures, and thorough training. In such an environment, all personnel will understand the hazards to which they are exposed, why the hazards pose a threat, and how to protect themselves and others form the hazards. Training for the purpose is reinforced by encouragement of attempt to work safely and by positive recognition of safe behavior.

If, in such a context, an employee, supervisor, or manager fails to follow a safe procedure, it is advisable not only to stop the unsafe action but also to determine whether some condition of the work has made it difficult to follow the procedure or whether some management system has failed to communicate the danger of the action and the means for avoiding it. If the unsafe action was not based on an external condition or a lack of understanding, or if, after such external condition or lack of understanding has been corrected, the person repeats the action, it is essential that corrective discipline be applied. To allow an unsafe action to continue not only continues to endanger the actor and perhaps others; it also undermines the positive discipline of the entire safety and health program. To be effective, corrective discipline must be applied consistently to all, regardless of role or rank; but it must be applied.

Factors which may affect the time required for correction of hazards include: (1) The complexity abatement technology; (2) the degree of risk; and (3) the availability of necessary equipment, materials, and staff qualified to complete the correction. Because conditions affecting hazard correction and control vary widely, it is impractical of OSHA to recommend specific time limits for all situations. An effective program corrects hazards in the shortest time permitted by the technology required and the availability of needed personnel and materials. It also provides for interim protection when immediate correction is not possible.

"(c)(3)(ii) Provide for facility and equipment maintenance, so that hazardous breakdown is prevented."

Comment: Maintenance of equipment of facilities in an especially important means of anticipating potential hazards and preventing their development. Planning, scheduling, and tracking preventive maintenance activities provides a systematic way of ensuring that they are not neglected.

"(c)(3)(iii) Plan and prepares for emergencies, and conduct training and drills as needed, so that the response of all parties to emergencies will be "second nature."

Comment: Planning and training for emergencies is essential in minimizing the harmful consequences of an accident or other threat if it does occur. If personnel are not so thoroughly trained to react to emergencies that their responses are immediate and precise, they may expose themselves and others to greater danger rather than reduce their exposure. The nature of potential emergencies depends on the nature of site operations and its geographical location. The extent to which training and drills are needed depends on the severity and complexity of the emergencies which may arise.

"(c)(2)(iv) Establish a medical program which includes availability of first aid on site and of physician and emergency medical care nearby, so that harm will be minimized if an injury or illness does occur."

Comment: The availability of first aid and emergency medial care are essential in minimizing the harmful consequences of injuries and illnesses if they do occur. The nature of services needed will depend on the seriousness of injuries or health hazard exposures which may occur. Minimum requirements are addressed in OSHA standards.

(c)(4) Safety and Health Training

Comment: Education and training are essential means for communicating practical understanding of the requirements of effective safety and health protection to all personnel. Without such understanding, managers, supervisors, and other employees will not perform their responsibilities for safety and health protection effectively.

It is not suggested that elaborate or formal training programs solely related to safety and health are always needed. Integrating consideration of safety and health protection into all organizational activities is the key to its effectiveness. Safety and health information and instruction is, therefore, often most effective when incorporated into other training about performance requirements and job practices, such as management training on performance evaluation, problem solving, or managing change; supervisors' training on the reinforcement of good work practices and the correction of poor ones; and employee training on the operation of a particular machine or the conduct of a specific task.

Each paragraph in this section recommends that the employer ensure understanding of safety and health information by employees, supervisors, and managers. The act of training itself is not sufficient to endure practical comprehension. Some means of verifying comprehension is essential. Formal testing, oral questioning, observation, and other means can be useful. In its Voluntary Protection Programs. OSHA has found that observing and interviewing employees, supervisors, and managers are the most effective measures for determining their understanding of what is expected of them in practice. Although there is no fully reliable means for ensuring understanding, effective safety and health management will apply the same diligence with respect to safety and health protection as is applied to ensuring an understanding of other operational requirements, such as time and attendance, production schedules, and jog skills.

"(c)(4)(i) Ensure that all employees understand the hazards to which they may be exposed and how to prevent harm to themselves and others from exposure to these hazards, so that employees accept and follow established safety and health protections."

Comment: The commitment and cooperation of employees in preventing and controlling exposure to hazards is critical, not only for their own safety and health but for that of others as well. That commitment and cooperation depends on their understanding what hazards they may be exposed to, why the hazards pose a threat, and how they can protect themselves and others from the hazards. The means of protection which they need to understand include not only the immediate protections from hazards in their work processes and locations, but also the management systems which commit the organization to safety and health protection and provide for employee involvement in hazard identification and prevention.

OSHA's Hazard Communication Standard specifies, for chemical hazards, an employer duty to inform employees about workplace hazards and to provide training that will enable them to avoid work-related injuries or illnesses. Other standards set forth training requirements, as summarized in OSHA Publication 2254. "Training Requirements in OSHA Standards and Training Guidelines." The rational for these standards requirements is, however, applicable in relation to all hazards.

Education and training in safety and health protection is especially critical for employees who are assuming new duties. This fact is reflected by the disproportionately high injury rates among workers newly assigned to work tasks. Although some of these injuries may be attributable to other causes, a substantial number are directly related to inadequate knowledge of job hazards and safe work practices. The Bureau of Labor Statistics reports that in 1979. 48 percent of workers injured had been on the job less than one year. ("The New Worker Factor Associated with Occupational Injuries and Illnesses," U.S. Department of Labor, Bureau of Labor Statistics, 1982.) These figures make clear the importance of training employees on job hazards and safe work practices before they assume new duties.

The extent of hazard information which is needed by employees will vary, but includes at least; (1) The general hazards and safety rules of the worksite; (2) specific hazards, safety rules, and practices related to particular work assignments; and (3) the employee's role in emergency situations. Such information and training is particularly relevant to hazards that may not be readily apparent to, to within the ordinary experience and knowledge of, the employee.

"(c)(4)(ii) So that supervisors will carry out their safety and health responsibilities effectively, ensure that they understand those responsibilities and the reasons for them, including;

(A) analyzing the work under their supervision to identify unrecognized potential hazards;

(B) maintaining physical protections in their work areas; and

(C) reinforcing employee training on the nature of potential hazards in their work and on needed protective measures, through continual performance feedback and, if necessary, through enforcement of safe work practices."

Comment: First-line supervisors have an especially critical role in safety and health protection because of their immediate responsibility for workers and for the work being performed. Effective training of supervisors will address their safety and health management responsibilities as well as information on hazards, hazard prevention, and response to emergencies. Although they may have other safety and health responsibilities, those listed in these guidelines merit particular attention.

"(c)(4)(iii) Ensure that managers understand their safety and health responsibilities" and described under (c)(1). "Management Commitment and Employee Involvement," so that the managers will effectively carry out those responsibilities."

Comment: Because there is a tendency in some businesses to consider safety and health a staff function and to neglect the training of managers in safety and health responsibilities, the importance of managerial training is noted separately. Managers who understand both the way and the extend to which effective safety and health protection impacts on the overall effectiveness of the business itself are far more likely to ensure that the necessary safety and health management systems operates as needed.

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Appendix C

2007 Electrical Rule

This appendix contains the text of the 2007 Final Rule for 29 CFR 1910 Subpart S--Electrical. The altered sections are 1910.302, 303, 304, 305, 306, 307, 308, and 399 and Appendix A to Subpart S. Appendices B and C are removed, and the remaining sections of Subpart S are unchanged. The full Federal Register announcement with the public comments and rationale appears on the OSHA web site at *http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=FEDERAL_REGISTER&p_id=19269.*

Subpart S--Electrical

Subpart S--Electrical

Authority:

Secs. 4, 6, 8, Occupational Safety and Health Act of 1970 (29 U.S.C. 653, 655, 657); Secretary of Labor's Order No. 8-76 (41 FR 25059), 1-90 (55 FR 9033), or 5-2002 (67 F.R. 65008), as applicable; 29 CFR Part 1911.

Design Safety Standards for Electrical Systems

§ 1910.302 Electric utilization systems.

Sections 1910.302 through 1910.308 contain design safety standards for electric utilization systems.

(a) Scope--

(1) Covered. The provisions of §§ 1910.302 through 1910.308 cover electrical installations and utilization equipment installed or used within or on buildings, structures, and other premises, including:

(i) Yards;

(ii) Carnivals;

(iii) Parking and other lots;

(iv) Mobile homes;

(v) Recreational vehicles;

(vi) Industrial substations;

(vii) Conductors that connect the installations to a supply of electricity; and

(viii) Other outside conductors on the premises.

(2) Not covered. The provisions of § § 1910.302 through

1910.308 do not cover:

(i) Installations in ships, watercraft, railway rolling stock, aircraft, or automotive vehicles other than mobile homes and recreational vehicles;

(ii) Installations underground in mines;

(iii) Installations of railways for generation, transformation, transmission, or distribution of power used exclusively for operation of rolling stock or installations used exclusively for signaling and communication purposes;

(iv) Installations of communication equipment under the exclusive control of communication utilities, located outdoors or in building spaces used exclusively for such installations; or

(v) Installations under the exclusive control of electric utilities for the purpose of communication or metering; or for the generation, control, transformation, transmission, and distribution of electric energy located in buildings used exclusively by utilities for such purposes or located outdoors on property owned or leased by the utility or on public highways, streets, roads, etc., or outdoors by established rights on private property.

(b) Extent of application--

(1) Requirements applicable to all installations. The following requirements apply to all electrical installations and utilization equipment, regardless of when they were designed or installed:

§ 1910.303(b)--Examination, installation, and use of equipment

§ 1910.303(c)(3)--Electrical connections--Splices

§ 1910.303(d)--Arcing parts

§ 1910.303(e)--Marking

§ 1910.303(f), except (f)(4) and (f)(5)--Disconnecting means and circuits

§ 1910.303(g)(2)--600 volts or less--Guarding of live parts

§ 1910.304(a)(3)--Use of grounding terminals and devices

§ 1910.304(f)(1)(i), (f)(1)(iv), and (f)(1)(v)--Overcurrent protection--600 volts, nominal, or less

§ 1910.304(g)(1)(ii), (g)(1)(iii), (g)(1)(iv), and (g)(1)(v)--Grounding--Systems to be grounded

§ 1910.304(g)(4)--Grounding--Grounding connections

§ 1910.304(g)(5)--Grounding--Grounding path

§ 1910.304(g)(6)(iv)(A) through (g)(6)(iv)(D), and (g)(6)(vi)--Grounding--Supports, enclosures, and equipment to be grounded

§ 1910.304(g)(7)--Grounding--Nonelectrical equipment

§ 1910.304(g)(8)(i)--Grounding--Methods of grounding fixed equipment

§ 1910.305(g)(1)--Flexible cords and cables--Use of flexible cords and cables

§ 1910.305(g)(2)(ii) and (g)(2)(iii)--Flexible cords and cables--Identification, splices, and terminations

§ 1910.307, except as specified in § 1910.307(b)--Hazardous (classified) locations

(2) Requirements applicable to installations made after March 15, 1972. Every electrical installation and all utilization equipment installed or overhauled after March 15, 1972, shall comply with the provisions of § § 1910.302 through 1910.308, except as noted in paragraphs (b)(3) and (b)(4) of this section.

(3) Requirements applicable only to installations made after April 16, 1981. The following requirements apply only to electrical installations and utilization equipment installed after April 16, 1981:

§ 1910.303(h)(4)--Over 600 volts, nominal--Entrance and access to work space

§ 1910.304(f)(1)(vii) and (f)(1)(viii)--Overcurrent protection--600 volts, nominal, or less

§ 1910.304(g)(9)(i)--Grounding--Grounding of systems and circuits of 1000 volts and over (high voltage)

§ 1910.305(j)(6)(ii)(D)--Equipment for general use--Capacitors

§ 1910.306(c)(9)--Elevators, dumbwaiters, escalators, moving walks, wheelchair lifts, and stairway chair lifts--Interconnection between multicar controllers

§ 1910.306(i)--Electrically driven or controlled irrigation machines

§ 1910.306(j)(5)--Swimming pools, fountains, and similar installations--Fountains

§ 1910.308(a)(1)(ii)--Systems over 600 volts, nominal--Aboveground wiring methods

§ 1910.308(c)(2)--Class 1, Class 2, and Class 3 remote control, signaling, and power-limited circuits--Marking

§ 1910.308(d)--Fire alarm systems

(4) Requirements applicable only to installations made after August 13, 2007. The following requirements apply only to electrical installations and utilization equipment installed after August 13, 2007:

§ 1910.303(f)(4)--Disconnecting means and circuits--Capable of accepting a lock

§ 1910.303(f)(5)--Disconnecting means and circuits--Marking for series combination ratings

§ 1910.303(g)(1)(iv) and (g)(1)(vii)--600 Volts, nominal, or less--Space about electric equipment

§ 1910.303(h)(5)(vi)--Over 600 volts, nominal--Working space and guarding

§ 1910.304(b)(1)--Branch circuits--Identification of multiwire branch circuits

§ 1910.304(b)(3)(i)--Branch circuits--Ground-fault circuit interrupter protection for personnel

§ 1910.304(f)(2)(i)(A), (f)(2)(i)(B) (but not the introductory text to § 1910.304(f)(2)(i)), and (f)(2)(iv)(A)--Overcurrent protection--Feeders and branch circuits over 600 volts, nominal

§ 1910.305(c)(3)(ii)--Switches--Connection of switches

§ 1910.305(c)(5)--Switches--Grounding

§ 1910.306(a)(1)(ii)--Electric signs and outline lighting--Disconnecting means

§ 1910.306(c)(4)--Elevators, dumbwaiters, escalators, moving walks, wheelchair lifts, and stairway chair lifts--Operation

§ 1910.306(c)(5)--Elevators, dumbwaiters, escalators, moving walks, wheelchair lifts, and stairway chair lifts--Location

§ 1910.306(c)(6)--Elevators, dumbwaiters, escalators, moving walks, wheelchair lifts, and stairway chair lifts--Identification and signs

§ 1910.306(c)(7)--Elevators, dumbwaiters, escalators, moving walks, wheelchair lifts, and stairway chair lifts--Single-car and multicar installations

§ 1910.306(j)(1)(iii)--Swimming pools, fountains, and similar installations--Receptacles

§ 1910.306(k)--Carnivals, circuses, fairs, and similar events

§ 1910.308(a)(5)(v) and (a)(5)(vi)(B)--Systems over 600 volts, nominal--Interrupting and isolating devices

§ 1910.308(a)(7)(vi)--Systems over 600 volts, nominal--Tunnel installations

§ 1910.308(b)(3)--Emergency power systems--Signs

§ 1910.308(c)(3)--Class 1, Class 2, and Class 3 remote control, signaling, and power-limited circuits--Separation from conductors of other circuits

§ 1910.308(f)--Solar photovoltaic systems

(c) Applicability of requirements for disconnecting means. The requirement in § 1910.147(c)(2)(iii) that energy isolating devices be capable of accepting a lockout device whenever replacement or major repair, renovation or modification of a machine or equipment is performed, and whenever new machines or equipment are installed after January 2, 1990, applies in addition to any requirements in § 1910.303 through § 1910.308 that disconnecting means be capable of being locked in the open position under certain conditions.

§ 1910.303 General.

(a) Approval.

The conductors and equipment required or permitted by this subpart shall be acceptable only if approved, as defined in § 1910.399.

(b) Examination, installation, and use of equipment-

(1) Examination. Electric equipment shall be free from recognized hazards that are likely to cause death or serious physical harm to employees. Safety of equipment shall be determined using the following considerations:

(i) Suitability for installation and use in conformity with the provisions of this subpart;

Note to paragraph (b)(1)(i) of this section: Suitability of equipment for an identified purpose may be evidenced by listing or labeling for that identified purpose.

(ii) Mechanical strength and durability, including, for parts designed to enclose and protect other equipment, the adequacy of the protection thus provided;

(iii) Wire-bending and connection space;

(iv) Electrical insulation;

(v) Heating effects under all conditions of use;

(vi) Arcing effects;

(vii) Classification by type, size, voltage, current capacity, and specific use; and

(viii) Other factors that contribute to the practical safeguarding of persons using or likely to come in contact with the equipment.

(2) Installation and use. Listed or labeled equipment shall be installed and used in accordance with any instructions included in the listing or labeling.

(3) Insulation integrity. Completed wiring installations shall be free from short circuits and from grounds other than those required or permitted by this subpart.

(4) Interrupting rating. Equipment intended to interrupt current at fault levels shall have an interrupting rating sufficient for the nominal circuit voltage and the current that is available at the line terminals of the equipment. Equipment intended to interrupt current at other than fault levels shall have an interrupting rating at nominal circuit voltage sufficient for the current that must be interrupted.

(5) Circuit impedance and other characteristics. The overcurrent protective devices, the total impedance, the component short-circuit current ratings, and other characteristics of the circuit to be protected shall be selected and coordinated to permit the circuit protective devices used to clear a fault to do so without the occurrence of extensive damage to the electrical components of the circuit. This fault shall be assumed to be either between two or more of the circuit conductors, or between any circuit conductor and the grounding conductor or enclosing metal raceway.

(6) Deteriorating agents. Unless identified for use in the operating environment, no conductors or equipment shall be located in damp or wet locations; where exposed to gases, fumes, vapors, liquids, or other agents that have a deteriorating effect on the conductors or equipment; or where exposed to excessive temperatures.

(7) Mechanical execution of work. Electric equipment shall be installed in a neat and workmanlike manner.

(i) Unused openings in boxes, raceways, auxiliary gutters, cabinets, equipment cases, or housings shall be effectively closed to afford protection substantially equivalent to the wall of the equipment.

(ii) Conductors shall be racked to provide ready and safe access in underground and subsurface enclosures that persons enter for installation and maintenance.

(iii) Internal parts of electrical equipment, including busbars, wiring terminals, insulators, and other surfaces, may not be damaged or contaminated by foreign materials such as paint, plaster, cleaners, abrasives, or corrosive residues.

(iv) There shall be no damaged parts that may adversely affect safe operation or mechanical strength of the equipment, such as parts that are broken, bent, cut, or deteriorated by corrosion, chemical action, or overheating.

(8) Mounting and cooling of equipment.

(i) Electric equipment shall be firmly secured to the surface on which it is mounted.

Note to paragraph (b)(8)(i) of this section: Wooden plugs driven into holes in masonry, concrete, plaster, or similar materials are not considered secure means of fastening electric equipment.

(ii) Electric equipment that depends on the natural circulation of air and convection principles for cooling of exposed surfaces shall be installed so that room airflow over such surfaces is not prevented by walls or by adjacent installed equipment. For equipment designed for floor mounting, clearance between top surfaces and adjacent surfaces shall be provided to dissipate rising warm air.

(iii) Electric equipment provided with ventilating openings shall be installed so that walls or other obstructions do not prevent the free circulation of air through the equipment.

(c) Electrical connections--

(1) General. Because of different characteristics of dissimilar metals:

(i) Devices such as pressure terminal or pressure splicing connectors and soldering lugs shall be identified for the material of the conductor and shall be properly installed and used;

(ii) Conductors of dissimilar metals may not be intermixed in a terminal or splicing connector where physical contact occurs between dissimilar conductors (such as copper and aluminum, copper and copper-clad aluminum, or aluminum and copper-clad aluminum) unless the device is identified for the purpose and conditions of use; and

(iii) Materials such as solder, fluxes, inhibitors, and compounds, where employed, shall be suitable for the use and shall be of a type that will not adversely affect the conductors, installation, or equipment.

(2) Terminals.

(i) Connection of conductors to terminal parts shall ensure a good connection without damaging the conductors and shall be made by means of pressure connectors (including set-screw type), solder lugs, or splices to flexible leads. However, No. 10 or smaller conductors may be connected by means of wire binding screws or studs and nuts having upturned lugs or equivalent.

(ii) Terminals for more than one conductor and terminals used to connect aluminum shall be so identified.

(3) Splices.

(i) Conductors shall be spliced or joined with splicing devices identified for the use or by brazing, welding, or soldering with a fusible metal or alloy. Soldered splices shall first be spliced or joined to be mechanically and electrically secure without solder and then soldered. All splices and joints and the free ends of conductors shall be covered with an insulation equivalent to that of the conductors or with an insulating device identified for the purpose.

(ii) Wire connectors or splicing means installed on conductors for direct burial shall be listed for such use.

(d) Arcing parts.

Parts of electric equipment that in ordinary operation produce arcs, sparks, flames, or molten metal shall be enclosed or separated and isolated from all combustible material.

(e) Marking--

(1) Identification of manufacturer and ratings. Electric equipment may not be used unless the following markings have been placed on the equipment:

(i) The manufacturer's name, trademark, or other descriptive marking by which the organization responsible for the product may be identified; and

(ii) Other markings giving voltage, current, wattage, or other ratings as necessary.

(2) Durability. The marking shall be of sufficient durability to withstand the environment involved.

(f) Disconnecting means and circuits--

(1) Motors and appliances. Each disconnecting means required by this subpart for motors and appliances shall be legibly marked to indicate its purpose, unless located and arranged so the purpose is evident.

(2) Services, feeders, and branch circuits. Each service, feeder, and branch circuit, at its disconnecting means or overcurrent device, shall be legibly marked to indicate its purpose, unless located and arranged so the purpose is evident.

(3) Durability of markings. The markings required by paragraphs (f)(1) and (f)(2) of this section shall be of sufficient durability to withstand the environment involved.

(4) Capable of accepting a lock. Disconnecting means required by this subpart shall be capable of being locked in the open position.

(5) Marking for series combination ratings.

(i) Where circuit breakers or fuses are applied in compliance with the series combination ratings marked on the equipment by the manufacturer, the equipment enclosures shall be legibly marked in the field to indicate that the equipment has been applied with a series combination rating.

(ii) The marking required by paragraph (f)(5)(i) of this section shall be readily visible and shall state ``Caution--Series Combination System Rated ---- Amperes. Identified Replacement Component Required."

(g) 600 Volts, nominal, or less.

This paragraph applies to electric equipment operating at 600 volts, nominal, or less to ground.

(1) Space about electric equipment. Sufficient access and working space shall be provided and maintained about all electric equipment to permit ready and safe operation and maintenance of such equipment.

(i) Working space for equipment likely to require examination, adjustment, servicing, or maintenance while energized shall comply with the following dimensions, except as required or permitted elsewhere in this subpart:

(A) The depth of the working space in the direction of access to live parts may not be less than indicated in Table S-1. Distances shall be measured from the live parts if they are exposed or from the enclosure front or opening if they are enclosed;

(B) The width of working space in front of the electric equipment shall be the width of the equipment or 762 mm (30 in.), whichever is greater. In all cases, the working space shall permit at least a 90-degree opening of equipment doors or hinged panels; and

(C) The work space shall be clear and extend from the grade, floor, or platform to the height required by paragraph (g)(1)(vi) of this section. However, other equipment associated with the electrical installation and located above or below the electric equipment may extend not more than 153 mm (6 in.) beyond the front of the electric equipment.

(ii) Working space required by this standard may not be used for storage. When normally enclosed live parts are exposed for inspection or servicing, the working space, if in a passageway or general open space, shall be suitably guarded.

(iii) At least one entrance of sufficient area shall be provided to give access to the working space about electric equipment.

(iv) For equipment rated 1200 amperes or more and over 1.83 m (6.0 ft) wide, containing overcurrent devices, switching devices, or control devices, there shall be one entrance not less than 610 mm (24 in.) wide and 1.98 m (6.5 ft) high at each end of the working space, except that:

(A) Where the location permits a continuous and unobstructed way of exit travel, one means of exit is permitted; or

(B) Where the working space required by paragraph (g)(1)(i) of this section is doubled, only one entrance to the working space is required; however, the entrance shall be located so that the edge of the entrance nearest the equipment is the minimum clear distance given in Table S-1 away from such equipment.

(v) Illumination shall be provided for all working spaces about service equipment, switchboards, panelboards, and motor control centers installed indoors. Additional lighting fixtures are not required where the working space is illuminated by an adjacent light source. In electric equipment rooms, the illumination may not be controlled by automatic means only.

(vi) The minimum headroom of working spaces about service equipment, switchboards, panelboards, or motor control centers shall be as follows:

(A) For installations built before August 13, 2007, 1.91 m (6.25 ft); and

(B) For installations built on or after August 13, 2007, 1.98 m (6.5 ft), except that where the electrical equipment exceeds 1.98 m (6.5 ft) in height, the minimum headroom may not be less than the height of the equipment.

Figure C.1: Table S-1 as published in Federal Register

TABLE S–1.—MINIMUM DEPTH OF CLEAR WORKING SPACE AT ELECTRIC EQUIPMENT, 600 V OR LESS

Nominal voltage to ground	Minimum clear distance for condition [2,3]					
	Condition A		Condition B		Condition C	
	m	ft	m	ft	m	ft
0–150	[1]0.9	[1]3.0	[1]0.9	[1]3.0	0.9	3.0
151–600	[1]0.9	[1]3.0	1.0	3.5	1.2	4.0

Notes to Table S–1:
1. Minimum clear distances may be 0.7 m (2.5 ft) for installations built before April 16, 1981.
2. Conditions A, B, and C are as follows:
Condition A—Exposed live parts on one side and no live or grounded parts on the other side of the working space, or exposed live parts on both sides effectively guarded by suitable wood or other insulating material. Insulated wire or insulated busbars operating at not over 300 volts are not considered live parts.
Condition B—Exposed live parts on one side and grounded parts on the other side.
Condition C—Exposed live parts on both sides of the work space (not guarded as provided in Condition A) with the operator between.
3. Working space is not required in back of assemblies such as dead-front switchboards or motor control centers where there are no renewable or adjustable parts (such as fuses or switches) on the back and where all connections are accessible from locations other than the back. Where rear access is required to work on deenergized parts on the back of enclosed equipment, a minimum working space of 762 mm (30 in.) horizontally shall be provided.

(vii) Switchboards, panelboards, and distribution boards installed for the control of light and power circuits, and motor control centers shall be located in dedicated spaces and protected from damage.

(A) For indoor installation, the dedicated space shall comply with the following:

(1) The space equal to the width and depth of the equipment and extending from the floor to a height of 1.83 m (6.0 ft) above the equipment or to the structural ceiling, whichever is lower, shall be dedicated to the electrical installation. Unless isolated from equipment by height or physical enclosures or covers that will afford adequate mechanical protection from vehicular traffic or accidental contact by unauthorized personnel or that complies with paragraph (g)(1)(vii)(A)(2) of this section, piping, ducts, or equipment foreign to the electrical installation may not be located in this area;

(2) The space equal to the width and depth of the equipment shall be kept clear of foreign systems unless protection is provided to avoid damage from condensation, leaks, or breaks in such foreign systems. This area shall extend from the top of the electric equipment to the structural ceiling;

(3) Sprinkler protection is permitted for the dedicated space where the piping complies with this section; and

(4) Control equipment that by its very nature or because of other requirements in this subpart must be adjacent to or within sight of its operating machinery is permitted in the dedicated space.

Note to paragraph (g)(1)(vii)(A) of this section: A dropped, suspended, or similar ceiling that does not add strength to the building structure is not considered a structural ceiling.

(B) Outdoor electric equipment shall be installed in suitable enclosures and shall be protected from accidental contact by unauthorized personnel, or by vehicular traffic, or by accidental spillage or leakage from piping systems. No architectural appurtenance or other equipment may be located in the working space required by paragraph (g)(1)(i) of this section.

(2) Guarding of live parts.

(i) Except as elsewhere required or permitted by this standard, live parts of electric equipment operating at 50 volts or more shall be guarded against accidental contact by use of approved cabinets or other forms of approved enclosures or by any of the following means:

(A) By location in a room, vault, or similar enclosure that is accessible only to qualified persons;

(B) By suitable permanent, substantial partitions or screens so arranged so that only qualified persons will have access to the space within reach of the live parts. Any openings in such partitions or screens shall be so sized and located that persons are not likely to come into accidental contact with the live parts or to bring conducting objects into contact with them;

(C) By placement on a suitable balcony, gallery, or platform so elevated and otherwise located as to prevent access by unqualified persons; or

(D) By elevation of 2.44 m (8.0 ft) or more above the floor or other working surface.

(ii) In locations where electric equipment is likely to be exposed to physical damage, enclosures or guards shall be so arranged and of such strength as to prevent such damage.

(iii) Entrances to rooms and other guarded locations containing exposed live parts shall be marked with conspicuous warning signs forbidding unqualified persons to enter.

(h) Over 600 volts, nominal--

(1) General. Conductors and equipment used on circuits exceeding 600 volts, nominal, shall comply with all applicable provisions of the paragraphs (a) through (g) of this section and with the following provisions, which supplement or modify the preceding requirements.

However, paragraphs (h)(2), (h)(3), and (h)(4) of this section do not apply to the equipment on the supply side of the service point.

(2) Enclosure for electrical installations.

(i) Electrical installations in a vault, room, or closet or in an area surrounded by a wall, screen, or fence, access to which is controlled by lock and key or other approved means, are considered to be accessible to qualified persons only. The type of enclosure used in a given case shall be designed and constructed according to the hazards associated with the installation.

(ii) For installations other than equipment described in paragraph (h)(2)(v) of this section, a wall, screen, or fence shall be used to enclose an outdoor electrical installation to deter access by persons who are not qualified. A fence may not be less than 2.13 m (7.0 ft) in height or a combination of 1.80 m (6.0 ft) or more of fence fabric and a 305-mm (1-ft) or more extension utilizing three or more strands of barbed wire or equivalent.

(iii) The following requirements apply to indoor installations that are accessible to other than qualified persons:

(A) The installations shall be made with metal-enclosed equipment or shall be enclosed in a vault or in an area to which access is controlled by a lock;

(B) Metal-enclosed switchgear, unit substations, transformers, pull boxes, connection boxes, and other similar associated equipment shall be marked with appropriate caution signs; and

(C) Openings in ventilated dry-type transformers and similar openings in other equipment shall be designed so that foreign objects inserted through these openings will be deflected from energized parts.

(iv) Outdoor electrical installations having exposed live parts shall be accessible to qualified persons only.

(v) The following requirements apply to outdoor enclosed equipment accessible to unqualified employees:

(A) Ventilating or similar openings in equipment shall be so designed that foreign objects inserted through these openings will be deflected from energized parts;

(B) Where exposed to physical damage from vehicular traffic, suitable guards shall be provided;

(C) Nonmetallic or metal-enclosed equipment located outdoors and accessible to the general public shall be designed so that exposed nuts or bolts cannot be readily removed, permitting access to live parts;

(D) Where nonmetallic or metal-enclosed equipment is accessible to the general public and the bottom of the enclosure is less than 2.44 m (8.0 ft) above the floor or grade level, the enclosure door or hinged cover shall be kept locked; and

(E) Except for underground box covers that weigh over 45.4 kg (100 lb), doors and covers of enclosures used solely as pull boxes, splice boxes, or junction boxes shall be locked, bolted, or screwed on.

(3) Work space about equipment. Sufficient space shall be provided and maintained about electric equipment to permit ready and safe operation and maintenance of such equipment. Where energized parts are exposed, the minimum clear work space may not be less than 1.98 m (6.5 ft) high (measured vertically from the floor or platform) or less than 914 mm (3.0 ft) wide (measured parallel to the equipment). The depth shall be as required in paragraph (h)(5)(i) of this section. In all cases, the work space shall be adequate to permit at least a 90-degree opening of doors or hinged panels.

(4) Entrance and access to work space.

(i) At least one entrance not less than 610 mm (24 in.) wide and 1.98 m (6.5 ft) high shall be provided to give access to the working space about electric equipment.

(A) On switchboard and control panels exceeding 1.83 m (6.0 ft) in width, there shall be one entrance at each end of such boards unless the location of the switchboards and control panels permits a continuous and unobstructed way of exit travel, or unless the work space required in paragraph (h)(5)(i) of this section is doubled.

(B) Where one entrance to the working space is permitted under the conditions described in paragraph (h)(4)(i)(A) of this section, the entrance shall be located so that the edge of the entrance nearest the switchboards and control panels is at least the minimum clear distance given in Table S-2 away from such equipment.

(C) Where bare energized parts at any voltage or insulated energized parts above 600 volts, nominal, to ground are located adjacent to such entrance, they shall be suitably guarded.

(ii) Permanent ladders or stairways shall be provided to give safe access to the working space around electric equipment installed on platforms, balconies, mezzanine floors, or in attic or roof rooms or spaces.

(5) Working space and guarding.

(i)(vi) Except as elsewhere required or permitted in this subpart, the minimum clear working space in the direction of access to live parts of electric equipment may not be less than specified in Table S-2. Distances shall be measured from the live parts, if they are exposed, or from the enclosure front or opening, if they are enclosed.

(ii) If switches, cutouts, or other equipment operating at 600 volts, nominal, or less, are installed in a room or enclosure where there are exposed live parts or exposed wiring operating at over 600 volts, nominal, the high-voltage equipment shall be effectively separated from the space occupied by the low-voltage equipment by a suitable partition, fence, or screen. However, switches or other equipment operating at 600 volts, nominal, or less, and serving only equipment within the high-voltage vault, room, or enclosure may be installed in the high-voltage enclosure, room, or vault if accessible to qualified persons only.

(iii) The following requirements apply to the entrances to all buildings, rooms, or enclosures containing exposed live parts or exposed conductors operating at over 600 volts, nominal:

(A) The entrances shall be kept locked unless they are under the observation of a qualified person at all times; and

(B) Permanent and conspicuous warning signs shall be provided, reading substantially as follows:

``DANGER--HIGH VOLTAGE--KEEP OUT."

(iv) Illumination shall be provided for all working spaces about electric equipment.

(A) The lighting outlets shall be arranged so that persons changing lamps or making repairs on the lighting system will not be endangered by live parts or other equipment.

(B) The points of control shall be located so that persons are prevented from contacting any live part or moving part of the equipment while turning on the lights.

(v) Unguarded live parts above working space shall be maintained at elevations not less than specified in Table S-3.

(vi) Pipes or ducts that are foreign to the electrical installation and that require periodic maintenance or whose malfunction would endanger the operation of the electrical system may not be located in the vicinity of service equipment, metal-enclosed power switchgear, or industrial control assemblies. Protection shall be provided where necessary to avoid damage from condensation leaks and breaks in such foreign systems.

Note to paragraph (h)(5)(vi) of this section: Piping and other facilities are not considered foreign if provided for fire protection of the electrical installation.

Figure C.2: Tables S-2 and S-3 as published in Federal Register

TABLE S–2.—MINIMUM DEPTH OF CLEAR WORKING SPACE AT ELECTRIC EQUIPMENT, OVER 600 V

Nominal voltage to ground	Minimum clear distance for condition [2] [3]					
	Condition A		Condition B		Condition C	
	m	ft	m	ft	m	ft
601–2500 V	0.9	3.0	1.2	4.0	1.5	5.0
2501–9000 V	1.2	4.0	1.5	5.0	1.8	6.0
9001 V–25 kV	1.5	5.0	1.8	6.0	2.8	9.0
Over 25–75 kV [1]	1.8	6.0	2.5	8.0	3.0	10.0
Above 75 kV [1]	2.5	8.0	3.0	10.0	3.7	12.0

Notes to Table S–2:

[1] Minimum depth of clear working space in front of electric equipment with a nominal voltage to ground above 25,000 volts may be the same as that for 25,000 volts under Conditions A, B, and C for installations built before April 16, 1981.

[2] Conditions A, B, and C are as follows:

Condition A—Exposed live parts on one side and no live or grounded parts on the other side of the working space, or exposed live parts on both sides effectively guarded by suitable wood or other insulating material. Insulated wire or insulated busbars operating at not over 300 volts are not considered live parts.

Condition B—Exposed live parts on one side and grounded parts on the other side. Concrete, brick, and tile walls are considered as grounded surfaces.

Condition C—Exposed live parts on both sides of the work space (not guarded as provided in Condition A) with the operator between.

[3] Working space is not required in back of equipment such as dead-front switchboards or control assemblies that has no renewable or adjustable parts (such as fuses or switches) on the back and where all connections are accessible from locations other than the back. Where rear access is required to work on the deenergized parts on the back of enclosed equipment, a minimum working space 762 mm (30 in.) horizontally shall be provided.

TABLE S–3.—ELEVATION OF UNGUARDED LIVE PARTS ABOVE WORKING SPACE

Nominal voltage between phases	Elevation	
	m	ft
601–7500 V	[1] 2.81	[1] 9.01.
7501 V–35 kV	2.8	9.0.
Over 35 kV	2.8 + 9.5 mm/kV over 35 kV	9.0 + 0.37 in./kV over 35 kV.

[1] The minimum elevation may be 2.6 m (8.5 ft) for installations built before August 13, 2007. The minimum elevation may be 2.4 m (8.0 ft) for installations built before April 16, 1981, if the nominal voltage between phases is in the range of 601–6600 volts.

§ 1910.304 Wiring design and protection.

(a) Use and identification of grounded and grounding conductors--

(1) Identification of conductors.

(i) A conductor used as a grounded conductor shall be identifiable and distinguishable from all other conductors.

(ii) A conductor used as an equipment grounding conductor shall be identifiable and distinguishable from all other conductors.

(2) Polarity of connections. No grounded conductor may be attached to any terminal or lead so as to reverse designated polarity.

(3) Use of grounding terminals and devices. A grounding terminal or grounding-type device on a receptacle, cord connector, or attachment plug may not be used for purposes other than grounding.

(b) Branch circuits--

(1) Identification of multiwire branch circuits.

Where more than one nominal voltage system exists in a building containing multiwire branch circuits, each ungrounded conductor of a multiwire branch circuit, where accessible, shall be identified by phase and system. The means of identification shall be permanently posted at each branch-circuit panelboard.

(2) Receptacles and cord connectors.

(i) Receptacles installed on 15- and 20-ampere branch circuits shall be of the grounding type except as permitted for replacement receptacles in paragraph (b)(2)(iv) of this section. Grounding-type receptacles shall be installed only on circuits of the voltage class and current for which they are rated, except as provided in Table S-4 and Table S-5.

(ii) Receptacles and cord connectors having grounding contacts shall have those contacts effectively grounded except for receptacles mounted on portable and vehicle-mounted generators in accordance with paragraph (g)(3) of this section and replacement receptacles installed in accordance with paragraph (b)(2)(iv) of this section.

(iii) The grounding contacts of receptacles and cord connectors shall be grounded by connection to the equipment grounding conductor of the circuit supplying the receptacle or cord connector. The branch circuit wiring method shall include or provide an equipment grounding conductor to which the grounding contacts of the receptacle or cord connector shall be connected.

(iv) Replacement of receptacles shall comply with the following requirements:

(A) Where a grounding means exists in the receptacle enclosure or a grounding conductor is installed, grounding-type receptacles shall be used and shall be connected to the grounding means or conductor;

(B) Ground-fault circuit-interrupter protected receptacles shall be provided where replacements are made at receptacle outlets that are required to be so protected elsewhere in this subpart; and

(C) Where a grounding means does not exist in the receptacle enclosure, the installation shall comply with one of the following provisions:

(1) A nongrounding-type receptacle may be replaced with another nongrounding-type receptacle; or

(2) A nongrounding-type receptacle may be replaced with a ground-fault circuit-interrupter-type of receptacle that is marked ``No Equipment Ground;'' an equipment grounding conductor may not be connected from the ground-fault circuit-interrupter-type receptacle to any outlet supplied from the ground-fault circuit-interrupter receptacle; or

(3) A nongrounding-type receptacle may be replaced with a grounding-type receptacle where supplied through a ground-fault circuit-interrupter; the replacement receptacle shall be marked ``GFCI Protected'' and ``No Equipment Ground;'' an equipment grounding conductor may not be connected to such grounding-type receptacles.

(v) Receptacles connected to circuits having different voltages, frequencies, or types of current (ac or dc) on the same premises shall be of such design that the attachment plugs used on these circuits are not interchangeable.

(3) Ground-fault circuit interrupter protection for personnel.

(i) All 125-volt, single-phase, 15- and 20-ampere receptacles installed in bathrooms or on rooftops shall have ground-fault circuit-interrupter protection for personnel.

(ii) The following requirements apply to temporary wiring installations that are used during maintenance, remodeling, or repair of buildings, structures, or equipment or during similar construction-like activities.

(A) All 125-volt, single-phase, 15-, 20-, and 30-ampere receptacle outlets that are not part of the permanent wiring of the building or structure and that are in use by personnel shall have ground-fault circuit-interrupter protection for personnel.

Note 1 to paragraph (b)(3)(ii)(A) of this section: A cord connector on an extension cord set is considered to be a receptacle outlet if the cord set is used for temporary electric power.

Note 2 to paragraph (b)(3)(ii)(A) of this section: Cord sets and devices incorporating the required ground-fault circuit-interrupter that are connected to the receptacle closest to the source of power are acceptable forms of protection.

(B) Receptacles other than 125 volt, single-phase, 15-, 20-, and 30-ampere receptacles that are not part of the permanent wiring of the building or structure and that are in use by personnel shall have ground-fault circuit-interrupter protection for personnel.

(C) Where the ground-fault circuit-interrupter protection required by paragraph (b)(3)(ii)(B) of this section is not available for receptacles other than 125-volt, single-phase, 15-, 20-, and 30-ampere, the employer shall establish and implement an assured equipment grounding conductor program covering cord sets, receptacles that are not a part of the building or structure, and equipment connected by cord and plug that are available for use or used by employees on those receptacles. This program shall comply with the following requirements:

(1) A written description of the program, including the specific procedures adopted by the employer, shall be available at the jobsite for inspection and copying by the Assistant Secretary of Labor and any affected employee;

(2) The employer shall designate one or more competent persons to implement the program;

(3) Each cord set, attachment cap, plug, and receptacle of cord sets, and any equipment connected by cord and plug, except cord sets and receptacles which are fixed and not exposed to damage, shall be visually inspected before each day's use for external defects, such as deformed or missing pins or insulation damage, and for indications of possible internal damage. Equipment found damaged or defective shall not be used until repaired;

(4) The following tests shall be performed on all cord sets and receptacles which are not a part of the permanent wiring of the building or structure, and cord- and plug-connected equipment required to be grounded:

(i) All equipment grounding conductors shall be tested for continuity and shall be electrically continuous;

(ii) Each receptacle and attachment cap or plug shall be tested for correct attachment of the equipment grounding conductor. The equipment grounding conductor shall be connected to its proper terminal; and

(iii) All required tests shall be performed before first use; before equipment is returned to service following any repairs; before equipment is used after any incident which can be reasonably suspected to have caused damage (for example, when a cord set is run over); and at intervals not to exceed 3 months, except that cord sets and receptacles which are fixed and not exposed to damage shall be tested at intervals not exceeding 6 months;

(5) The employer shall not make available or permit the use by employees of any equipment which has not met the requirements of paragraph (b)(3)(ii)(C) of this section; and

(6) Tests performed as required in paragraph (b)(3)(ii)(C) of this section shall be recorded. This test record shall identify each receptacle, cord set, and cord- and plug-connected equipment that passed the test and shall indicate the last date it was tested or the interval for which it was tested. This record shall be kept by means of logs, color coding, or other effective means and shall be maintained until replaced by a more current record. The record shall be made available on the jobsite for inspection by the Assistant Secretary and any affected employee.

(4) Outlet devices. Outlet devices shall have an ampere rating not less than the load to be served and shall comply with the following provisions:

(i) Where connected to a branch circuit having a rating in excess of 20 amperes, lampholders shall be of the heavy-duty type. A heavy-duty lampholder shall have a rating of not less than 660 watts if of the admedium type and not less than 750 watts if of any other type; and

(ii) Receptacle outlets shall comply with the following provisions:

(A) A single receptacle installed on an individual branch circuit shall have an ampere rating of not less than that of the branch circuit;

(B) Where connected to a branch circuit supplying two or more receptacles or outlets, a receptacle may not supply a total cord- and plug-connected load in excess of the maximum specified in Table S-4; and

(C) Where connected to a branch circuit supplying two or more receptacles or outlets, receptacle ratings shall conform to the values listed in Table S-5; or, where larger than 50 amperes, the receptacle rating may not be less than the branch-circuit rating.

However, receptacles of cord- and plug-connected arc welders may have ampere ratings not less than the minimum branch-circuit conductor ampacity.

Table C.1: Table S-4--Maximum Cord- and Plug-Connected Load to Receptacle

Circuit rating (amperes)	Receptacle rating (amperes)	Maximum load (amperes)
15 or 20	15	12
20	20	16
30	30	24

Table C.2: Table S-5.--Receptacle Ratings for Various Size Circuits

Circuit rating (amperes)	Receptacle rating (amperes)
15	Not over 15.
20	15 or 20.
30	30.
40	40 or 50.
50	50.

(5) Cord connections. A receptacle outlet shall be installed wherever flexible cords with attachment plugs are used. Where flexible cords are permitted to be permanently connected, receptacles may be omitted.

(c) Outside conductors, 600 volts, nominal, or less.

The following requirements apply to branch-circuit, feeder, and service conductors rated 600 volts, nominal, or less and run outdoors as open conductors.

(1) Conductors on poles. Conductors on poles shall have a separation of not less than 305 mm (1.0 ft) where not placed on racks or brackets. Conductors supported on poles shall provide a horizontal climbing space not less than the following:

(i) Power conductors below communication conductors--762 mm (30 in.);

(ii) Power conductors alone or above communication conductors:

(A) 300 volts or less--610 mm (24 in.),

(B) Over 300 volts--762 mm (30 in.);

(iii) Communication conductors below power conductors--same as power conductors; and

(iv) Communications conductors alone--no requirement.

(2) Clearance from ground. Open conductors, open multiconductor cables, and service-drop conductors of not over 600 volts, nominal, shall conform to the minimum clearances specified in Table S-6.

Figure C.3: Table S-6 as published in Federal Register

TABLE S–66.—CLEARANCES FROM GROUND

Distance	Installations built before August 13, 2007		Installations built on or after August 13, 2007	
	Maximum voltage	Conditions	Voltage to ground	Conditions
3.05 m (10.0 ft)	< 600 V	Above finished grade or sidewalks, or from any platform or projection from which they might be reached. (If these areas are accessible to other than pedestrian traffic, then one of the other conditions applies).	< 150 V	Above finished grade or sidewalks, or from any platform or projection from which they might be reached. (If these areas are accessible to other than pedestrian traffic, then one of the other conditions applies.)
3.66 m (12.0 ft)	< 600 V	Over areas, other than public streets, alleys, roads, and driveways, subject to vehicular traffic other than truck traffic.	< 300 V	Over residential property and driveways. Over commercial areas subject to pedestrian traffic or to vehicular traffic other than truck traffic. (This category includes conditions covered under the 3.05-m (10.0-ft) category where the voltage exceeds 150 V.)
4.57 m (15.0 ft)	< 600 V	Over areas, other than public streets, alleys, roads, and driveways, subject to truck traffic.	301 to 600 V	Over residential property and driveways. Over commercial areas subject to pedestrian traffic or to vehicular traffic other than truck traffic. (This category includes conditions covered under the 3.05-m (10.0-ft) category where the voltage exceeds 300 V.)
5.49 m (18.0 ft)	< 600 V	Over public streets, alleys, roads, and driveways.	< 600 V	Over public streets, alleys, roads, and driveways. Over commercial areas subject to truck traffic. Other land traversed by vehicles, including land used for cultivating or grazing and forests and orchards.

(3) Clearance from building openings.

(i) Service conductors installed as open conductors or multiconductor cable without an overall outer jacket shall have a clearance of not less than 914 mm (3.0 ft) from windows that are designed to be opened, doors, porches, balconies, ladders, stairs, fire escapes, and similar locations. However, conductors that run above the top level of a window may be less than 914 mm (3.0 ft) from the window. Vertical clearance of final spans above, or within 914 mm (3.0 ft) measured horizontally of, platforms, projections, or surfaces from which they might be reached shall be maintained in accordance with paragraph (c)(2) of this section.

(ii) Overhead service conductors may not be installed beneath openings through which materials may be moved, such as openings in farm and commercial buildings, and may not be installed where they will obstruct entrance to these building openings.

(4) Above roofs. Overhead spans of open conductors and open multiconductor cables shall have a vertical clearance of not less than 2.44 m (8.0 ft) above the roof surface. The vertical clearance above the roof level shall be maintained for a distance not less than 914 mm (3.0 ft) in all directions from the edge of the roof.

(i) The area above a roof surface subject to pedestrian or vehicular traffic shall have a vertical clearance from the roof surface in accordance with the clearance requirements of paragraph (c)(2) of this section.

(ii) A reduction in clearance to 914 mm (3.0 ft) is permitted where the voltage between conductors does not exceed 300 and the roof has a slope of 102 mm (4 in.) in 305 mm (12 in.) or greater.

(iii) A reduction in clearance above only the overhanging portion of the roof to not less than 457 mm (18 in.) is permitted where the voltage between conductors does not exceed 300 if:

(A) The conductors do not pass above the roof overhang for a distance of more than 1.83 m (6.0 ft), 1.22 m (4.0 ft) horizontally, and

(B) The conductors are terminated at a through-the-roof raceway or approved support.

(iv) The requirement for maintaining a vertical clearance of 914 mm (3.0 ft) from the edge of the roof does not apply to the final conductor span, where the conductors are attached to the side of a building.

(d) Location of outdoor lamps.

Lamps for outdoor lighting shall be located below all energized conductors, transformers, or other electric equipment, unless such equipment is controlled by a disconnecting means that can be locked in the open position, or unless adequate clearances or other safeguards are provided for relamping operations.

(e) Services--

(1) Disconnecting means.

(i) Means shall be provided to disconnect all conductors in a building or other structure from the service-entrance conductors. The service disconnecting means shall plainly indicate whether it is in the open or closed position and shall be installed at a readily accessible location nearest the point of entrance of the service-entrance conductors.

(ii) Each service disconnecting means shall simultaneously disconnect all ungrounded conductors.

(iii) Each service disconnecting means shall be suitable for the prevailing conditions.

(2) Services over 600 volts, nominal. The following additional requirements apply to services over 600 volts, nominal.

(i) Service-entrance conductors installed as open wires shall be guarded to make them accessible only to qualified persons.

(ii) Signs warning of high voltage shall be posted where unqualified employees might come in contact with live parts.

(f) Overcurrent protection--

(1) 600 volts, nominal, or less. The following requirements apply to overcurrent protection of circuits rated 600 volts, nominal, or less.

(i) Conductors and equipment shall be protected from overcurrent in accordance with their ability to safely conduct current.

(ii) Except for motor running overload protection, overcurrent devices may not interrupt the continuity of the grounded conductor unless all conductors of the circuit are opened simultaneously.

(iii) A disconnecting means shall be provided on the supply side of all fuses in circuits over 150 volts to ground and cartridge fuses in circuits of any voltage where accessible to other than qualified persons so that each individual circuit containing fuses can be independently disconnected from the source of power. However, a current-limiting device without a disconnecting means is permitted on the supply side of the service disconnecting means. In addition, a single disconnecting means is permitted on the supply side of more than one set of fuses as permitted by the exception in § 1910.305(j)(4)(vi) for group operation of motors, and a single disconnecting means is permitted for fixed electric space-heating equipment.

(iv) Overcurrent devices shall be readily accessible to each employee or authorized building management personnel. These overcurrent devices may not be located where they will be exposed to physical damage or in the vicinity of easily ignitable material.

(v) Fuses and circuit breakers shall be so located or shielded that employees will not be burned or otherwise injured by their operation. Handles or levers of circuit breakers, and similar parts that may move suddenly in such a way that persons in the vicinity are likely to be injured by being struck by them, shall be guarded or isolated.

(vi) Circuit breakers shall clearly indicate whether they are in the open (off) or closed (on) position.

(vii) Where circuit breaker handles on switchboards are operated vertically rather than horizontally or rotationally, the up position of the handle shall be the closed (on) position.

(viii) Circuit breakers used as switches in 120-volt and 277-volt, fluorescent lighting circuits shall be listed and marked ``SWD."

(ix) A circuit breaker with a straight voltage rating, such as 240 V or 480 V, may only be installed in a circuit in which the nominal voltage between any two conductors does not exceed the circuit breaker's voltage rating. A two-pole circuit breaker may not be used for protecting a 3-phase, corner-grounded delta circuit unless the circuit breaker is marked 1[Phi]--3[Phi] to indicate such suitability. A circuit breaker with a slash rating, such as 120/240 V or 480Y/277 V, may only be installed in a circuit where the nominal voltage of any conductor to ground does not exceed the lower of the two values of the circuit breaker's voltage rating and the nominal voltage between any two conductors does not exceed the higher value of the circuit breaker's voltage rating.

(2) Feeders and branch circuits over 600 volts, nominal. The following requirements apply to feeders and branch circuits energized at more than 600 volts, nominal:

(i) Feeder and branch-circuit conductors shall have overcurrent protection in each ungrounded conductor located at the point where the conductor receives its supply or at a location in the circuit determined under engineering supervision;

(A) Circuit breakers used for overcurrent protection of three-phase circuits shall have a minimum of three overcurrent relays operated from three current transformers. On three-phase, three-wire circuits, an overcurrent relay in the residual circuit of the current transformers may replace one of the phase relays. An overcurrent relay, operated from a current transformer that links all phases of a three-phase, three-wire circuit, may replace the residual relay and one other phase-conductor current transformer. Where the neutral is not grounded on the load side of the circuit, the current transformer may link all three phase conductors and the grounded circuit conductor (neutral); and

(B) If fuses are used for overcurrent protection, a fuse shall be connected in series with each ungrounded conductor;

(ii) Each protective device shall be capable of detecting and interrupting all values of current that can occur at its location in excess of its trip setting or melting point;

(iii) The operating time of the protective device, the available short-circuit current, and the conductor used shall be coordinated to prevent damaging or dangerous temperatures in conductors or conductor insulation under short-circuit conditions; and

(iv) The following additional requirements apply to feeders only:

(A) The continuous ampere rating of a fuse may not exceed three times the ampacity of the conductors. The long-time trip element setting of a breaker or the minimum trip setting of an electronically actuated fuse may not exceed six times the ampacity of the conductor. For fire pumps, conductors may be protected for short circuit only; and

(B) Conductors tapped to a feeder may be protected by the feeder overcurrent device where that overcurrent device also protects the tap conductor.

(g) Grounding.

Paragraphs (g)(1) through (g)(9) of this section contain grounding requirements for systems, circuits, and equipment.

(1) Systems to be grounded. Systems that supply premises wiring shall be grounded as follows:

(i) All 3-wire dc systems shall have their neutral conductor grounded;

(ii) Two-wire dc systems operating at over 50 volts through 300 volts between conductors shall be grounded unless:

(A) They supply only industrial equipment in limited areas and are equipped with a ground detector;

(B) They are rectifier-derived from an ac system complying with paragraphs (g)(1)(iii), (g)(1)(iv), and (g)(1)(v) of this section; or

(C) They are fire-alarm circuits having a maximum current of 0.030 amperes;

(iii) AC circuits of less than 50 volts shall be grounded if they are installed as overhead conductors outside of buildings or if they are supplied by transformers and the transformer primary supply system is ungrounded or exceeds 150 volts to ground;

(iv) AC systems of 50 volts to 1000 volts shall be grounded under any of the following conditions, unless exempted by paragraph (g)(1)(v) of this section:

(A) If the system can be so grounded that the maximum voltage to ground on the ungrounded conductors does not exceed 150 volts;

(B) If the system is nominally rated three-phase, four-wire wye connected in which the neutral is used as a circuit conductor;

(C) If the system is nominally rated three-phase, four-wire delta connected in which the midpoint of one phase is used as a circuit conductor; or

(D) If a service conductor is uninsulated;

(v) AC systems of 50 volts to 1000 volts are not required to be grounded under any of the following conditions:

(A) If the system is used exclusively to supply industrial electric furnaces for melting, refining, tempering, and the like;

(B) If the system is separately derived and is used exclusively for rectifiers supplying only adjustable speed industrial drives;

(C) If the system is separately derived and is supplied by a transformer that has a primary voltage rating less than 1000 volts, provided all of the following conditions are met:

(1) The system is used exclusively for control circuits;

(2) The conditions of maintenance and supervision ensure that only qualified persons will service the installation;

(3) Continuity of control power is required; and

(4) Ground detectors are installed on the control system;

(D) If the system is an isolated power system that supplies circuits in health care facilities; or

(E) If the system is a high-impedance grounded neutral system in which a grounding impedance, usually a resistor, limits the ground-fault current to a low value for 3-phase ac systems of 480 volts to 1000 volts provided all of the following conditions are met:

(1) The conditions of maintenance and supervision ensure that only qualified persons will service the installation;

(2) Continuity of power is required;

(3) Ground detectors are installed on the system; and

(4) Line-to-neutral loads are not served.

(2) Conductor to be grounded. The conductor to be grounded for ac premises wiring systems required to be grounded by paragraph (g)(1) of this section shall be as follows:

(i) One conductor of a single-phase, two-wire system shall be grounded;

(ii) The neutral conductor of a single-phase, three-wire system shall be grounded;

(iii) The common conductor of a multiphase system having one wire common to all phases shall be grounded;

(iv) One phase conductor of a multiphase system where one phase is grounded shall be grounded; and

(v) The neutral conductor of a multiphase system in which one phase is used as a neutral conductor shall be grounded.

(3) Portable and vehicle-mounted generators.

(i) The frame of a portable generator need not be grounded and may serve as the grounding electrode for a system supplied by the generator under the following conditions:

(A) The generator supplies only equipment mounted on the generator or cord- and plug-connected equipment through receptacles mounted on the generator, or both; and

(B) The noncurrent-carrying metal parts of equipment and the equipment grounding conductor terminals of the receptacles are bonded to the generator frame.

(ii) The frame of a vehicle need not be grounded and may serve as the grounding electrode for a system supplied by a generator located on the vehicle under the following conditions:

(A) The frame of the generator is bonded to the vehicle frame;

(B) The generator supplies only equipment located on the vehicle and cord- and plug-connected equipment through receptacles mounted on the vehicle;

(C) The noncurrent-carrying metal parts of equipment and the equipment grounding conductor terminals of the receptacles are bonded to the generator frame; and

(D) The system complies with all other provisions of paragraph (g) of this section.

(iii) A system conductor that is required to be grounded by the provisions of paragraph (g)(2) of this section shall be bonded to the generator frame where the generator is a component of a separately derived system.

(4) Grounding connections.

(i) For a grounded system, a grounding electrode conductor shall be used to connect both the equipment grounding conductor and the grounded circuit conductor to the grounding electrode. Both the equipment grounding conductor and the grounding electrode conductor shall be connected to the grounded circuit conductor on the supply side of the service disconnecting means or on the supply side of the system disconnecting means or overcurrent devices if the system is separately derived.

(ii) For an ungrounded service-supplied system, the equipment grounding conductor shall be connected to the grounding electrode conductor at the service equipment. For an ungrounded separately derived system, the equipment grounding conductor shall be connected to the grounding electrode conductor at, or ahead of, the system disconnecting means or overcurrent devices.

(iii) On extensions of existing branch circuits that do not have an equipment grounding conductor, grounding-type receptacles may be grounded to a grounded cold water pipe near the equipment if the extension was installed before August 13, 2007. When any element of this branch circuit is replaced, the entire branch circuit shall use an equipment grounding conductor that complies with all other provisions of paragraph (g) of this section.

(5) Grounding path. The path to ground from circuits, equipment, and enclosures shall be permanent, continuous, and effective.

(6) Supports, enclosures, and equipment to be grounded.

(i) Metal cable trays, metal raceways, and metal enclosures for conductors shall be grounded, except that:

(A) Metal enclosures such as sleeves that are used to protect cable assemblies from physical damage need not be grounded; and

(B) Metal enclosures for conductors added to existing installations of open wire, knob-and-tube wiring, and nonmetallic-sheathed cable need not be grounded if all of the following conditions are met:

(1) Runs are less than 7.62 meters (25.0 ft);

(2) Enclosures are free from probable contact with ground, grounded metal, metal laths, or other conductive materials; and

(3) Enclosures are guarded against employee contact.

(ii) Metal enclosures for service equipment shall be grounded.

(iii) Frames of electric ranges, wall-mounted ovens, counter-mounted cooking units, clothes dryers, and metal outlet or junction boxes that are part of the circuit for these appliances shall be grounded.

(iv) Exposed noncurrent-carrying metal parts of fixed equipment that may become energized shall be grounded under any of the following conditions:

(A) If within 2.44 m (8 ft) vertically or 1.52 m (5 ft) horizontally of ground or grounded metal objects and subject to employee contact;

(B) If located in a wet or damp location and not isolated;

(C) If in electrical contact with metal;

(D) If in a hazardous (classified) location;

(E) If supplied by a metal-clad, metal-sheathed, or grounded metal raceway wiring method; or

(F) If equipment operates with any terminal at over 150 volts to ground.

(v) Notwithstanding the provisions of paragraph (g)(6)(iv) of this section, exposed noncurrent-carrying metal parts of the following types of fixed equipment need not be grounded:

(A) Enclosures for switches or circuit breakers used for other than service equipment and accessible to qualified persons only;

(B) Electrically heated appliances that are permanently and effectively insulated from ground;

(C) Distribution apparatus, such as transformer and capacitor cases, mounted on wooden poles, at a height exceeding 2.44 m (8.0 ft) above ground or grade level; and

(D) Listed equipment protected by a system of double insulation, or its equivalent, and distinctively marked as such.

(vi) Exposed noncurrent-carrying metal parts of cord- and plug-connected equipment that may become energized shall be grounded under any of the following conditions:

(A) If in hazardous (classified) locations (see § 1910.307);

(B) If operated at over 150 volts to ground, except for guarded motors and metal frames of electrically heated appliances if the appliance frames are permanently and effectively insulated from ground;

(C) If the equipment is of the following types:

(1) Refrigerators, freezers, and air conditioners;

(2) Clothes-washing, clothes-drying, and dishwashing machines, sump pumps, and electric aquarium equipment;

(3) Hand-held motor-operated tools, stationary and fixed motor-operated tools, and light industrial motor-operated tools;

(4) Motor-operated appliances of the following types: hedge clippers, lawn mowers, snow blowers, and wet scrubbers;

(5) Cord- and plug-connected appliances used in damp or wet locations, or by employees standing on the ground or on metal floors or working inside of metal tanks or boilers;

(6) Portable and mobile X-ray and associated equipment;

(7) Tools likely to be used in wet and conductive locations; and

(8) Portable hand lamps.

(vii) Notwithstanding the provisions of paragraph (g)(6)(vi) of this section, the following equipment need not be grounded:

(A) Tools likely to be used in wet and conductive locations if supplied through an isolating transformer with an ungrounded secondary of not over 50 volts; and

(B) Listed or labeled portable tools and appliances if protected by an approved system of double insulation, or its equivalent, and distinctively marked.

(7) Nonelectrical equipment. The metal parts of the following nonelectrical equipment shall be grounded: frames and tracks of electrically operated cranes and hoists; frames of nonelectrically driven elevator cars to which electric conductors are attached; hand-operated metal shifting ropes or cables of electric elevators; and metal partitions, grill work, and similar metal enclosures around equipment of over 750 volts between conductors.

(8) Methods of grounding fixed equipment.

(i) Noncurrent-carrying metal parts of fixed equipment, if required to be grounded by this subpart, shall be grounded by an equipment grounding conductor that is contained within the same raceway, cable, or cord, or runs with or encloses the circuit conductors. For dc circuits only, the equipment grounding conductor may be run separately from the circuit conductors.

(ii) Electric equipment is considered to be effectively grounded if it is secured to, and in electrical contact with, a metal rack or structure that is provided for its support and the metal rack or structure is grounded by the method specified for the noncurrent-carrying metal parts of fixed equipment in paragraph (g)(8)(i) of this section. Metal car frames supported by metal hoisting cables attached to or running over metal sheaves or drums of grounded elevator machines are also considered to be effectively grounded.

(iii) For installations made before April 16, 1981, electric equipment is also considered to be effectively grounded if it is secured to, and in metallic contact with, the grounded structural metal frame of a building. When any element of this branch circuit is replaced, the entire branch circuit shall use an equipment grounding conductor that complies with all other provisions of paragraph (g) of this section.

(9) Grounding of systems and circuits of 1000 volts and over (high voltage). If high voltage systems are grounded, they shall comply with all applicable provisions of paragraphs (g)(1) through (g)(8) of this section as supplemented and modified by the following requirements:

(i) Systems supplying portable or mobile high voltage equipment, other than substations installed on a temporary basis, shall comply with the following:

(A) The system shall have its neutral grounded through an impedance. If a delta-connected high voltage system is used to supply the equipment, a system neutral shall be derived.

(B) Exposed noncurrent-carrying metal parts of portable and mobile equipment shall be connected by an equipment grounding conductor to the point at which the system neutral impedance is grounded.

(C) Ground-fault detection and relaying shall be provided to automatically deenergize any high voltage system component that has developed a ground fault. The continuity of the equipment grounding conductor shall be continuously monitored so as to deenergize automatically the high voltage feeder to the portable equipment upon loss of continuity of the equipment grounding conductor.

(D) The grounding electrode to which the portable equipment system neutral impedance is connected shall be isolated from and separated in the ground by at least 6.1 m (20.0 ft) from any other system or equipment grounding electrode, and there shall be no direct connection between the grounding electrodes, such as buried pipe, fence, and so forth.

(ii) All noncurrent-carrying metal parts of portable equipment and fixed equipment, including their associated fences, housings, enclosures, and supporting structures, shall be grounded. However, equipment that is guarded by location and isolated from ground need not be grounded. Additionally, pole-mounted distribution apparatus at a height exceeding 2.44 m (8.0 ft) above ground or grade level need not be grounded.

§ 1910.305 Wiring methods, components, and equipment for general use.

(a) Wiring methods.

The provisions of this section do not apply to conductors that are an integral part of factory-assembled equipment.

(1) General requirements.

(i) Metal raceways, cable trays, cable armor, cable sheath, enclosures, frames, fittings, and other metal noncurrent-carrying parts that are to serve as grounding conductors, with or without the use of supplementary equipment grounding conductors, shall be effectively bonded where necessary to ensure electrical continuity and the capacity to conduct safely any fault current likely to be imposed on them. Any nonconductive paint, enamel, or similar coating shall be removed at threads, contact points, and contact surfaces or be connected by means of fittings designed so as to make such removal unnecessary.

(ii) Where necessary for the reduction of electrical noise (electromagnetic interference) of the grounding circuit, an equipment enclosure supplied by a branch circuit may be isolated from a raceway containing circuits supplying only that equipment by one or more listed nonmetallic raceway fittings located at the point of attachment of the raceway to the equipment enclosure. The metal raceway shall be supplemented by an internal insulated equipment grounding conductor installed to ground the equipment enclosure.

(iii) No wiring systems of any type may be installed in ducts used to transport dust, loose stock, or flammable vapors. No wiring system of any type may be installed in any duct used for vapor removal or for ventilation of commercial-type cooking equipment, or in any shaft containing only such ducts.

(2) Temporary wiring. Except as specifically modified in this paragraph, all other requirements of this subpart for permanent wiring shall also apply to temporary wiring installations.

(i) Temporary electrical power and lighting installations of 600 volts, nominal, or less may be used only as follows:

(A) During and for remodeling, maintenance, or repair of buildings, structures, or equipment, and similar activities;

(B) For a period not to exceed 90 days for Christmas decorative lighting, carnivals, and similar purposes; or

(C) For experimental or development work, and during emergencies.

(ii) Temporary wiring shall be removed immediately upon completion of the project or purpose for which the wiring was installed.

(iii) Temporary electrical installations of more than 600 volts may be used only during periods of tests, experiments, emergencies, or construction-like activities.

(iv) The following requirements apply to feeders:

(A) Feeders shall originate in an approved distribution center.

(B) Conductors shall be run as multiconductor cord or cable assemblies. However, if installed as permitted in paragraph (a)(2)(i)(C) of this section, and if accessible only to qualified persons, feeders may be run as single insulated conductors.

(v) The following requirements apply to branch circuits:

(A) Branch circuits shall originate in an approved power outlet or panelboard.

(B) Conductors shall be multiconductor cord or cable assemblies or open conductors. If run as open conductors, they shall be fastened at ceiling height every 3.05 m (10.0 ft).

(C) No branch-circuit conductor may be laid on the floor.

(D) Each branch circuit that supplies receptacles or fixed equipment shall contain a separate equipment grounding conductor if run as open conductors.

(vi) Receptacles shall be of the grounding type. Unless installed in a continuous grounded metallic raceway or metallic covered cable, each branch circuit shall contain a separate equipment grounding conductor and all receptacles shall be electrically connected to the grounding conductor.

(vii) No bare conductors nor earth returns may be used for the wiring of any temporary circuit.

(viii) Suitable disconnecting switches or plug connectors shall be installed to permit the disconnection of all ungrounded conductors of each temporary circuit. Multiwire branch circuits shall be provided with a means to disconnect simultaneously all ungrounded conductors at the power outlet or panelboard where the branch circuit originated.

Note to paragraph (a)(2)(viii) of this section. Circuit breakers with their handles connected by approved handle ties are considered a single disconnecting means for the purpose of this requirement.

(ix) All lamps for general illumination shall be protected from accidental contact or breakage by a suitable fixture or lampholder with a guard. Brass shell, paper-lined sockets, or other metal-cased sockets may not be used unless the shell is grounded.

(x) Flexible cords and cables shall be protected from accidental damage, as might be caused, for example, by sharp corners, projections, and doorways or other pinch points.

(xi) Cable assemblies and flexible cords and cables shall be supported in place at intervals that ensure that they will be protected from physical damage. Support shall be in the form of staples, cables ties, straps, or similar type fittings installed so as not to cause damage.

(3) Cable trays.

(i) Only the following wiring methods may be installed in cable tray systems: armored cable; electrical metallic tubing; electrical nonmetallic tubing; fire alarm cables; flexible metal conduit; flexible metallic tubing; instrumentation tray cable; intermediate metal conduit; liquidtight flexible metal conduit; liquidtight flexible nonmetallic conduit; metal-clad cable; mineral-insulated, metal-sheathed cable; multiconductor service-entrance cable; multiconductor underground feeder and branch-circuit cable; multipurpose and communications cables; nonmetallic-sheathed cable; power and control tray cable; power-limited tray cable; optical fiber cables; and other factory-assembled, multiconductor control, signal, or power cables that are specifically approved for installation in cable trays, rigid metal conduit, and rigid nonmetallic conduit.

(ii) In industrial establishments where conditions of maintenance and supervision assure that only qualified persons will service the installed cable tray system, the following cables may also be installed in ladder, ventilated-trough, or ventilated-channel cable trays:

(A) Single conductor cable; the cable shall be No. 1/0 or larger and shall be of a type listed and marked on the surface for use in cable trays; where Nos. 1/0 through 4/0 single conductor cables are installed in ladder cable tray, the maximum allowable rung spacing for the ladder cable tray shall be 229 mm (9 in.); where exposed to direct rays of the sun, cables shall be identified as being sunlight resistant;

(B) Welding cables installed in dedicated cable trays;

(C) Single conductors used as equipment grounding conductors; these conductors, which may be insulated, covered, or bare, shall be No. 4 or larger; and

(D) Multiconductor cable, Type MV; where exposed to direct rays of the sun, the cable shall be identified as being sunlight resistant.

(iii) Metallic cable trays may be used as equipment grounding conductors only where continuous maintenance and supervision ensure that qualified persons will service the installed cable tray system.

(iv) Cable trays in hazardous (classified) locations may contain only the cable types permitted in such locations. (See § 1910.307.)

(v) Cable tray systems may not be used in hoistways or where subjected to severe physical damage.

(4) Open wiring on insulators.

(i) Open wiring on insulators is only permitted on systems of 600 volts, nominal, or less for industrial or agricultural establishments, indoors or outdoors, in wet or dry locations, where subject to corrosive vapors, and for services.

(ii) Conductors smaller than No. 8 shall be rigidly supported on noncombustible, nonabsorbent insulating materials and may not contact any other objects. Supports shall be installed as follows:

(A) Within 152 mm (6 in.) from a tap or splice;

(B) Within 305 mm (12 in.) of a dead-end connection to a lampholder or receptacle; and

(C) At intervals not exceeding 1.37 m (4.5 ft), and at closer intervals sufficient to provide adequate support where likely to be disturbed.

(iii) In dry locations, where not exposed to severe physical damage, conductors may be separately enclosed in flexible nonmetallic tubing. The tubing shall be in continuous lengths not exceeding 4.57 m (15.0 ft) and secured to the surface by straps at intervals not exceeding 1.37 m (4.5 ft).

(iv) Open conductors shall be separated from contact with walls, floors, wood cross members, or partitions through which they pass by tubes or bushings of noncombustible, nonabsorbent insulating material. If the bushing is shorter than the hole, a waterproof sleeve of nonconductive material shall be inserted in the hole and an insulating bushing slipped into the sleeve at each end in such a manner as to keep the conductors absolutely out of contact with the sleeve. Each conductor shall be carried through a separate tube or sleeve.

(v) Where open conductors cross ceiling joints and wall studs and are exposed to physical damage (for example, located within 2.13 m (7.0 ft) of the floor), they shall be protected.

(b) Cabinets, boxes, and fittings--

(1) Conductors entering boxes, cabinets, or fittings.

(i) Conductors entering cutout boxes, cabinets, or fittings shall be protected from abrasion, and openings through which conductors enter shall be effectively closed.

(ii) Unused openings in cabinets, boxes, and fittings shall be effectively closed.

(iii) Where cable is used, each cable shall be secured to the cabinet, cutout box, or meter socket enclosure. However, where cable with an entirely nonmetallic sheath enters the top of a surface-mounted enclosure through one or more nonflexible raceways not less than 457 mm (18 in.) or more than 3.05 m (10.0 ft) in length, the cable need not be secured to the cabinet, box, or enclosure provided all of the following conditions are met:

(A) Each cable is fastened within 305 mm (12 in.) of the outer end of the raceway, measured along the sheath;

(B) The raceway extends directly above the enclosure and does not penetrate a structural ceiling;

(C) A fitting is provided on each end of the raceway to protect the cable from abrasion, and the fittings remain accessible after installation;

(D) The raceway is sealed or plugged at the outer end using approved means so as to prevent access to the enclosure through the raceway;

(E) The cable sheath is continuous through the raceway and extends into the enclosure not less than 6.35 mm (0.25 in.) beyond the fitting;

(F) The raceway is fastened at its outer end and at other points as necessary; and

(G) Where installed as conduit or tubing, the allowable cable fill does not exceed that permitted for complete conduit or tubing systems.

(2) Covers and canopies.

(i) All pull boxes, junction boxes, and fittings shall be provided with covers identified for the purpose. If metal covers are used, they shall be grounded. In completed installations, each outlet box shall have a cover, faceplate, or fixture canopy. Covers of outlet boxes having holes through which flexible cord pendants pass shall be provided with bushings designed for the purpose or shall have smooth, well-rounded surfaces on which the cords may bear.

(ii) Where a fixture canopy or pan is used, any combustible wall or ceiling finish exposed between the edge of the canopy or pan and the outlet box shall be covered with noncombustible material.

(3) Pull and junction boxes for systems over 600 volts, nominal. In addition to other requirements in this section, the following requirements apply to pull and junction boxes for systems over 600 volts, nominal:

(i) Boxes shall provide a complete enclosure for the contained conductors or cables.

(ii) Boxes shall be closed by suitable covers securely fastened in place.

Note to paragraph (b)(3)(ii) of this section: Underground box covers that weigh over 45.4 kg (100 lbs) meet this requirement.

(iii) Covers for boxes shall be permanently marked ``HIGH VOLTAGE." The marking shall be on the outside of the box cover and shall be readily visible and legible.

(c) Switches--

(1) Single-throw knife switches. Single-throw knife switches shall be so placed that gravity will not tend to close them. Single-throw knife switches approved for use in the inverted position shall be provided with a locking device that will ensure that the blades remain in the open position when so set.

(2) Double-throw knife switches. Double-throw knife switches may be mounted so that the throw will be either vertical or horizontal. However, if the throw is vertical, a locking device shall be provided to ensure that the blades remain in the open position when so set.

(3) Connection of switches.

(i) Single-throw knife switches and switches with butt contacts shall be connected so that the blades are deenergized when the switch is in the open position.

(ii) Single-throw knife switches, molded-case switches, switches with butt contacts, and circuit breakers used as switches shall be connected so that the terminals supplying the load are deenergized when the switch is in the open position. However, blades and terminals supplying the load of a switch may be energized when the switch is in the open position where the switch is connected to circuits or equipment inherently capable of providing a backfeed source of power. For such installations, a permanent sign shall be installed on the switch enclosure or immediately adjacent to open switches that read, ``WARNING--LOAD SIDE TERMINALS MAY BE ENERGIZED BY BACKFEED."

(4) Faceplates for flush-mounted snap switches. Snap switches mounted in boxes shall have faceplates installed so as to completely cover the opening and seat against the finished surface.

(5) Grounding. Snap switches, including dimmer switches, shall be effectively grounded and shall provide a means to ground metal faceplates, whether or not a metal faceplate is installed. However, if no grounding means exists within the snap-switch enclosure, or where the wiring method does not include or provide an equipment ground, a snap switch without a grounding connection is permitted for replacement purposes only. Such snap switches shall be provided with a faceplate of nonconducting, noncombustible material if they are located within reach of conducting floors or other conducting surfaces.

(d) Switchboards and panelboards--

(1) Switchboards with exposed live parts. Switchboards that have any exposed live parts shall be located in permanently dry locations and shall be accessible only to qualified persons.

(2) Panelboard enclosures. Panelboards shall be mounted in cabinets, cutout boxes, or enclosures designed for the purpose and shall be dead front. However, panelboards other than the dead front externally-operable type are permitted where accessible only to qualified persons.

(3) Knife switches mounted in switchboards or panelboards.

Exposed blades of knife switches mounted in switchboards or panelboards shall be dead when open.

(e) Enclosures for damp or wet locations--

(1) Cabinets, cutout boxes, fittings, boxes, and panelboard enclosures. Cabinets, cutout boxes, fittings, boxes, and panelboard enclosures in damp or wet locations shall be installed so as to prevent moisture or water from entering and accumulating within the enclosures and shall be mounted so there is at least 6.35-mm (0.25-in.) airspace between the enclosure and the wall or other supporting surface. However, nonmetallic enclosures may be installed without the airspace on a concrete, masonry, tile, or similar surface. The enclosures shall be weatherproof in wet locations.

(2) Switches, circuit breakers, and switchboards. Switches, circuit breakers, and switchboards installed in wet locations shall be enclosed in weatherproof enclosures.

(f) Conductors for general wiring--

(1) Insulation. All conductors used for general wiring shall be insulated unless otherwise permitted in this subpart.

(2) Type. The conductor insulation shall be of a type that is approved for the voltage, operating temperature, and location of use.

(3) Distinguishable. Insulated conductors shall be distinguishable by appropriate color or other suitable means as being grounded conductors, ungrounded conductors, or equipment grounding conductors.

(g) Flexible cords and cables--

(1)Use of flexible cords and cables.

(i) Flexible cords and cables shall be approved for conditions of use and location.

(ii) Flexible cords and cables may be used only for:

(A) Pendants;

(B) Wiring of fixtures;

(C) Connection of portable lamps or appliances;

(D) Portable and mobile signs;

(E) Elevator cables;

(F) Wiring of cranes and hoists;

(G) Connection of stationary equipment to facilitate their frequent interchange;

(H) Prevention of the transmission of noise or vibration;

(I) Appliances where the fastening means and mechanical connections are designed to permit removal for maintenance and repair;

(J) Data processing cables approved as a part of the data processing system;

(K) Connection of moving parts; and

(L) Temporary wiring as permitted in paragraph (a)(2) of this section.

(iii) If used as permitted in paragraphs (g)(1)(ii)(C), (g)(1)(ii)(G), or (g)(1)(ii)(I) of this section, the flexible cord shall be equipped with an attachment plug and shall be energized from an approved receptacle outlet.

(iv) Unless specifically permitted otherwise in paragraph (g)(1)(ii) of this section, flexible cords and cables may not be used:

(A) As a substitute for the fixed wiring of a structure;

(B) Where run through holes in walls, ceilings, or floors;

(C) Where run through doorways, windows, or similar openings;

(D) Where attached to building surfaces;

(E) Where concealed behind building walls, ceilings, or floors; or

(F) Where installed in raceways, except as otherwise permitted in this subpart.

(v) Flexible cords used in show windows and showcases shall be Type S, SE, SEO, SEOO, SJ, SJE, SJEO, SJEOO, SJO, SJOO, SJT, SJTO, SJTOO, SO, SOO, ST, STO, or STOO, except for the wiring of chain-supported lighting fixtures and supply cords for portable lamps and other merchandise being displayed or exhibited.

(2) Identification, splices, and terminations.

(i) A conductor of a flexible cord or cable that is used as a grounded conductor or an equipment grounding conductor shall be distinguishable from other conductors. Types S, SC, SCE, SCT, SE, SEO, SEOO, SJ, SJE, SJEO, SJEOO, SJO, SJT, SJTO, SJTOO, SO, SOO, ST, STO, and STOO flexible cords and Types G, G-GC, PPE, and W flexible cables shall be durably marked on the surface at intervals not exceeding 610 mm (24 in.) with the type designation, size, and number of conductors.

(ii) Flexible cords may be used only in continuous lengths without splice or tap. Hard-service cord and junior hard-service cord No. 14 and larger may be repaired if spliced so that the splice retains the insulation, outer sheath properties, and usage characteristics of the cord being spliced.

(iii) Flexible cords and cables shall be connected to devices and fittings so that strain relief is provided that will prevent pull from being directly transmitted to joints or terminal screws.

(h) Portable cables over 600 volts, nominal.

This paragraph applies to portable cables used at more than 600 volts, nominal.

(1) Conductor construction. Multiconductor portable cable for use in supplying power to portable or mobile equipment at over 600 volts, nominal, shall consist of No. 8 or larger conductors employing flexible stranding. However, the minimum size of the insulated ground-check conductor of Type G-GC cables shall be No. 10.

(2) Shielding. Cables operated at over 2,000 volts shall be shielded for the purpose of confining the voltage stresses to the insulation.

(3) Equipment grounding conductors. Grounding conductors shall be provided.

(4) Grounding shields. All shields shall be grounded.

(5) Minimum bending radii. The minimum bending radii for portable cables during installation and handling in service shall be adequate to prevent damage to the cable.

(6) Fittings. Connectors used to connect lengths of cable in a run shall be of a type that lock firmly together. Provisions shall be made to prevent opening or closing these connectors while energized. Strain relief shall be provided at connections and terminations.

(7) Splices. Portable cables may not be operated with splices unless the splices are of the permanent molded, vulcanized, or other approved type.

(8) Terminations. Termination enclosures shall be suitably marked with a high voltage hazard warning, and terminations shall be accessible only to authorized and qualified employees.

(i) Fixture wires--

(1) General. Fixture wires shall be approved for the voltage, temperature, and location of use. A fixture wire which is used as a grounded conductor shall be identified.

(2) Uses permitted. Fixture wires may be used only:

(i) For installation in lighting fixtures and in similar equipment where enclosed or protected and not subject to bending or twisting in use; or

(ii) For connecting lighting fixtures to the branch-circuit conductors supplying the fixtures.

(3) Uses not permitted. Fixture wires may not be used as branch-circuit conductors except as permitted for Class 1 power limited circuits and for fire alarm circuits.

(j) Equipment for general use--

(1) Lighting fixtures, lampholders, lamps, and receptacles.

(i) Fixtures, lampholders, lamps, rosettes, and receptacles may have no live parts normally exposed to employee contact. However, rosettes and cleat-type lampholders and receptacles located at least 2.44 m (8.0 ft) above the floor may have exposed terminals.

(ii) Handlamps of the portable type supplied through flexible cords shall be equipped with a handle of molded composition or other material identified for the purpose, and a substantial guard shall be attached to the lampholder or the handle. Metal shell, paper-lined lampholders may not be used.

(iii) Lampholders of the screw-shell type shall be installed for use as lampholders only. Where supplied by a circuit having a grounded conductor, the grounded conductor shall be connected to the screw shell. Lampholders installed in wet or damp locations shall be of the weatherproof type.

(iv) Fixtures installed in wet or damp locations shall be identified for the purpose and shall be so constructed or installed that water cannot enter or accumulate in wireways, lampholders, or other electrical parts.

(2) Receptacles, cord connectors, and attachment plugs (caps).

(i) All 15- and 20-ampere attachment plugs and connectors shall be constructed so that there are no exposed current-carrying parts except the prongs, blades, or pins. The cover for wire terminations shall be a part that is essential for the operation of an attachment plug or connector (dead-front construction). Attachment plugs shall be installed so that their prongs, blades, or pins are not energized unless inserted into an energized receptacle. No receptacles may be installed so as to require an energized attachment plug as its source of supply.

(ii) Receptacles, cord connectors, and attachment plugs shall be constructed so that no receptacle or cord connector will accept an attachment plug with a different voltage or current rating than that for which the device is intended. However, a 20-ampere T-slot receptacle or cord connector may accept a 15-ampere attachment plug of the same voltage rating.

(iii) Nongrounding-type receptacles and connectors may not be used for grounding-type attachment plugs.

(iv) A receptacle installed in a wet or damp location shall be suitable for the location.

(v) A receptacle installed outdoors in a location protected from the weather or in other damp locations shall have an enclosure for the receptacle that is weatherproof when the receptacle is covered (attachment plug cap not inserted and receptacle covers closed).

Note to paragraph (j)(2)(v) of this section. A receptacle is considered to be in a location protected from the weather when it is located under roofed open porches, canopies, marquees, or the like and where it will not be subjected to a beating rain or water runoff.

(vi) A receptacle installed in a wet location where the product intended to be plugged into it is not attended while in use (for example, sprinkler system controllers, landscape lighting, and holiday lights) shall have an enclosure that is weatherproof with the attachment plug cap inserted or removed.

(vii) A receptacle installed in a wet location where the product intended to be plugged into it will be attended while in use (for example, portable tools) shall have an enclosure that is weatherproof when the attachment plug cap is removed.

(3) Appliances.

(i) Appliances may have no live parts normally exposed to contact other than parts functioning as open-resistance heating elements, such as the heating elements of a toaster, which are necessarily exposed.

(ii) Each appliance shall have a means to disconnect it from all ungrounded conductors. If an appliance is supplied by more than one source, the disconnecting means shall be grouped and identified.

(iii) Each electric appliance shall be provided with a nameplate giving the identifying name and the rating in volts and amperes, or in volts and watts. If the appliance is to be used on a specific frequency or frequencies, it shall be so marked. Where motor overload protection external to the appliance is required, the appliance shall be so marked.

(iv) Marking shall be located so as to be visible or easily accessible after installation.

(4) Motors. This paragraph applies to motors, motor circuits, and controllers.

(i) If specified in paragraph (j)(4) of this section that one piece of equipment shall be ``within sight of'' another piece of equipment, the piece of equipment shall be visible and not more than 15.24 m (50.0 ft) from the other.

(ii) An individual disconnecting means shall be provided for each controller. A disconnecting means shall be located within sight of the controller location. However, a single disconnecting means may be located adjacent to a group of coordinated controllers mounted adjacent to each other on a multi-motor continuous process machine. The controller disconnecting means for motor branch circuits over 600 volts, nominal, may be out of sight of the controller, if the controller is marked with a warning label giving the location and identification of the disconnecting means that is to be locked in the open position.

(iii) The disconnecting means shall disconnect the motor and the controller from all ungrounded supply conductors and shall be so designed that no pole can be operated independently.

(iv) The disconnecting means shall plainly indicate whether it is in the open (off) or closed (on) position.

(v) The disconnecting means shall be readily accessible. If more than one disconnect is provided for the same equipment, only one need be readily accessible.

(vi) An individual disconnecting means shall be provided for each motor, but a single disconnecting means may be used for a group of motors under any one of the following conditions:

(A) If a number of motors drive several parts of a single machine or piece of apparatus, such as a metal or woodworking machine, crane, or hoist;

(B) If a group of motors is under the protection of one set of branch-circuit protective devices; or

(C) If a group of motors is in a single room within sight of the location of the disconnecting means.

(vii) Motors, motor-control apparatus, and motor branch-circuit conductors shall be protected against overheating due to motor overloads or failure to start, and against short-circuits or ground faults. These provisions do not require overload protection that will stop a motor where a shutdown is likely to introduce additional or increased hazards, as in the case of fire pumps, or where continued operation of a motor is necessary for a safe shutdown of equipment or process and motor overload sensing devices are connected to a supervised alarm.

(viii) Where live parts of motors or controllers operating at over 150 volts to ground are guarded against accidental contact only by location, and where adjustment or other attendance may be necessary during the operation of the apparatus, suitable insulating mats or platforms shall be provided so that the attendant cannot readily touch live parts unless standing on the mats or platforms.

(5) Transformers.

(i) Paragraph (j)(5) of this section covers the installation of all transformers except the following:

(A) Current transformers;

(B) Dry-type transformers installed as a component part of other apparatus;

(C) Transformers that are an integral part of an X-ray, high frequency, or electrostatic-coating apparatus;

(D) Transformers used with Class 2 and Class 3 circuits, sign and outline lighting, electric discharge lighting, and power-limited fire-alarm circuits; and

(E) Liquid-filled or dry-type transformers used for research, development, or testing, where effective safeguard arrangements are provided.

(ii) The operating voltage of exposed live parts of transformer installations shall be indicated by signs or visible markings on the equipment or structure.

(iii) Dry-type, high fire point liquid-insulated, and askarel-insulated transformers installed indoors and rated over 35kV shall be in a vault.

(iv) Oil-insulated transformers installed indoors shall be installed in a vault.

(v) Combustible material, combustible buildings and parts of buildings, fire escapes, and door and window openings shall be safeguarded from fires that may originate in oil-insulated transformers attached to or adjacent to a building or combustible material.

(vi) Transformer vaults shall be constructed so as to contain fire and combustible liquids within the vault and to prevent unauthorized access. Locks and latches shall be so arranged that a vault door can be readily opened from the inside.

(vii) Any pipe or duct system foreign to the electrical installation may not enter or pass through a transformer vault.

Note to paragraph (j)(5)(vii) of this section. Piping or other facilities provided for vault fire protection, or for transformer cooling, are not considered foreign to the electrical installation.

(viii) Material may not be stored in transformer vaults.

(6) Capacitors.

(i) All capacitors, except surge capacitors or capacitors included as a component part of other apparatus, shall be provided with an automatic means of draining the stored charge after the capacitor is disconnected from its source of supply.

(ii) The following requirements apply to capacitors installed on circuits operating at more than 600 volts, nominal:

(A) Group-operated switches shall be used for capacitor switching and shall be capable of the following:

(1) Carrying continuously not less than 135 percent of the rated current of the capacitor installation;

(2) Interrupting the maximum continuous load current of each capacitor, capacitor bank, or capacitor installation that will be switched as a unit;

(3) Withstanding the maximum inrush current, including contributions from adjacent capacitor installations; and

(4) Carrying currents due to faults on the capacitor side of the switch;

(B) A means shall be installed to isolate from all sources of voltage each capacitor, capacitor bank, or capacitor installation that will be removed from service as a unit. The isolating means shall provide a visible gap in the electric circuit adequate for the operating voltage;

(C) Isolating or disconnecting switches (with no interrupting rating) shall be interlocked with the load interrupting device or shall be provided with prominently displayed caution signs to prevent switching load current; and

(D) For series capacitors, the proper switching shall be assured by use of at least one of the following:

(1) Mechanically sequenced isolating and bypass switches;

(2) Interlocks; or

(3) Switching procedure prominently displayed at the switching location.

(7) Storage Batteries. Provisions shall be made for sufficient diffusion and ventilation of gases from storage batteries to prevent the accumulation of explosive mixtures.

§ 1910.306 Specific purpose equipment and installations.

(a) Electric signs and outline lighting--

(1) Disconnecting means.

(i) Each sign and outline lighting system, or feeder circuit or branch circuit supplying a sign or outline lighting system, shall be controlled by an externally operable switch or circuit breaker that will open all ungrounded conductors. However, a disconnecting means is not required for an exit directional sign located within a building or for cord-connected signs with an attachment plug.

(ii) Signs and outline lighting systems located within fountains shall have the disconnect located at least 1.52 m (5.0 ft) from the inside walls of the fountain.

(2) Location.

(i) The disconnecting means shall be within sight of the sign or outline lighting system that it controls. Where the disconnecting means is out of the line of sight from any section that may be energized, the disconnecting means shall be capable of being locked in the open position.

(ii) Signs or outline lighting systems operated by electronic or electromechanical controllers located external to the sign or outline lighting system may have a disconnecting means located within sight of the controller or in the same enclosure with the controller. The disconnecting means shall disconnect the sign or outline lighting system and the controller from all ungrounded supply conductors. It shall be designed so no pole can be operated independently and shall be capable of being locked in the open position.

(iii) Doors or covers giving access to uninsulated parts of indoor signs or outline lighting exceeding 600 volts and accessible to other than qualified persons shall either be provided with interlock switches to disconnect the primary circuit or shall be so fastened that the use of other than ordinary tools will be necessary to open them.

(b) Cranes and hoists.

This paragraph applies to the installation of electric equipment and wiring used in connection with cranes, monorail hoists, hoists, and all runways.

(1) Disconnecting means for runway conductors. A disconnecting means shall be provided between the runway contact conductors and the power supply. Such disconnecting means shall consist of a motor-circuit switch, circuit breaker, or molded case switch. The disconnecting means shall open all ungrounded conductors simultaneously and shall be:

(i) Readily accessible and operable from the ground or floor level;

(ii) Arranged to be locked in the open position; and

(iii) Placed within view of the runway contact conductors.

(2) Disconnecting means for cranes and monorail hoists.

(i) Except as provided in paragraph (b)(2)(iv) of this section, a motor-circuit switch, molded case switch, or circuit breaker shall be provided in the leads from the runway contact conductors or other power supply on all cranes and monorail hoists.

(ii) The disconnecting means shall be capable of being locked in the open position.

(iii) Means shall be provided at the operating station to open the power circuit to all motors of the crane or monorail hoist where the disconnecting means is not readily accessible from the crane or monorail hoist operating station.

(iv) The disconnecting means may be omitted where a monorail hoist or hand-propelled crane bridge installation meets all of the following conditions:

(A) The unit is controlled from the ground or floor level;

(B) The unit is within view of the power supply disconnecting means; and

(C) No fixed work platform has been provided for servicing the unit.

(3) Limit switch. A limit switch or other device shall be provided to prevent the load block from passing the safe upper limit of travel of any hoisting mechanism.

(4) Clearance. The dimension of the working space in the direction of access to live parts that may require examination, adjustment, servicing, or maintenance while alive shall be a minimum of 762 mm (2.5 ft). Where controls are enclosed in cabinets, the doors shall either open at least 90 degrees or be removable.

(c) Elevators, dumbwaiters, escalators, moving walks, wheelchair lifts, and stairway chair lifts.

The following requirements apply to elevators, dumbwaiters, escalators, moving walks, wheelchair lifts, and stairway chair lifts.

(1) Disconnecting means. Elevators, dumbwaiters, escalators, moving walks, wheelchair lifts, and stairway chair lifts shall have a single means for disconnecting all ungrounded main power supply conductors for each unit.

(2) Control panels. Control panels not located in the same space as the drive machine shall be located in cabinets with doors or panels capable of being locked closed.

(3) Type. The disconnecting means shall be an enclosed externally operable fused motor circuit switch or circuit breaker capable of being locked in the open position. The disconnecting means shall be a listed device.

(4) Operation. No provision may be made to open or close this disconnecting means from any other part of the premises. If sprinklers are installed in hoistways, machine rooms, or machinery spaces, the disconnecting means may automatically open the power supply to the affected elevators prior to the application of water. No provision may be made to close this disconnecting means automatically (that is, power may only be restored by manual means).

(5) Location. The disconnecting means shall be located where it is readily accessible to qualified persons.

(i) On elevators without generator field control, the disconnecting means shall be located within sight of the motor controller. Driving machines or motion and operation controllers not within sight of the disconnecting means shall be provided with a manually operated switch installed in the control circuit adjacent to the equipment in order to prevent starting. Where the driving machine is located in a remote machinery space, a single disconnecting means for disconnecting all ungrounded main power supply conductors shall be provided and be capable of being locked in the open position.

(ii) On elevators with generator field control, the disconnecting means shall be located within sight of the motor controller for the driving motor of the motor-generator set. Driving machines, motor-generator sets, or motion and operation controllers not within sight of the disconnecting means shall be provided with a manually operated switch installed in the control circuit to prevent starting. The manually operated switch shall be installed adjacent to this equipment. Where the driving machine or the motor-generator set is located in a remote machinery space, a single means for disconnecting all ungrounded main power supply conductors shall be provided and be capable of being locked in the open position.

(iii) On escalators and moving walks, the disconnecting means shall be installed in the space where the controller is located.

(iv) On wheelchair lifts and stairway chair lifts, the disconnecting means shall be located within sight of the motor controller.

(6) Identification and signs.

(i) Where there is more than one driving machine in a machine room, the disconnecting means shall be numbered to correspond to the identifying number of the driving machine that they control.

(ii) The disconnecting means shall be provided with a sign to identify the location of the supply-side overcurrent protective device.

(7) Single-car and multicar installations. On single-car and multicar installations, equipment receiving electrical power from more than one source shall be provided with a disconnecting means for each source of electrical power. The disconnecting means shall be within sight of the equipment served.

(8) Warning sign for multiple disconnecting means. A warning sign shall be mounted on or next to the disconnecting means where multiple disconnecting means are used and parts of the controllers remain energized from a source other than the one disconnected. The sign shall be clearly legible and shall read “WARNING--PARTS OF THE CONTROLLER ARE NOT DEENERGIZED BY THIS SWITCH.”

(9) Interconnection between multicar controllers. A warning sign worded as required in paragraph (c)(8) of this section shall be mounted on or next to the disconnecting means where interconnections between controllers are necessary for the operation of the system on multicar installations that remain energized from a source other than the one disconnected.

(10) Motor controllers. Motor controllers may be located outside the spaces otherwise required by paragraph (c) of this section, provided they are in enclosures with doors or removable panels capable of being locked closed and the disconnecting means is located adjacent to or is an integral part of the motor controller. Motor controller enclosures for escalators or moving walks may be located in the balustrade on the side located away from the moving steps or moving treadway. If the disconnecting means is an integral part of the motor controller, it shall be operable without opening the enclosure.

(d) Electric welders--disconnecting means--

(1) Arc welders. A disconnecting means shall be provided in the supply circuit for each arc welder that is not equipped with a disconnect mounted as an integral part of the welder. The disconnecting means shall be a switch or circuit breaker, and its rating may not be less than that necessary to accommodate overcurrent protection.

(2) Resistance welders. A switch or circuit breaker shall be provided by which each resistance welder and its control equipment can be disconnected from the supply circuit. The ampere rating of this disconnecting means may not be less than the supply conductor ampacity. The supply circuit switch may be used as the welder disconnecting means where the circuit supplies only one welder.

(e) Information technology equipment--

(1) Disconnecting means.

A means shall be provided to disconnect power to all electronic equipment in an information technology equipment room. There shall also be a similar means to disconnect the power to all dedicated heating, ventilating, and air-conditioning (HVAC) systems serving the room and to cause all required fire/smoke dampers to close.

(2) Grouping. The control for these disconnecting means shall be grouped and identified and shall be readily accessible at the principal exit doors. A single means to control both the electronic equipment and HVAC system is permitted.

(3) Exception. Integrated electrical systems covered by § 1910.308(g) need not have the disconnecting means required by paragraph (e)(1) of this section.

(f) X-Ray equipment.

This paragraph applies to X-ray equipment.

(1) Disconnecting means.

(i) A disconnecting means shall be provided in the supply circuit. The disconnecting means shall be operable from a location readily accessible from the X-ray control. For equipment connected to a 120-volt branch circuit of 30 amperes or less, a grounding-type attachment plug cap and receptacle of proper rating may serve as a disconnecting means.

(ii) If more than one piece of equipment is operated from the same high-voltage circuit, each piece or each group of equipment as a unit shall be provided with a high-voltage switch or equivalent disconnecting means. The disconnecting means shall be constructed, enclosed, or located so as to avoid contact by employees with its live parts.

(2) Control. The following requirements apply to industrial and commercial laboratory equipment.

(i) Radiographic and fluoroscopic-type equipment shall be effectively enclosed or shall have interlocks that deenergize the equipment automatically to prevent ready access to live current-carrying parts.

(ii) Diffraction- and irradiation-type equipment shall have a pilot light, readable meter deflection, or equivalent means to indicate when the equipment is energized, unless the equipment or installation is effectively enclosed or is provided with interlocks to prevent access to live current-carrying parts during operation.

(g) Induction and dielectric heating equipment.

This paragraph applies to induction and dielectric heating equipment and accessories for industrial and scientific applications, but not for medical or dental applications or for appliances.

(1) Guarding and grounding.

(i) The converting apparatus (including the dc line) and high-frequency electric circuits (excluding the output circuits and remote-control circuits) shall be completely contained within enclosures of noncombustible material.

(ii) All panel controls shall be of dead-front construction.

(iii) Doors or detachable panels shall be employed for internal access. Where doors are used giving access to voltages from 500 to 1000 volts ac or dc, either door locks shall be provided or interlocks shall be installed. Where doors are used giving access to voltages of over 1000 volts ac or dc, either mechanical lockouts with a disconnecting means to prevent access until circuit parts within the cubicle are deenergized, or both door interlocking and mechanical door locks, shall be provided. Detachable panels not normally used for access to such parts shall be fastened in a manner that will make them difficult to remove (for example, by requiring the use of tools).

(iv) Warning labels or signs that read ``DANGER--HIGH VOLTAGE--KEEP OUT'' shall be attached to the equipment and shall be plainly visible where persons might contact energized parts when doors are opened or closed or when panels are removed from compartments containing over 250 volts ac or dc.

(v) Induction and dielectric heating equipment shall be protected as follows:

(A) Protective cages or adequate shielding shall be used to guard work applicators other than induction heating coils.

(B) Induction heating coils shall be protected by insulation or refractory materials or both.

(C) Interlock switches shall be used on all hinged access doors, sliding panels, or other such means of access to the applicator, unless the applicator is an induction heating coil at dc ground potential or operating at less than 150 volts ac.

(D) Interlock switches shall be connected in such a manner as to remove all power from the applicator when any one of the access doors or panels is open.

(vi) A readily accessible disconnecting means shall be provided by which each heating equipment can be isolated from its supply circuit. The ampere rating of this disconnecting means may not be less than the nameplate current rating of the equipment. The supply circuit disconnecting means is permitted as a heating equipment disconnecting means where the circuit supplies only one piece of equipment.

(2) Remote control.

(i) If remote controls are used for applying power, a selector switch shall be provided and interlocked to provide power from only one control point at a time.

(ii) Switches operated by foot pressure shall be provided with a shield over the contact button to avoid accidental closing of the switch.

(h) Electrolytic cells.

This paragraph applies to the installation of the electrical components and accessory equipment of electrolytic cells, electrolytic cell lines, and process power supply for the production of aluminum, cadmium, chlorine, copper, fluorine, hydrogen peroxide, magnesium, sodium, sodium chlorate, and zinc. Cells used as a source of electric energy and for electroplating processes and cells used for production of hydrogen are not covered by this paragraph.

(1) Application. Installations covered by paragraph (h) of this section shall comply with all applicable provisions of this subpart, except as follows:

(i) Overcurrent protection of electrolytic cell dc process power circuits need not comply with the requirements of § 1910.304(f);

(ii) Equipment located or used within the cell line working zone or associated with the cell line dc power circuits need not comply with the provisions of § 1910.304(g); and

(iii) Electrolytic cells, cell line conductors, cell line attachments, and the wiring of auxiliary equipment and devices within the cell line working zone need not comply with the provisions of § 1910.303 or § 1910.304(b) and (c).

(2) Disconnecting means. If more than one dc cell line process power supply serves the same cell line, a disconnecting means shall be provided on the cell line circuit side of each power supply to disconnect it from the cell line circuit. Removable links or removable conductors may be used as the disconnecting means.

(3) Portable electric equipment.

(i) The frames and enclosures of portable electric equipment used within the cell line working zone may not be grounded, unless the cell line circuit voltage does not exceed 200 volts DC or the frames are guarded.

(ii) Ungrounded portable electric equipment shall be distinctively marked and shall employ plugs and receptacles of a configuration that prevents connection of this equipment to grounding receptacles and that prevents inadvertent interchange of ungrounded and grounded portable electric equipment.

(4) Power supply circuits and receptacles for portable electric equipment.

(i) Circuits supplying power to ungrounded receptacles for hand-held, cord- and plug-connected equipment shall meet the following requirements:

(A) The circuits shall be electrically isolated from any distribution system supplying areas other than the cell line working zone and shall be ungrounded;

(B) The circuits shall be supplied through isolating transformers with primaries operating at not more than 600 volts between conductors and protected with proper overcurrent protection;

(C) The secondary voltage of the isolating transformers may not exceed 300 volts between conductors; and

(D) All circuits supplied from the secondaries shall be ungrounded and shall have an approved overcurrent device of proper rating in each conductor.

(ii) Receptacles and their mating plugs for ungrounded equipment may not have provision for a grounding conductor and shall be of a configuration that prevents their use for equipment required to be grounded.

(iii) Receptacles on circuits supplied by an isolating transformer with an ungrounded secondary:

(A) Shall have a distinctive configuration;

(B) Shall be distinctively marked; and

(C) May not be used in any other location in the facility.

(5) Fixed and portable electric equipment.

(i) The following need not be grounded:

(A) AC systems supplying fixed and portable electric equipment within the cell line working zone; and

(B) Exposed conductive surfaces, such as electric equipment housings, cabinets, boxes, motors, raceways and the like that are within the cell line working zone.

(ii) Auxiliary electric equipment, such as motors, transducers, sensors, control devices, and alarms, mounted on an electrolytic cell or other energized surface shall be connected to the premises wiring systems by any of the following means:

(A) Multiconductor hard usage or extra hard usage flexible cord;

(B) Wire or cable in suitable nonmetallic raceways or cable trays; or

(C) Wire or cable in suitable metal raceways or metal cable trays installed with insulating breaks such that they will not cause a potentially hazardous electrical condition.

(iii) Fixed electric equipment may be bonded to the energized conductive surfaces of the cell line, its attachments, or auxiliaries. If fixed electric equipment is mounted on an energized conductive surface, it shall be bonded to that surface.

(6) Auxiliary nonelectrical connections. Auxiliary nonelectrical connections such as air hoses, water hoses, and the like, to an electrolytic cell, its attachments, or auxiliary equipment may not have continuous conductive reinforcing wire, armor, braids, or the like. Hoses shall be of a nonconductive material.

(7) Cranes and hoists.

(i) The conductive surfaces of cranes and hoists that enter the cell line working zone need not be grounded. The portion of an overhead crane or hoist that contacts an energized electrolytic cell or energized attachments shall be insulated from ground.

(ii) Remote crane or hoist controls that may introduce hazardous electrical conditions into the cell line working zone shall employ one or more of the following systems:

(A) Isolated and ungrounded control circuit;

(B) Nonconductive rope operator;

(C) Pendant pushbutton with nonconductive supporting means and with nonconductive surfaces or ungrounded exposed conductive surfaces; or

(D) Radio.

(i) Electrically driven or controlled irrigation machines--(1) Lightning protection. If an irrigation machine has a stationary point, a grounding electrode system shall be connected to the machine at the stationary point for lightning protection.

(2) Disconnecting means.

(i) The main disconnecting means for a center pivot irrigation machine shall be located at the point of connection of electrical power to the machine or shall be visible and not more than 15.2 m (50 ft) from the machine.

(ii) The disconnecting means shall be readily accessible and capable of being locked in the open position.

(iii) A disconnecting means shall be provided for each motor and controller.

(j) Swimming pools, fountains, and similar installations.

This paragraph applies to electric wiring for and equipment in or adjacent to all swimming, wading, therapeutic, and decorative pools and fountains; hydro-massage bathtubs, whether permanently installed or storable; and metallic auxiliary equipment, such as pumps, filters, and similar equipment. Therapeutic pools in health care facilities are exempt from these provisions.

(1) Receptacles.

(i) A single receptacle of the locking and grounding type that provides power for a permanently installed swimming pool recirculating pump motor may be located not less than 1.52 m (5 ft) from the inside walls of a pool. All other receptacles on the property shall be located at least 3.05 m (10 ft) from the inside walls of a pool.

(ii) Receptacles that are located within 4.57 m (15 ft), or 6.08 m (20 ft) if the installation was built after August 13, 2007, of the inside walls of the pool shall be protected by ground-fault circuit interrupters.

(iii) Where a pool is installed permanently at a dwelling unit, at least one 125-volt, 15- or 20-ampere receptacle on a general-purpose branch circuit shall be located a minimum of 3.05 m (10 ft) and not more than 6.08 m (20 ft) from the inside wall of the pool. This receptacle shall be located not more than 1.98 m (6.5 ft) above the floor, platform, or grade level serving the pool.

Note to paragraph (j)(1) of this section: In determining these dimensions, the distance to be measured is the shortest path the supply cord of an appliance connected to the receptacle would follow without piercing a floor, wall, or ceiling of a building or other effective permanent barrier.

(2) Lighting fixtures, lighting outlets, and ceiling suspended (paddle) fans.

(i) In outdoor pool areas, lighting fixtures, lighting outlets, and ceiling-suspended (paddle) fans may not be installed over the pool or over the area extending 1.52 m (5 ft) horizontally from the inside walls of a pool unless no part of the lighting fixture of a ceiling-suspended (paddle) fan is less than 3.66 m (12 ft) above the maximum water level. However, a lighting fixture or lighting outlet that was installed before April 16, 1981, may be located less than 1.52 m (5 ft) measured horizontally from the inside walls of a pool if it is at least 1.52 m (5 ft) above the surface of the maximum water level and is rigidly attached to the existing structure. It shall also be protected by a ground-fault circuit interrupter installed in the branch circuit supplying the fixture.

(ii) Lighting fixtures and lighting outlets installed in the area extending between 1.52 m (5 ft) and 3.05 m (10 ft) horizontally from the inside walls of a pool shall be protected by a ground-fault circuit interrupter unless installed 1.52 m (5 ft) above the maximum water level and rigidly attached to the structure adjacent to or enclosing the pool.

(3) Cord- and plug-connected equipment. Flexible cords used with the following equipment may not exceed 0.9 m (3 ft) in length and shall have a copper equipment grounding conductor with a grounding-type attachment plug:

(i) Cord- and plug-connected lighting fixtures installed within 4.88 m (16 ft) of the water surface of permanently installed pools; and

(ii) Other cord- and plug-connected, fixed or stationary equipment used with permanently installed pools.

(4) Underwater equipment.

(i) A ground-fault circuit interrupter shall be installed in the branch circuit supplying underwater fixtures operating at more than 15 volts. Equipment installed underwater shall be identified for the purpose.

(ii) No underwater lighting fixtures may be installed for operation at over 150 volts between conductors.

(iii) A lighting fixture facing upward shall have the lens adequately guarded to prevent contact by any person.

(5) Fountains.

All electric equipment, including power supply cords, operating at more than 15 volts and used with fountains shall be protected by ground-fault circuit interrupters.

(k) Carnivals, circuses, fairs, and similar events.

This paragraph covers the installation of portable wiring and equipment, including wiring in or on all structures, for carnivals, circuses, exhibitions, fairs, traveling attractions, and similar events.

(1) Protection of electric equipment. Electric equipment and wiring methods in or on rides, concessions, or other units shall be provided with mechanical protection where such equipment or wiring methods are subject to physical damage.

(2) Installation.

(i) Services shall be installed in accordance with applicable requirements of this subpart, and, in addition, shall comply with the following:

(A) Service equipment may not be installed in a location that is accessible to unqualified persons, unless the equipment is lockable; and

(B) Service equipment shall be mounted on solid backing and installed so as to be protected from the weather, unless the equipment is of weatherproof construction.

(ii) Amusement rides and amusement attractions shall be maintained not less than 4.57 m (15 ft) in any direction from overhead conductors operating at 600 volts or less, except for the conductors supplying the amusement ride or attraction. Amusement rides or attractions may not be located under or within 4.57 m (15 ft) horizontally of conductors operating in excess of 600 volts.

(iii) Flexible cords and cables shall be listed for extra-hard usage. When used outdoors, flexible cords and cables shall also be listed for wet locations and shall be sunlight resistant.

(iv) Single conductor cable shall be size No. 2 or larger.

(v) Open conductors are prohibited except as part of a listed assembly or festoon lighting installed in accordance with § 1910.304(c).

(vi) Flexible cords and cables shall be continuous without splice or tap between boxes or fittings. Cord connectors may not be laid on the ground unless listed for wet locations. Connectors and cable connections may not be placed in audience traffic paths or within areas accessible to the public unless guarded.

(vii) Wiring for an amusement ride, attraction, tent, or similar structure may not be supported by another ride or structure unless specifically identified for the purpose.

(viii) Flexible cords and cables run on the ground, where accessible to the public, shall be covered with approved nonconductive mats. Cables and mats shall be arranged so as not to present a tripping hazard.

(ix) A box or fitting shall be installed at each connection point, outlet, switch point, or junction point.

(3) Inside tents and concessions. Electrical wiring for temporary lighting, where installed inside of tents and concessions, shall be securely installed, and, where subject to physical damage, shall be provided with mechanical protection. All temporary lamps for general illumination shall be protected from accidental breakage by a suitable fixture or lampholder with a guard.

(4) Portable distribution and termination boxes. Employers may only use portable distribution and termination boxes that meet the following requirements:

(i) Boxes shall be designed so that no live parts are exposed to accidental contact. Where installed outdoors, the box shall be of weatherproof construction and mounted so that the bottom of the enclosure is not less than 152 mm (6 in.) above the ground;

(ii) Busbars shall have an ampere rating not less than the overcurrent device supplying the feeder supplying the box. Busbar connectors shall be provided where conductors terminate directly on busbars;

(iii) Receptacles shall have overcurrent protection installed within the box. The overcurrent protection may not exceed the ampere rating of the receptacle, except as permitted in § 1910.305(j)(4) for motor loads;

(iv) Where single-pole connectors are used, they shall comply with the following:

(A) Where ac single-pole portable cable connectors are used, they shall be listed and of the locking type. Where paralleled sets of current-carrying single-pole separable connectors are provided as input devices, they shall be prominently labeled with a warning indicating the presence of internal parallel connections. The use of single-pole separable connectors shall comply with at least one of the following conditions:

(1) Connection and disconnection of connectors are only possible where the supply connectors are interlocked to the source and it is not possible to connect or disconnect connectors when the supply is energized; or

(2) Line connectors are of the listed sequential-interlocking type so that load connectors are connected in the following sequence:

(i) Equipment grounding conductor connection;

(ii) Grounded circuit-conductor connection, if provided; and

(iii) Ungrounded conductor connection; and so that disconnection is in the reverse order; or

(3) A caution notice is provided adjacent to the line connectors indicating that plug connection must be in the following sequence:

(i) Equipment grounding conductor connection;

(ii) Grounded circuit-conductor connection, if provided; and

(iii) Ungrounded conductor connection; and indicating that disconnection is in the reverse order; and

(B) Single-pole separable connectors used in portable professional motion picture and television equipment may be interchangeable for ac or dc use or for different current ratings on the same premises only if they are listed for ac/dc use and marked to identify the system to which they are connected;

(v) Overcurrent protection of equipment and conductors shall be provided; and

(vi) The following equipment connected to the same source shall be bonded:

(A) Metal raceways and metal sheathed cable;

(B) Metal enclosures of electrical equipment; and

(C) Metal frames and metal parts of rides, concessions, trailers, trucks, or other equipment that contain or support electrical equipment.

(5) Disconnecting means.

(i) Each ride and concession shall be provided with a fused disconnect switch or circuit breaker located within sight and within 1.83 m (6 ft) of the operator's station.

(ii) The disconnecting means shall be readily accessible to the operator, including when the ride is in operation.

(iii) Where accessible to unqualified persons, the enclosure for the switch or circuit breaker shall be of the lockable type.

(iv) A shunt trip device that opens the fused disconnect or circuit breaker when a switch located in the ride operator's console is closed is a permissible method of opening the circuit.

§ 1910.307 Hazardous (classified) locations.

(a) Scope--

1) Applicability. This section covers the requirements for electric equipment and wiring in locations that are classified depending on the properties of the flammable vapors, liquids or gases, or combustible dusts or fibers that may be present therein and the likelihood that a flammable or combustible concentration or quantity is present. Hazardous (classified) locations may be found in occupancies such as, but not limited to, the following: aircraft hangars, gasoline dispensing and service stations, bulk storage plants for gasoline or other volatile flammable liquids, paint-finishing process plants, health care facilities, agricultural or other facilities where excessive combustible dusts may be present, marinas, boat yards, and petroleum and chemical processing plants. Each room, section or area shall be considered individually in determining its classification.

(2) Classifications.

(i) These hazardous (classified) locations are assigned the following designations:

(A) Class I, Division 1

(B) Class I, Division 2

(C) Class I, Zone 0

(D) Class I, Zone 1

(E) Class I, Zone 2

(F) Class II, Division 1

(G) Class II, Division 2

(H) Class III, Division 1

(I) Class III, Division 2

(ii) For definitions of these locations, see § 1910.399.

(3) Other sections of this subpart. All applicable requirements in this subpart apply to hazardous (classified) locations unless modified by provisions of this section.

(4) Division and zone classification. In Class I locations, an installation must be classified as using the division classification system meeting paragraphs (c), (d), (e), and (f) of this section or using the zone classification system meeting paragraph (g) of this section. In Class II and Class III locations, an installation must be classified using the division classification system meeting paragraphs (c), (d), (e), and (f) of this section.

(b) Documentation.

All areas designated as hazardous (classified) locations under the Class and Zone system and areas designated under the Class and Division system established after August 13, 2007 shall be properly documented. This documentation shall be available to those authorized to design, install, inspect, maintain, or operate electric equipment at the location.

(c) Electrical installations.

Equipment, wiring methods, and installations of equipment in hazardous (classified) locations shall be intrinsically safe, approved for the hazardous (classified) location, or safe for the hazardous (classified) location. Requirements for each of these options are as follows:

(1) Intrinsically safe. Equipment and associated wiring approved as intrinsically safe is permitted in any hazardous (classified) location for which it is approved;

(2) Approved for the hazardous (classified) location.

(i) Equipment shall be approved not only for the class of location, but also for the ignitable or combustible properties of the specific gas, vapor, dust, or fiber that will be present.

Note to paragraph (c)(2)(i) of this section: NFPA 70, the National Electrical Code, lists or defines hazardous gases, vapors, and dusts by ``Groups'' characterized by their ignitable or combustible properties.

(ii) Equipment shall be marked to show the class, group, and operating temperature or temperature range, based on operation in a

40-degree C ambient, for which it is approved. The temperature marking may not exceed the ignition temperature of the specific gas or vapor to be encountered. However, the following provisions modify this marking requirement for specific equipment:

(A) Equipment of the nonheat-producing type, such as junction boxes, conduit, and fittings, and equipment of the heat-producing type having a maximum temperature not more than 100[deg] C (212[deg] F) need not have a marked operating temperature or temperature range;

(B) Fixed lighting fixtures marked for use in Class I, Division 2 or Class II, Division 2 locations only need not be marked to indicate the group;

(C) Fixed general-purpose equipment in Class I locations, other than lighting fixtures, that is acceptable for use in Class I, Division 2 locations need not be marked with the class, group, division, or operating temperature;

(D) Fixed dust-tight equipment, other than lighting fixtures, that is acceptable for use in Class II, Division 2 and Class III locations need not be marked with the class, group, division, or operating temperature; and

(E) Electric equipment suitable for ambient temperatures exceeding 40[deg] C (104[deg] F) shall be marked with both the maximum ambient temperature and the operating temperature or temperature range at that ambient temperature; and

(3) Safe for the hazardous (classified) location. Equipment that is safe for the location shall be of a type and design that the employer demonstrates will provide protection from the hazards arising from the combustibility and flammability of vapors, liquids, gases, dusts, or fibers involved.

Note to paragraph (c)(3) of this section: The National Electrical Code, NFPA 70, contains guidelines for determining the type and design of equipment and installations that will meet this requirement. Those guidelines address electric wiring, equipment, and systems installed in hazardous (classified) locations and contain specific provisions for the following: wiring methods, wiring connections; conductor insulation, flexible cords, sealing and drainage, transformers, capacitors, switches, circuit breakers, fuses, motor controllers, receptacles, attachment plugs, meters, relays, instruments, resistors, generators, motors, lighting fixtures, storage battery charging equipment, electric cranes, electric hoists and similar equipment, utilization equipment, signaling systems, alarm systems, remote control systems, local loud *speaker and communication systems, ventilation piping, live parts, lightning surge protection, and grounding.*

(d) Conduits.

All conduits shall be threaded and shall be made wrench-tight. Where it is impractical to make a threaded joint tight, a bonding jumper shall be utilized.

(e) Equipment in Division 2 locations.

Equipment that has been approved for a Division 1 location may be installed in a Division 2 location of the same class and group. General-purpose equipment or equipment in general-purpose enclosures may be installed in Division 2 locations if the employer can demonstrate that the equipment does not constitute a source of ignition under normal operating conditions.

(f) Protection techniques.

The following are acceptable protection techniques for electric and electronic equipment in hazardous (classified) locations.

(1) Explosionproof apparatus. This protection technique is permitted for equipment in the Class I, Division 1 and 2 locations for which it is approved.

(2) Dust ignitionproof. This protection technique is permitted for equipment in the Class II, Division 1 and 2 locations for which it is approved.

(3) Dust-tight. This protection technique is permitted for equipment in the Class II, Division 2 and Class III locations for which it is approved.

(4) Purged and pressurized. This protection technique is permitted for equipment in any hazardous (classified) location for which it is approved.

(5) Nonincendive circuit. This protection technique is permitted for equipment in Class I, Division 2; Class II, Division 2; or Class III, Division 1or 2 locations.

(6) Nonincendive equipment. This protection technique is permitted for equipment in Class I, Division 2; Class II, Division 2; or Class III, Division 1 or 2 locations.

(7) Nonincendive component. This protection technique is permitted for equipment in Class I, Division 2; Class II, Division 2; or Class III, Division 1 or 2 locations.

(8) Oil immersion. This protection technique is permitted for current-interrupting contacts in Class I, Division 2 locations as described in the Subpart.

(9) Hermetically sealed. This protection technique is permitted for equipment in Class I, Division 2; Class II, Division 2; and Class III, Division 1 or 2 locations.

(10) Other protection techniques. Any other protection technique that meets paragraph (c) of this section is acceptable in any hazardous (classified) location.

(g) Class I, Zone 0, 1, and 2 locations--

(1) Scope. Employers may use the zone classification system as an alternative to the division classification system for electric and electronic equipment and wiring for all voltage in Class I, Zone 0, Zone 1, and Zone 2 hazardous (classified) locations where fire or explosion hazards may exist due to flammable gases, vapors, or liquids.

(2) Location and general requirements.

(i) Locations shall be classified depending on the properties of the flammable vapors, liquids, or gases that may be present and the likelihood that a flammable or combustible concentration or quantity is present. Where pyrophoric materials are the only materials used or handled, these locations need not be classified.

(ii) Each room, section, or area shall be considered individually in determining its classification.

(iii) All threaded conduit shall be threaded with an NPT (National (American) Standard Pipe Taper) standard conduit cutting die that provides \3/4\-in. taper per foot. The conduit shall be made wrench tight to prevent sparking when fault current flows through the conduit system and to ensure the explosionproof or flameproof integrity of the conduit system where applicable.

(iv) Equipment provided with threaded entries for field wiring connection shall be installed in accordance with paragraph (g)(2)(iv)(A) or (g)(2)(iv)(B) of this section.

(A) For equipment provided with threaded entries for NPT threaded conduit or fittings, listed conduit, conduit fittings, or cable fittings shall be used.

(B) For equipment with metric threaded entries, such entries shall be identified as being metric, or listed adaptors to permit connection to conduit of NPT-threaded fittings shall be provided with the equipment. Adapters shall be used for connection to conduit or NPT-threaded fittings.

(3) Protection techniques. One or more of the following protection techniques shall be used for electric and electronic equipment in hazardous (classified) locations classified under the zone classification system.

(i) Flameproof ``d''--This protection technique is permitted for equipment in the Class I, Zone 1 locations for which it is approved.

(ii) Purged and pressurized--This protection technique is permitted for equipment in the Class I, Zone 1 or Zone 2 locations for which it is approved.

(iii) Intrinsic safety--This protection technique is permitted for equipment in the Class I, Zone 0 or Zone 1 locations for which it is approved.

(iv) Type of protection ``n''--This protection technique is permitted for equipment in the Class I, Zone 2 locations for which it is approved. Type of protection ``n'' is further subdivided into nA, nC, and nR.

(v) Oil Immersion ``o''--This protection technique is permitted for equipment in the Class I, Zone 1 locations for which it is approved.

(vi) Increased safety ``e''--This protection technique is permitted for equipment in the Class I, Zone 1 locations for which it is approved.

(vii) Encapsulation ``m''--This protection technique is permitted for equipment in the Class I, Zone 1 locations for which it is approved.

(viii) Powder Filling ``q''--This protection technique is permitted for equipment in the Class I, Zone 1 locations for which it is approved.

(4) Special precaution. Paragraph (g) of this section requires equipment construction and installation that will ensure safe performance under conditions of proper use and maintenance.

(i) Classification of areas and selection of equipment and wiring methods shall be under the supervision of a qualified registered professional engineer.

(ii) In instances of areas within the same facility classified separately, Class I, Zone 2 locations may abut, but not overlap, Class I, Division 2 locations. Class I, Zone 0 or Zone 1 locations may not abut Class I, Division 1 or Division 2 locations.

(iii) A Class I, Division 1 or Division 2 location may be reclassified as a Class I, Zone 0, Zone 1, or Zone 2 location only if all of the space that is classified because of a single flammable gas or vapor source is reclassified.

Note to paragraph (g)(4) of this section: Low ambient conditions require special consideration. Electric equipment depending on the protection techniques described by paragraph (g)(3)(i) of this section may not be suitable for use at temperatures lower than -20 [deg]C (-4 [deg]F) unless they are approved for use at lower temperatures. However, at low ambient temperatures, flammable concentrations of vapors may not exist in a location classified Class I, Zone 0, 1, or 2 at normal ambient temperature.

(5) Listing and marking.

(i) Equipment that is listed for a Zone 0 location may be installed in a Zone 1 or Zone 2 location of the same gas or vapor. Equipment that is listed for a Zone 1 location may be installed in a Zone 2 location of the same gas or vapor.

(ii) Equipment shall be marked in accordance with paragraph (g)(5)(ii)(A) and (g)(5)(ii)(B) of this section, except as provided in (g)(5)(ii)(C).

(A) Equipment approved for Class I, Division 1 or Class 1, Division 2 shall, in addition to being marked in accordance with (c)(2)(ii), be marked with the following:

(1) Class I, Zone 1 or Class I, Zone 2 (as applicable);

(2) Applicable gas classification groups; and

(3) Temperature classification; or

(B) Equipment meeting one or more of the protection techniques described in paragraph (g)(3) of this section shall be marked with the following in the order shown:

(1) Class, except for intrinsically safe apparatus;

(2) Zone, except for intrinsically safe apparatus;

(3) Symbol ``AEx;"

(4) Protection techniques;

(5) Applicable gas classification groups; and

(6) Temperature classification, except for intrinsically safe apparatus.

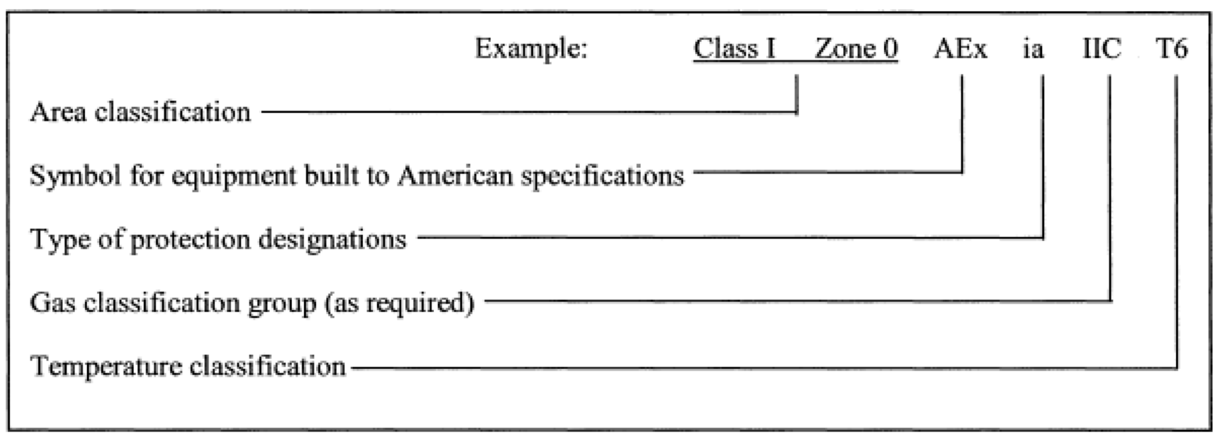
Note to paragraph (g)(5)(ii)(B) of this section: An example of such a required marking is ``Class I, Zone 0, AEx ia IIC T6." See Figure S-1 for an explanation of this marking.

(C) Equipment that the employer demonstrates will provide protection from the hazards arising from the flammability of the gas or vapor and the zone of location involved and will be recognized as providing such protection by employees need not be marked.

Note to paragraph (g)(5)(ii)(C) of this section: The National Electrical Code, NFPA 70, contains guidelines for determining the type and design of equipment and installations that will meet this provision.

Figure C.4: Figure D-1 as published in Federal Register

Figure S-1—Example Marking for Class I, Zone 0, AEx ia IIC T6



§ 1910.308 Special systems.

(a) Systems over 600 volts, nominal.

This paragraph covers the general requirements for all circuits and equipment operated at over 600 volts.

(1) Aboveground wiring methods.

(i) Aboveground conductors shall be installed in rigid metal conduit, in intermediate metal conduit, in electrical metallic tubing, in rigid nonmetallic conduit, in cable trays, as busways, as cablebus, in other identified raceways, or as open runs of metal-clad cable suitable for the use and purpose. In locations accessible to qualified persons only, open runs of Type MV cables, bare conductors, and bare busbars are also permitted. Busbars shall be either copper or aluminum. Open runs of insulated wires and cables having a bare lead sheath or a braided outer covering shall be supported in a manner designed to prevent physical damage to the braid or sheath.

(ii) Conductors emerging from the ground shall be enclosed in approved raceways.

(2) Braid-covered insulated conductors--open installations. The braid on open runs of braid-covered insulated conductors shall be flame retardant or shall have a flame-retardant saturant applied after installation. This treated braid covering shall be stripped back a safe distance at conductor terminals, according to the operating voltage.

(3) Insulation shielding.

(i) Metallic and semiconductor insulation shielding components of shielded cables shall be removed for a distance dependent on the circuit voltage and insulation. Stress reduction means shall be provided at all terminations of factory-applied shielding.

(ii) Metallic shielding components such as tapes, wires, or braids, or combinations thereof, and their associated conducting and semiconducting components shall be grounded.

(4) Moisture or mechanical protection for metal-sheathed cables.

Where cable conductors emerge from a metal sheath and where protection against moisture or physical damage is necessary, the insulation of the conductors shall be protected by a cable sheath terminating device.

(5) Interrupting and isolating devices.

(i) Circuit breaker installations located indoors shall consist of metal-enclosed units or fire-resistant cell-mounted units. In locations accessible only to qualified employees, open mounting of circuit breakers is permitted. A means of indicating the open and closed position of circuit breakers shall be provided.

(ii) Where fuses are used to protect conductors and equipment, a fuse shall be placed in each ungrounded conductor. Two power fuses may be used in parallel to protect the same load, if both fuses have identical ratings, and if both fuses are installed in an identified common mounting with electrical connections that will divide the current equally. Power fuses of the vented type may not be used indoors, underground, or in metal enclosures unless identified for the use.

(iii) Fused cutouts installed in buildings or transformer vaults shall be of a type identified for the purpose. Distribution cutouts may not be used indoors, underground, or in metal enclosures. They shall be readily accessible for fuse replacement.

(iv) Where fused cutouts are not suitable to interrupt the circuit manually while carrying full load, an approved means shall be installed to interrupt the entire load. Unless the fused cutouts are interlocked with the switch to prevent opening of the cutouts under load, a conspicuous sign shall be placed at such cutouts reading: ``WARNING--DO NOT OPERATE UNDER LOAD."

(v) Suitable barriers or enclosures shall be provided to prevent contact with nonshielded cables or energized parts of oil-filled cutouts.

(vi) Load interrupter switches may be used only if suitable fuses or circuits are used in conjunction with these devices to interrupt fault currents.

(A) Where these devices are used in combination, they shall be coordinated electrically so that they will safely withstand the effects of closing, carrying, or interrupting all possible currents up to the assigned maximum short-circuit rating.

(B) Where more than one switch is installed with interconnected load terminals to provide for alternate connection to different supply conductors, each switch shall be provided with a conspicuous sign reading: ``WARNING--SWITCH MAY BE ENERGIZED BY BACKFEED."

(vii) A means (for example, a fuseholder and fuse designed for the purpose) shall be provided to completely isolate equipment for inspection and repairs. Isolating means that are not designed to interrupt the load current of the circuit shall be either interlocked with an approved circuit interrupter or provided with a sign warning against opening them under load.

(6) Mobile and portable equipment.

(i) A metallic enclosure shall be provided on the mobile machine for enclosing the terminals of the power cable. The enclosure shall include provisions for a solid connection for the grounding terminal to effectively ground the machine frame. The method of cable termination used shall prevent any strain or pull on the cable from stressing the electrical connections. The enclosure shall have provision for locking so only authorized qualified persons may open it and shall be marked with a sign warning of the presence of energized parts.

(ii) All energized switching and control parts shall be enclosed in effectively grounded metal cabinets or enclosures. Circuit breakers and protective equipment shall have the operating means projecting through the metal cabinet or enclosure so these units can be reset without locked doors being opened. Enclosures and metal cabinets shall be locked so that only authorized qualified persons have access and shall be marked with a sign warning of the presence of energized parts. Collector ring assemblies on revolving-type machines (shovels, draglines, etc.) shall be guarded.

(7) Tunnel installations. This paragraph applies to installation and use of high-voltage power distribution and utilization equipment that is portable or mobile, such as substations, trailers, cars, mobile shovels, draglines, hoists, drills, dredges, compressors, pumps, conveyors, and underground excavators.

(i) Conductors in tunnels shall be installed in one or more of the following:

(A) Metal conduit or other metal raceway;

(B) Type MC cable; or

(C) Other approved multiconductor cable.

(ii) Multiconductor portable cable may supply mobile equipment.

(iii) Conductors and cables shall also be so located or guarded as to protect them from physical damage. An equipment grounding conductor shall be run with circuit conductors inside the metal raceway or inside the multiconductor cable jacket. The equipment grounding conductor may be insulated or bare.

(iv) Bare terminals of transformers, switches, motor controllers, and other equipment shall be enclosed to prevent accidental contact with energized parts.

(v) Enclosures for use in tunnels shall be drip-proof, weatherproof, or submersible as required by the environmental conditions.

(vi) Switch or contactor enclosures may not be used as junction boxes or raceways for conductors feeding through or tapping off to other switches, unless special designs are used to provide adequate space for this purpose.

(vii) A disconnecting means that simultaneously opens all ungrounded conductors shall be installed at each transformer or motor location.

(viii) All nonenergized metal parts of electric equipment and metal raceways and cable sheaths shall be effectively grounded and bonded to all metal pipes and rails at the portal and at intervals not exceeding 305 m (1000 ft) throughout the tunnel.

(b) Emergency power systems.

This paragraph applies to circuits, systems, and equipment intended to supply power for illumination and special loads in the event of failure of the normal supply.

(1) Wiring methods. Emergency circuit wiring shall be kept entirely independent of all other wiring and equipment and may not enter the same raceway, cable, box, or cabinet or other wiring except either where common circuit elements suitable for the purpose are required, or for transferring power from the normal to the emergency source.

(2) Emergency illumination. Emergency illumination shall include all required means of egress lighting, illuminated exit signs, and all other lights necessary to provide illumination. Where emergency lighting is necessary, the system shall be so arranged that the failure of any individual lighting element, such as the burning out of a light bulb, cannot leave any space in total darkness.

(3) Signs.

(i) A sign shall be placed at the service entrance equipment indicating the type and location of on-site emergency power sources. However, a sign is not required for individual unit equipment.

(ii) Where the grounded circuit conductor connected to the emergency source is connected to a grounding electrode conductor at a location remote from the emergency source, there shall be a sign at the grounding location that shall identify all emergency and normal sources connected at that location.

(c) Class 1, Class 2, and Class 3 remote control, signaling, and power-limited circuits--

(1) Classification. Class 1, Class 2, and Class 3 remote control, signaling, or power-limited circuits are characterized by their usage and electrical power limitation that differentiates them from light and power circuits. These circuits are classified in accordance with their respective voltage and power limitations as summarized in paragraphs (c)(1)(i) through (c)(1)(iii) of this section.

(i) A Class 1 power-limited circuit shall be supplied from a source having a rated output of not more than 30 volts and 1000 volt-amperes.

(ii) A Class 1 remote control circuit or a Class 1 signaling circuit shall have a voltage not exceeding 600 volts; however, the power output of the source need not be limited.

(iii) The power source for a Class 2 or Class 3 circuit shall be listed equipment marked as a Class 2 or Class 3 power source, except as follows:

(A) Thermocouples do not require listing as a Class 2 power source; and

(B) A dry cell battery is considered an inherently limited Class 2 power source, provided the voltage is 30 volts or less and the capacity is less than or equal to that available from series-connected No. 6 carbon zinc cells.

(2) Marking.

A Class 2 or Class 3 power supply unit shall be durably marked where plainly visible to indicate the class of supply and its electrical rating.

(3) Separation from conductors of other circuits.

Cables and conductors of Class 2 and Class 3 circuits may not be placed in any cable, cable tray, compartment, enclosure, manhole, outlet box, device box, raceway, or similar fitting with conductors of electric light, power, Class 1, nonpower-limited fire alarm circuits, and medium power network-powered broadband communications cables unless a barrier or other equivalent form of protection against contact is employed.

(d) Fire alarm systems--

(1) Classifications. Fire alarm circuits shall be classified either as nonpower limited or power limited.

(2) Power sources. The power sources for use with fire alarm circuits shall be either power limited or nonpower limited as follows:

(i) The power source of nonpower-limited fire alarm (NPLFA) circuits shall have an output voltage of not more than 600 volts, nominal; and

(ii) The power source for a power-limited fire alarm (PLFA) circuit shall be listed equipment marked as a PLFA power source.

(3) Separation from conductors of other circuits.

(i) Nonpower-limited fire alarm circuits and Class 1 circuits may occupy the same enclosure, cable, or raceway provided all conductors are insulated for maximum voltage of any conductor within the enclosure, cable, or raceway. Power supply and fire alarm circuit conductors are permitted in the same enclosure, cable, or raceway only if connected to the same equipment.

(ii) Power-limited circuit cables and conductors may not be placed in any cable, cable tray, compartment, enclosure, outlet box, raceway, or similar fitting with conductors of electric light, power, Class 1, nonpower-limited fire alarm circuit conductors, or medium power network-powered broadband communications circuits.

(iii) Power-limited fire alarm circuit conductors shall be separated at least 50.8 mm (2 in.) from conductors of any electric light, power, Class 1, nonpower-limited fire alarm, or medium power network-powered broadband communications circuits unless a special and equally protective method of conductor separation is employed.

(iv) Conductors of one or more Class 2 circuits are permitted within the same cable, enclosure, or raceway with conductors of power-limited fire alarm circuits provided that the insulation of Class 2 circuit conductors in the cable, enclosure, or raceway is at least that needed for the power-limited fire alarm circuits.

(4) Identification. Fire alarm circuits shall be identified at terminal and junction locations in a manner that will prevent unintentional interference with the signaling circuit during testing and servicing. Power-limited fire alarm circuits shall be durably marked as such where plainly visible at terminations.

(e) Communications systems.

This paragraph applies to central-station-connected and non-central-station-connected telephone circuits, radio and television receiving and transmitting equipment, including community antenna television and radio distribution systems, telegraph, district messenger, and outside wiring for fire and burglar alarm, and similar central station systems. These installations need not comply with the provisions of § 1910.303 through § 1910.308(d), except for § 1910.304(c)(1) and § 1910.307.

(1) Protective devices.

(i) A listed primary protector shall be provided on each circuit run partly or entirely in aerial wire or aerial cable not confined within a block.

(ii) A listed primary protector shall be also provided on each aerial or underground circuit when the location of the circuit within the block containing the building served allows the circuit to be exposed to accidental contact with electric light or power conductors operating at over 300 volts to ground.

(iii) In addition, where there exists a lightning exposure, each interbuilding circuit on premises shall be protected by a listed primary protector at each end of the interbuilding circuit.

(2) Conductor location.

(i) Lead-in or aerial-drop cables from a pole or other support, including the point of initial attachment to a building or structure, shall be kept away from electric light, power, Class 1, or nonpower-limited fire alarm circuit conductors so as to avoid the possibility of accidental contact.

(ii) A separation of at least 1.83 m (6 ft) shall be maintained between communications wires and cables on buildings and lightning conductors.

(iii) Where communications wires and cables and electric light or power conductors are supported by the same pole or run parallel to each other in-span, the following conditions shall be met:

(A) Where practicable, communication wires and cables on poles shall be located below the electric light or power conductors; and

(B) Communications wires and cables may not be attached to a crossarm that carries electric light or power conductors.

(iv) Indoor communications wires and cables shall be separated at least 50.8 mm (2 in.) from conductors of any electric light, power, Class 1, nonpower-limited fire alarm, or medium power network-powered broadband communications circuits, unless a special and equally protective method of conductor separation, identified for the purpose, is employed.

(3) Equipment location. Outdoor metal structures supporting antennas, as well as self-supporting antennas such as vertical rods or dipole structures, shall be located as far away from overhead conductors of electric light and power circuits of over 150 volts to ground as necessary to prevent the antenna or structure from falling into or making accidental contact with such circuits.

(4) Grounding.

(i) If exposed to contact with electric light and power conductors, the metal sheath of aerial cables entering buildings shall be grounded or shall be interrupted close to the entrance to the building by an insulating joint or equivalent device. Where protective devices are used, they shall be grounded in an approved manner.

(ii) Masts and metal structures supporting antennas shall be permanently and effectively grounded without splice or connection in the grounding conductor.

(iii) Transmitters shall be enclosed in a metal frame or grill or separated from the operating space by a barrier, all metallic parts of which are effectively connected to ground. All external metal handles and controls accessible to the operating personnel shall be effectively grounded. Unpowered equipment and enclosures are considered to be grounded where connected to an attached coaxial cable with an effectively grounded metallic shield.

(f) Solar photovoltaic systems.

This paragraph covers solar photovoltaic systems that can be interactive with other electric power production sources or can stand alone with or without electrical energy storage such as batteries. These systems may have ac or dc output for utilization.

(1) Conductors of different systems. Photovoltaic source circuits and photovoltaic output circuits may not be contained in the same raceway, cable tray, cable, outlet box, junction box, or similar fitting as feeders or branch circuits of other systems, unless the conductors of the different systems are separated by a partition or are connected together.

(2) Disconnecting means. Means shall be provided to disconnect all current-carrying conductors of a photovoltaic power source from all other conductors in a building or other structure. Where a circuit grounding connection is not designed to be automatically interrupted as part of the ground-fault protection system, a switch or circuit breaker used as disconnecting means may not have a pole in the grounded conductor.

(g) Integrated electrical systems--

(1) Scope. Paragraph (g) of this section covers integrated electrical systems, other than unit equipment, in which orderly shutdown is necessary to ensure safe operation. An integrated electrical system as used in this section shall be a unitized segment of an industrial wiring system where all of the following conditions are met:

(i) An orderly shutdown process minimizes employee hazard and equipment damage;

(ii) The conditions of maintenance and supervision ensure that only qualified persons will service the system; and

(iii) Effective safeguards are established and maintained.

(2) Location of overcurrent devices in or on premises. Overcurrent devices that are critical to integrated electrical systems need not be readily accessible to employees as required by § 1910.304(f)(1)(iv) if they are located with mounting heights to ensure security from operation by nonqualified persons.

§ 1910.399 Definitions applicable to this subpart.

Acceptable. An installation or equipment is acceptable to the Assistant Secretary of Labor, and approved within the meaning of this Subpart S:

(1) If it is accepted, or certified, or listed, or labeled, or otherwise determined to be safe by a nationally recognized testing laboratory recognized pursuant to § 1910.7; or

(2) With respect to an installation or equipment of a kind that no nationally recognized testing laboratory accepts, certifies, lists, labels, or determines to be safe, if it is inspected or tested by another Federal agency, or by a State, municipal, or other local authority responsible for enforcing occupational safety provisions of the National Electrical Code, and found in compliance with the provisions of the National Electrical Code as applied in this subpart; or

(3) With respect to custom-made equipment or related installations that are designed, fabricated for, and intended for use by a particular customer, if it is determined to be safe for its intended use by its manufacturer on the basis of test data which the employer keeps and makes available for inspection to the Assistant Secretary and his authorized representatives.

Accepted. An installation is ``accepted'' if it has been inspected and found by a nationally recognized testing laboratory to conform to specified plans or to procedures of applicable codes.

Accessible. (As applied to wiring methods.) Capable of being removed or exposed without damaging the building structure or finish, or not permanently closed in by the structure or finish of the building. (See ``concealed'' and ``exposed.'')

Accessible. (As applied to equipment.) Admitting close approach; not guarded by locked doors, elevation, or other effective means. (See ``Readily accessible.'')

Ampacity. The current, in amperes, that a conductor can carry continuously under the conditions of use without exceeding its temperature rating.

Appliances. Utilization equipment, generally other than industrial, normally built in standardized sizes or types, that is installed or connected as a unit to perform one or more functions.

Approved. Acceptable to the authority enforcing this subpart. The authority enforcing this subpart is the Assistant Secretary of Labor for Occupational Safety and Health. The definition of ``acceptable'' indicates what is acceptable to the Assistant Secretary of Labor, and therefore approved within the meaning of this subpart.

Armored cable (Type AC). A fabricated assembly of insulated conductors in a flexible metallic enclosure.

Askarel. A generic term for a group of nonflammable synthetic chlorinated hydrocarbons used as electrical insulating media. Askarels of various compositional types are used. Under arcing conditions, the gases produced, while consisting predominantly of noncombustible hydrogen chloride, can include varying amounts of combustible gases depending upon the askarel type.

Attachment plug (Plug cap)(Cap). A device that, by insertion in a receptacle, establishes a connection between the conductors of the attached flexible cord and the conductors connected permanently to the receptacle.

Automatic. Self-acting, operating by its own mechanism when actuated by some impersonal influence, as, for example, a change in current strength, pressure, temperature, or mechanical configuration.

Bare conductor. See Conductor.

Barrier.

A physical obstruction that is intended to prevent contact with equipment or live parts or to prevent unauthorized access to a work area.

Bathroom. An area including a basin with one or more of the following: a toilet, a tub, or a shower.

Bonding (Bonded). The permanent joining of metallic parts to form an electrically conductive path that ensures electrical continuity and the capacity to conduct safely any current likely to be imposed.

Bonding jumper. A conductor that assures the necessary electrical conductivity between metal parts required to be electrically connected.

Branch circuit. The circuit conductors between the final overcurrent device protecting the circuit and the outlets.

Building. A structure that stands alone or is cut off from adjoining structures by fire walls with all openings therein protected by approved fire doors.

Cabinet. An enclosure designed either for surface or flush mounting, and provided with a frame, mat, or trim in which a swinging door or doors are or can be hung.

Cable tray system. A unit or assembly of units or sections and associated fittings forming a rigid structural system used to securely fasten or support cables and raceways. Cable tray systems include ladders, troughs, channels, solid bottom trays, and other similar structures.

Cablebus. An assembly of insulated conductors with fittings and conductor terminations in a completely enclosed, ventilated, protective metal housing.

Cell line. An assembly of electrically interconnected electrolytic cells supplied by a source of direct current power.

Cell line attachments and auxiliary equipment. Cell line attachments and auxiliary equipment include, but are not limited to, auxiliary tanks, process piping, ductwork, structural supports, exposed cell line conductors, conduits and other raceways, pumps, positioning equipment, and cell cutout or bypass electrical devices. Auxiliary equipment also includes tools, welding machines, crucibles, and other portable equipment used for operation and maintenance within the electrolytic cell line working zone. In the cell line working zone, auxiliary equipment includes the exposed conductive surfaces of ungrounded cranes and crane-mounted cell-servicing equipment.

Center pivot irrigation machine. A multi-motored irrigation machine that revolves around a central pivot and employs alignment switches or similar devices to control individual motors.

Certified. Equipment is ``certified'' if it bears a label, tag, or other record of certification that the equipment:

(1) Has been tested and found by a nationally recognized testing laboratory to meet nationally recognized standards or to be safe for use in a specified manner; or

(2) Is of a kind whose production is periodically inspected by a nationally recognized testing laboratory and is accepted by the laboratory as safe for its intended use.

Circuit breaker. A device designed to open and close a circuit by nonautomatic means and to open the circuit automatically on a predetermined overcurrent without damage to itself when properly applied within its rating.

Class I locations. Class I locations are those in which flammable gases or vapors are or may be present in the air in quantities sufficient to produce explosive or ignitable mixtures. Class I locations include the following:

(1) Class I, Division 1. A Class I, Division 1 location is a location:

(i) In which ignitable concentrations of flammable gases or vapors may exist under normal operating conditions; or

(ii) In which ignitable concentrations of such gases or vapors may exist frequently because of repair or maintenance operations or because of leakage; or

(iii) In which breakdown or faulty operation of equipment or processes might release ignitable concentrations of flammable gases or vapors, and might also cause simultaneous failure of electric equipment.

Note to the definition of ``Class I, Division 1:'' This classification usually includes locations where volatile flammable liquids or liquefied flammable gases are transferred from one container to another; interiors of spray booths and areas in the vicinity of spraying and painting operations where volatile flammable solvents are used; locations containing open tanks or vats of volatile flammable liquids; drying rooms or compartments for the evaporation of flammable solvents; locations containing fat and oil extraction equipment using volatile flammable solvents; portions of cleaning and dyeing plants where flammable liquids are used; gas generator rooms and other portions of gas manufacturing plants where flammable gas may escape; inadequately ventilated pump rooms for flammable gas or for volatile flammable liquids; the interiors of refrigerators and freezers in which volatile flammable materials are stored in open, lightly stoppered, or easily ruptured containers; and all other locations where ignitable concentrations of flammable vapors or gases are likely to occur in the course of normal operations.

(2) Class I, Division 2. A Class I, Division 2 location is a location:

(i) In which 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 the event of accidental rupture or breakdown of such containers or systems, or as a result of abnormal operation of equipment; or

(ii) In which ignitable concentrations of gases or vapors are normally prevented by positive mechanical ventilation, and which might become hazardous through failure or abnormal operations of the ventilating equipment; or

(iii) That is adjacent to a Class I, Division 1 location, and to which ignitable concentrations of gases or vapors might occasionally be communicated unless such communication is prevented by adequate positive-pressure ventilation from a source of clean air, and effective safeguards against ventilation failure are provided.

Note to the definition of ``Class I, Division 2:'' This classification usually includes locations where volatile flammable liquids or flammable gases or vapors are used, but which would become *hazardous only in case of an accident or of some unusual operating condition. The quantity of flammable 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 merit consideration in determining the classification and extent of each location.*

Piping without valves, checks, meters, and similar devices would not ordinarily introduce a hazardous condition even though used for flammable liquids or gases. Locations used for the storage of flammable liquids or liquefied or compressed gases in sealed containers would not normally be considered hazardous unless also subject to other hazardous conditions.

Electrical conduits and their associated enclosures separated from process fluids by a single seal or barrier are classed as a Division 2 location if the outside of the conduit and enclosures is a nonhazardous location.

(3) Class I, Zone 0. A Class I, Zone 0 location is a location in which one of the following conditions exists:

(i) Ignitable concentrations of flammable gases or vapors are present continuously; or

(ii) Ignitable concentrations of flammable gases or vapors are present for long periods of time.

Note to the definition of ``Class I, Zone 0:'' As a guide in determining when flammable gases or vapors are present continuously or for long periods of time, refer to Recommended Practice for Classification of Locations for Electrical Installations of Petroleum Facilities Classified as Class I, Zone 0, Zone 1 or Zone 2, API RP 505-1997; Electrical Apparatus for Explosive Gas Atmospheres, Classifications of Hazardous Areas, IEC 79-10-1995; Area Classification Code for Petroleum Installations, Model Code--Part 15, Institute for Petroleum; and Electrical Apparatus for Explosive Gas Atmospheres, Classifications of Hazardous (Classified) Locations, ISA S12.24.01-1997.

(4) Class I, Zone 1. A Class I, Zone 1 location is a location in which one of the following conditions exists:

(i) Ignitable concentrations of flammable gases or vapors are likely to exist under normal operating conditions; or

(ii) Ignitable concentrations of flammable gases or vapors may exist frequently because of repair or maintenance operations or because of leakage; or

(iii) Equipment is operated or processes are carried on of such a nature that equipment breakdown or faulty operations could result in the release of ignitable concentrations of flammable gases or vapors and also cause simultaneous failure of electric equipment in a manner that would cause the electric equipment to become a source of ignition; or

(iv) A location that is adjacent to a Class I, Zone 0 location from which ignitable concentrations of vapors could be communicated, unless communication is prevented by adequate positive pressure ventilation from a source of clean air and effective safeguards against ventilation failure are provided.

(5) Class I, Zone 2. A Class I, Zone 2 location is a location in which one of the following conditions exists:

(i) Ignitable concentrations of flammable gases or vapors are not likely to occur in normal operation and if they do occur will exist only for a short period; or

(ii) Volatile flammable liquids, flammable gases, or flammable vapors are handled, processed, or used, but in which the liquids, gases, or vapors are normally confined within closed containers or closed systems from which they can escape only as a result of accidental rupture or breakdown of the containers or system or as the result of the abnormal operation of the equipment with which the liquids or gases are handled, processed, or used; or

(iii) Ignitable concentrations of flammable gases or vapors normally are prevented by positive mechanical ventilation, but which may become hazardous as the result of failure or abnormal operation of the ventilation equipment; or

(iv) A location that is adjacent to a Class I, Zone 1 location, from which ignitable concentrations of flammable gases or vapors could be communicated, unless such communication is prevented by adequate positive-pressure ventilation from a source of clean air, and effective safeguards against ventilation failure are provided.

Class II locations. Class II locations are those that are hazardous because of the presence of combustible dust. Class II locations include the following:

(1) Class II, Division 1. A Class II, Division 1 location is a location:

(i) In which combustible dust is or may be in suspension in the air under normal operating conditions, in quantities sufficient to produce explosive or ignitable mixtures; or

(ii) Where mechanical failure or abnormal operation of machinery or equipment might cause such explosive or ignitable mixtures to be produced, and might also provide a source of ignition through simultaneous failure of electric equipment, through operation of protection devices, or from other causes; or

(iii) In which combustible dusts of an electrically conductive nature may be present.

Note to the definition of ``Class II, Division 1:'' This classification may include areas of grain handling and processing plants, starch plants, sugar-pulverizing plants, malting plants, hay-grinding plants, coal pulverizing plants, areas where metal dusts and powders are produced or processed, and other similar locations that contain dust producing machinery and equipment (except where the equipment is dust-tight or vented to the outside). These areas would have combustible dust in the air, under normal operating conditions, in quantities sufficient to produce explosive or ignitable mixtures. Combustible dusts that are electrically nonconductive include dusts produced in the handling and processing of grain and grain products, pulverized sugar and cocoa, dried egg and milk powders, pulverized spices, starch and pastes, potato and wood flour, oil meal from beans and seed, dried hay, and other organic materials which may produce combustible dusts when processed or handled. Dusts containing magnesium or aluminum are particularly hazardous, and the use of extreme caution is necessary to avoid ignition and explosion.

(2) Class II, Division 2. A Class II, Division 2 location is a location where:

(i) Combustible dust will not normally be in suspension in the air in quantities sufficient to produce explosive or ignitable mixtures, and dust accumulations will normally be insufficient to interfere with the normal operation of electric equipment or other apparatus, but combustible dust may be in suspension in the air as a result of infrequent malfunctioning of handling or processing equipment; and

(ii) Resulting combustible dust accumulations on, in, or in the vicinity of the electric equipment may be sufficient to interfere with the safe dissipation of heat from electric equipment or may be ignitable by abnormal operation or failure of electric equipment.

Note to the definition of ``Class II, Division 2:'' This classification includes locations where dangerous concentrations of suspended dust would not be likely, but where dust accumulations might form *on or in the vicinity of electric equipment. These areas may contain equipment from which appreciable quantities of dust would escape under abnormal operating conditions or be adjacent to a Class II Division 1 location, as described above, into which an explosive or ignitable concentration of dust may be put into suspension under abnormal operating conditions.*

Class III locations. Class III locations are those that 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. Class III locations include the following:

(1) Class III, Division 1. A Class III, Division 1 location is a location in which easily ignitable fibers or materials producing combustible flyings are handled, manufactured, or used.

Note to the definition of ``Class III, Division 1:'' Such locations usually include some parts of rayon, cotton, and other textile mills; combustible fiber manufacturing and processing plants; cotton gins and cotton-seed mills; flax-processing plants; clothing manufacturing plants; woodworking plants, and establishments; and industries involving similar hazardous processes or conditions.

Easily ignitable fibers and flyings include rayon, cotton (including cotton linters and cotton waste), sisal or henequen, istle, jute, hemp, tow, cocoa fiber, oakum, baled waste kapok, Spanish moss, excelsior, and other materials of similar nature.

(2) Class III, Division 2. A Class III, Division 2 location is a location in which easily ignitable fibers are stored or handled, other than in the process of manufacture.

Collector ring. An assembly of slip rings for transferring electric energy from a stationary to a rotating member.

Competent Person. One who is capable of identifying existing and predictable hazards in the surroundings or working conditions that are unsanitary, hazardous, or dangerous to employees and who has authorization to take prompt corrective measures to eliminate them.

Concealed. Rendered inaccessible by the structure or finish of the building. Wires in concealed raceways are considered concealed, even though they may become accessible by withdrawing them. (See Accessible. (As applied to wiring methods.))

Conductor--:

(1) Bare. A conductor having no covering or electrical insulation whatsoever.

(2) Covered. A conductor encased within material of composition or thickness that is not recognized by this subpart as electrical insulation.

(3) Insulated. A conductor encased within material of composition and thickness that is recognized by this subpart as electrical insulation.

Conduit body. A separate portion of a conduit or tubing system that provides access through one or more removable covers to the interior of the system at a junction of two or more sections of the system or at a terminal point of the system. Boxes such as FS and FD or larger cast or sheet metal boxes are not classified as conduit bodies.

Controller. A device or group of devices that serves to govern, in some predetermined manner, the electric power delivered to the apparatus to which it is connected.

Covered conductor. See Conductor.

Cutout. (Over 600 volts, nominal.) An assembly of a fuse support with either a fuseholder, fuse carrier, or disconnecting blade. The fuseholder or fuse carrier may include a conducting element (fuse link), or may act as the disconnecting blade by the inclusion of a nonfusible member.

Cutout box. An enclosure designed for surface mounting and having swinging doors or covers secured directly to and telescoping with the walls of the box proper. (See Cabinet.)

Damp location. See Location.

Dead front. Without live parts exposed to a person on the operating side of the equipment

Deenergized. Free from any electrical connection to a source of potential difference and from electrical charge; not having a potential different from that of the earth.

Device. A unit of an electrical system that is intended to carry but not utilize electric energy.

Dielectric heating. The heating of a nominally insulating material due to its own dielectric losses when the material is placed in a varying electric field.

Disconnecting means. A device, or group of devices, or other means by which the conductors of a circuit can be disconnected from their source of supply.

Disconnecting (or Isolating) switch. (Over 600 volts, nominal.) : A mechanical switching device used for isolating a circuit or equipment from a source of power.

Electrolytic cell line working zone. The cell line working zone is the space envelope wherein operation or maintenance is normally performed on or in the vicinity of exposed energized surfaces of electrolytic cell lines or their attachments.

Electrolytic cells. A tank or vat in which electrochemical reactions are caused by applying energy for the purpose of refining or producing usable materials.

Enclosed. Surrounded by a case, housing, fence, or walls that will prevent persons from accidentally contacting energized parts.

Enclosure. The case or housing of apparatus, or the fence or walls surrounding an installation to prevent personnel from accidentally contacting energized parts, or to protect the equipment from physical damage.

Energized. Electrically connected to a source of potential difference.

Equipment. A general term including material, fittings, devices, appliances, fixtures, apparatus, and the like, used as a part of, or in connection with, an electrical installation.

Equipment grounding conductor. See Grounding conductor, equipment.

Explosion-proof apparatus. Apparatus enclosed in a case that is capable of withstanding an explosion of a specified gas or vapor that may occur within it and of preventing the ignition of a specified gas or vapor surrounding the enclosure by sparks, flashes, or explosion of the gas or vapor within, and that operates at such an external temperature that it will not ignite a surrounding flammable atmosphere.

Exposed. (As applied to live parts.) : Capable of being inadvertently touched or approached nearer than a safe distance by a person. It is applied to parts not suitably guarded, isolated, or insulated. (See Accessible and Concealed.)

Exposed. (As applied to wiring methods.) : On or attached to the surface, or behind panels designed to allow access. (See Accessible. (As applied to wiring methods.))

Exposed. (For the purposes of § 1910.308(e).) : Where the circuit is in such a position that in case of failure of supports or insulation, contact with another circuit may result.

Externally operable. Capable of being operated without exposing the operator to contact with live parts.

Feeder. All circuit conductors between the service equipment, the source of a separate derived system, or other power supply source and the final branch-circuit overcurrent device.

Fitting. An accessory such as a locknut, bushing, or other part of a wiring system that is intended primarily to perform a mechanical rather than an electrical function.

Fountain. Fountains, ornamental pools, display pools, and reflection pools.

Note to the definition of ``fountain:'' This definition does not include drinking fountains.

Fuse. (Over 600 volts, nominal.) : An overcurrent protective device with a circuit opening fusible part that is heated and severed by the passage of overcurrent through it. A fuse comprises all the parts that form a unit capable of performing the prescribed functions. It may or may not be the complete device necessary to connect it into an electrical circuit.

Ground. A conducting connection, whether intentional or accidental, between an electric circuit or equipment and the earth, or to some conducting body that serves in place of the earth.

Grounded. Connected to the earth or to some conducting body that serves in place of the earth.

Grounded, effectively. Intentionally connected to earth through a ground connection or connections of sufficiently low impedance and having sufficient current-carrying capacity to prevent the buildup of voltages that may result in undue hazards to connected equipment or to persons.

Grounded conductor. A system or circuit conductor that is intentionally grounded.

Grounding conductor. A conductor used to connect equipment or the grounded circuit of a wiring system to a grounding electrode or electrodes.

Grounding conductor, equipment. The conductor used to connect the noncurrent-carrying metal parts of equipment, raceways, and other enclosures to the system grounded conductor, the grounding electrode conductor, or both, at the service equipment or at the source of a separately derived system.

Grounding electrode conductor. The conductor used to connect the grounding electrode to the equipment grounding conductor, to the grounded conductor, or to both, of the circuits at the service equipment or at the source of a separately derived system.

Ground-fault circuit-interrupter. A device intended for the protection of personnel that functions to deenergize a circuit or a portion of a circuit within an established period of time when a current to ground exceeds some predetermined value that is less than that required to operate the overcurrent protective device of the supply circuit.

Guarded. Covered, shielded, fenced, enclosed, or otherwise protected by means of suitable covers, casings, barriers, rails, screens, mats, or platforms to remove the likelihood of approach to a point of danger or contact by persons or objects.

Health care facilities. Buildings or portions of buildings in which medical, dental, psychiatric, nursing, obstetrical, or surgical care are provided.

Note to the definition of ``health care facilities:'' Health care facilities include, but are not limited to, hospitals, nursing homes, limited care facilities, clinics, medical and dental offices, and ambulatory care centers, whether permanent or movable.

Heating equipment. For the purposes of § 1910.306(g), the term ``heating equipment'' includes any equipment used for heating purposes if heat is generated by induction or dielectric methods.

Hoistway. Any shaftway, hatchway, well hole, or other vertical opening or space that is designed for the operation of an elevator or dumbwaiter.

Identified (as applied to equipment). Approved as suitable for the specific purpose, function, use, environment, or application, where described in a particular requirement.

Note to the definition of ``identified:'' Some examples of ways to determine suitability of equipment for a specific purpose, environment, or application include investigations by a nationally recognized testing laboratory (through listing and labeling), inspection agency, or other organization recognized under the definition of ``acceptable.''

Induction heating. The heating of a nominally conductive material due to its own I\2\R losses when the material is placed in a varying electromagnetic field.

Insulated. Separated from other conducting surfaces by a dielectric (including air space) offering a high resistance to the passage of current.

Insulated conductor. See Conductor, Insulated.

Interrupter switch. (Over 600 volts, nominal.) : A switch capable of making, carrying, and interrupting specified currents.

Irrigation Machine. An electrically driven or controlled machine, with one or more motors, not hand portable, and used primarily to transport and distribute water for agricultural purposes.

Isolated. (As applied to location.) : Not readily accessible to persons unless special means for access are used.

Isolated power system. A system comprising an isolating transformer or its equivalent, a line isolation monitor, and its ungrounded circuit conductors.

Labeled. Equipment is ``labeled'' if there is attached to it a label, symbol, or other identifying mark of a nationally recognized testing laboratory:

(1) That makes periodic inspections of the production of such equipment, and

(2) Whose labeling indicates compliance with nationally recognized standards or tests to determine safe use in a specified manner.

Lighting outlet. An outlet intended for the direct connection of a lampholder, a lighting fixture, or a pendant cord terminating in a lampholder.

Line-clearance tree trimming. The pruning, trimming, repairing, maintaining, removing, or clearing of trees or cutting of brush that is within 305 cm (10 ft) of electric supply lines and equipment.

Listed. Equipment is ``listed'' if it is of a kind mentioned in a list that:

(1) Is published by a nationally recognized laboratory that makes periodic inspection of the production of such equipment, and

(2) States that such equipment meets nationally recognized standards or has been tested and found safe for use in a specified manner.

Live parts. Energized conductive components.

Location--:

(1) Damp location. Partially protected locations under canopies, marquees, roofed open porches, and like locations, and interior locations subject to moderate degrees of moisture, such as some basements, some barns, and some cold-storage warehouses.

(2) Dry location. A location not normally subject to dampness or wetness. A location classified as dry may be temporarily subject to dampness or wetness, as in the case of a building under construction.

(3) Wet location. Installations underground or in concrete slabs or masonry in direct contact with the earth, and locations subject to saturation with water or other liquids, such as vehicle-washing areas, and locations unprotected and exposed to weather.

Medium voltage cable (Type MV). A single or multiconductor solid dielectric insulated cable rated 2001 volts or higher.

Metal-clad cable (Type MC). A factory assembly of one or more insulated circuit conductors with or without optical fiber members enclosed in an armor of interlocking metal tape, or a smooth or corrugated metallic sheath.

Mineral-insulated metal-sheathed cable (Type MI). Type MI, mineral-insulated metal-sheathed, cable is a factory assembly of one or more conductors insulated with a highly compressed refractory mineral insulation and enclosed in a liquidtight and gastight continuous copper or alloy steel sheath.

Mobile X-ray. X-ray equipment mounted on a permanent base with wheels or casters or both for moving while completely assembled.

Motor control center. An assembly of one or more enclosed sections having a common power bus and principally containing motor control units.

Nonmetallic-sheathed cable (Types NM, NMC, and NMS). A factory assembly of two or more insulated conductors having an outer sheath of moisture resistant, flame-retardant, nonmetallic material.

Oil (filled) cutout. (Over 600 volts, nominal.) : A cutout in which all or part of the fuse support and its fuse link or disconnecting blade are mounted in oil with complete immersion of the contacts and the fusible portion of the conducting element (fuse link), so that arc interruption by severing of the fuse link or by opening of the contacts will occur under oil.

Open wiring on insulators. Open wiring on insulators is an exposed wiring method using cleats, knobs, tubes, and flexible tubing for the protection and support of single insulated conductors run in or on buildings, and not concealed by the building structure.

Outlet. A point on the wiring system at which current is taken to supply utilization equipment.

Outline lighting. An arrangement of incandescent lamps or electric discharge lighting to outline or call attention to certain features, such as the shape of a building or the decoration of a window.

Overcurrent. Any current in excess of the rated current of equipment or the ampacity of a conductor. It may result from overload, short circuit, or ground fault.

Overhaul : means to perform a major replacement, modification, repair, or rehabilitation similar to that involved when a new building or facility is built, a new wing is added, or an entire floor is renovated.

Overload. Operation of equipment in excess of normal, full-load rating, or of a conductor in excess of rated ampacity that, when it persists for a sufficient length of time, would cause damage or dangerous overheating. A fault, such as a short circuit or ground fault, is not an overload. (See Overcurrent.)

Panelboard. A single panel or group of panel units designed for assembly in the form of a single panel; including buses, automatic overcurrent devices, and with or without switches for the control of light, heat, or power circuits; designed to be placed in a cabinet or cutout box placed in or against a wall or partition and accessible only from the front. (See Switchboard.)

Permanently installed decorative fountains and reflection pools.

Pools that are constructed in the ground, on the ground, or in a building in such a manner that the fountain or pool cannot be readily disassembled for storage, whether or not served by electrical circuits of any nature. These units are primarily constructed for their aesthetic value and are not intended for swimming or wading.

Permanently installed swimming, wading, and therapeutic pools.

Pools that are constructed in the ground or partially in the ground, and all other capable of holding water in a depth greater than 1.07 m (42 in.). The definition also applies to all pools installed inside of a building, regardless of water depth, whether or not served by electric circuits of any nature.

Portable X-ray. X-ray equipment designed to be hand-carried.

Power and control tray cable (Type TC). A factory assembly of two or more insulated conductors, with or without associated bare or covered grounding conductors under a nonmetallic sheath, approved for installation in cable trays, in raceways, or where supported by a messenger wire.

Power fuse. (Over 600 volts, nominal.) : See Fuse.

Power-limited tray cable (Type PLTC). A factory assembly of two or more insulated conductors under a nonmetallic jacket.

Power outlet. An enclosed assembly, which may include receptacles, circuit breakers, fuseholders, fused switches, buses, and watt-hour meter mounting means, that is intended to supply and control power to mobile homes, recreational vehicles, or boats or to serve as a means for distributing power needed to operate mobile or temporarily installed equipment.

Premises wiring. (Premises wiring system.) : The interior and exterior wiring, including power, lighting, control, and signal circuit wiring together with all of their associated hardware, fittings, and wiring devices, both permanently and temporarily installed, that extends from the service point of utility conductors or source of power (such as a battery, a solar photovoltaic system, or a generator, transformer, or converter) to the outlets. Such wiring does not include wiring internal to appliances, fixtures, motors, controllers, motor control centers, and similar equipment.

Qualified person. One who has received training in and has demonstrated skills and knowledge in the construction and operation of electric equipment and installations and the hazards involved.

Note 1 to the definition of ``qualified person:'' Whether an employee is considered to be a ``qualified person'' will depend upon various circumstances in the workplace. For example, it is possible and, in fact, likely for an individual to be considered ``qualified'' with regard to certain equipment in the workplace, but ``unqualified'' as to other equipment. (See 1910.332(b)(3) for training requirements that specifically apply to qualified persons.)

Note 2 to the definition of ``qualified person:'' An employee who is undergoing on-the-job training and who, in the course of such training, has demonstrated an ability to perform duties safely at his or her level of training and who is under the direct supervision of a qualified person is considered to be a qualified person for the performance of those duties.

Raceway. An enclosed channel of metal or nonmetallic materials designed expressly for holding wires, cables, or busbars, with additional functions as permitted in this standard. Raceways include, but are not limited to, rigid metal conduit, rigid nonmetallic conduit, intermediate metal conduit, liquidtight flexible conduit, flexible metallic tubing, flexible metal conduit, electrical metallic tubing, electrical nonmetallic tubing, underfloor raceways, cellular concrete floor raceways, cellular metal floor raceways, surface raceways, wireways, and busways.

Readily accessible. Capable of being reached quickly for operation, renewal, or inspections, so that those needing ready access do not have to climb over or remove obstacles or to resort to portable ladders, chairs, etc. (See Accessible.)

Receptacle. A receptacle is a contact device installed at the outlet for the connection of an attachment plug. A single receptacle is a single contact device with no other contact device on the same yoke. A multiple receptacle is two or more contact devices on the same yoke.

Receptacle outlet. An outlet where one or more receptacles are installed.

Remote-control circuit. Any electric circuit that controls any other circuit through a relay or an equivalent device.

Sealable equipment. Equipment enclosed in a case or cabinet that is provided with a means of sealing or locking so that live parts cannot be made accessible without opening the enclosure. The equipment may or may not be operable without opening the enclosure.

Separately derived system. A premises wiring system whose power is derived from a battery, a solar photovoltaic system, or from a generator, transformer, or converter windings, and that has no direct electrical connection, including a solidly connected grounded circuit conductor, to supply conductors originating in another system.

Service. The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

Service cable. Service conductors made up in the form of a cable.

Service conductors. The conductors from the service point to the service disconnecting means.

Service drop. The overhead service conductors from the last pole or other aerial support to and including the splices, if any, connecting to the service-entrance conductors at the building or other structure.

Service-entrance cable. A single conductor or multiconductor assembly provided with or without an overall covering, primarily used for services, and is of the following types:

(1) Type SE. Type SE, having a flame-retardant, moisture resistant covering; and

(2) Type USE. Type USE, identified for underground use, having a moisture-resistant covering, but not required to have a flame-retardant covering. Cabled, single-conductor, Type USE constructions recognized for underground use may have a bare copper conductor cabled with the assembly. Type USE single, parallel, or cable conductor assemblies recognized for underground use may have a bare copper concentric conductor applied. These constructions do not require an outer overall covering.

Service-entrance conductors, overhead system. The service conductors between the terminals of the service equipment and a point usually outside the building, clear of building walls, where joined by tap or splice to the service drop.

Service entrance conductors, underground system. The service conductors between the terminals of the service equipment and the point of connection to the service lateral.

Service equipment. The necessary equipment, usually consisting of one or more circuit breakers or switches and fuses, and their accessories, connected to the load end of service conductors to a building or other structure, or an otherwise designated area, and intended to constitute the main control and cutoff of the supply.

Service point. The point of connection between the facilities of the serving utility and the premises wiring.

Shielded nonmetallic-sheathed cable (Type SNM). A factory assembly of two or more insulated conductors in an extruded core of moisture-resistant, flame-resistant nonmetallic material, covered with an overlapping spiral metal tape and wire shield and jacketed with an extruded moisture-, flame-, oil-, corrosion-, fungus-, and sunlight-resistant nonmetallic material.

Show window. Any window used or designed to be used for the display of goods or advertising material, whether it is fully or partly enclosed or entirely open at the rear and whether or not it has a platform raised higher than the street floor level.

Signaling circuit. Any electric circuit that energizes signaling equipment.

Storable swimming or wading pool. A pool that is constructed on or above the ground and is capable of holding water to a maximum depth of 1.07 m (42 in.), or a pool with nonmetallic, molded polymeric walls or inflatable fabric walls regardless of dimension.

Switchboard. A large single panel, frame, or assembly of panels on which are mounted, on the face or back, or both, switches, overcurrent and other protective devices, buses, and (usually) instruments. Switchboards are generally accessible from the rear as well as from the front and are not intended to be installed in cabinets. (See Panelboard.)

Switch--:

(1) General-use switch. A switch intended for use in general distribution and branch circuits. It is rated in amperes, and it is capable of interrupting its rated current at its rated voltage.

(2) General-use snap switch. A form of general-use switch constructed so that it can be installed in device boxes or on box

covers, or otherwise used in conjunction with wiring systems recognized by this subpart.

(3) Isolating switch. A switch intended for isolating an electric circuit from the source of power. It has no interrupting rating, and it is intended to be operated only after the circuit has been opened by some other means.

(4) Motor-circuit switch. A switch, rated in horsepower, capable of interrupting the maximum operating overload current of a motor of the same horsepower rating as the switch at the rated voltage.

Switching devices. (Over 600 volts, nominal.) : Devices designed to close and open one or more electric circuits. Included in this category are circuit breakers, cutouts, disconnecting (or isolating) switches, disconnecting means, interrupter switches, and oil (filled) cutouts.

Transportable X-ray. X-ray equipment installed in a vehicle or that may readily be disassembled for transport in a vehicle.

Utilization equipment. Equipment that utilizes electric energy for electronic, electromechanical, chemical, heating, lighting, or similar purposes.

Ventilated. Provided with a means to permit circulation of air sufficient to remove an excess of heat, fumes, or vapors.

Volatile flammable liquid. A flammable liquid having a flash point below 38 [deg]C (100 [deg]F), or a flammable liquid whose temperature is above its flash point, or a Class II combustible liquid having a vapor pressure not exceeding 276 kPa (40 psia) at 38 [deg]C (100 [deg]F) and whose temperature is above its flash point.

Voltage (of a circuit). The greatest root-mean-square (rms) (effective) difference of potential between any two conductors of the circuit concerned.

Voltage, nominal. A nominal value assigned to a circuit or system for the purpose of conveniently designating its voltage class (as 120/240 volts, 480Y/277 volts, 600 volts). The actual voltage at which a circuit operates can vary from the nominal within a range that permits satisfactory operation of equipment.

Voltage to ground. For grounded circuits, the voltage between the given conductor and that point or conductor of the circuit that is grounded; for ungrounded circuits, the greatest voltage between the given conductor and any other conductor of the circuit.

Watertight. So constructed that moisture will not enter the enclosure.

Weatherproof. So constructed or protected that exposure to the weather will not interfere with successful operation. Rainproof, raintight, or watertight equipment can fulfill the requirements for weatherproof where varying weather conditions other than wetness, such as snow, ice, dust, or temperature extremes, are not a factor.

Wireways. Sheet-metal troughs with hinged or removable covers for housing and protecting electric wires and cable and in which conductors are laid in place after the wireway has been installed as a complete system.

Appendix A--References for Further Information

The references contained in this appendix provide nonmandatory information that can be helpful in understanding and complying with Subpart S of this Part. However, compliance with these standards is not a substitute for compliance with Subpart S of this Part.

ANSI/API RP 500-1998 (2002) Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I Division 1 and Division 2.

ANSI/API RP 505-1997 (2002) Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Zone 0, Zone 1 and Zone 2.

ANSI/ASME A17.1-2004 Safety Code for Elevators and Escalators.

ANSI/ASME B30.2-2005 Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist).

ANSI/ASME B30.3-2004 Construction Tower Cranes.

ANSI/ASME B30.4-2003 Portal, Tower, and Pedestal Cranes.

ANSI/ASME B30.5-2004 Mobile And Locomotive Cranes.

ANSI/ASME B30.6-2003 Derricks.

ANSI/ASME B30.7-2001 Base Mounted Drum Hoists.

ANSI/ASME B30.8-2004 Floating Cranes And Floating Derricks.

ANSI/ASME B30.11-2004 Monorails And Underhung Cranes.

ANSI/ASME B30.12-2001 Handling Loads Suspended from Rotorcraft.

ANSI/ASME B30.13-2003 Storage/Retrieval (S/R) Machines and Associated Equipment.

ANSI/ASME B30.16-2003 Overhead Hoists (Underhung).

ANSI/ASME B30.22-2005 Articulating Boom Cranes.

ANSI/ASSE Z244.1-2003 Control of Hazardous Energy Lockout/Tagout and Alternative Methods.

ANSI/ASSE Z490.1-2001 Criteria for Accepted Practices in Safety, Health, and Environmental Training.

ANSI/IEEE C2-2002 National Electrical Safety Code.

ANSI K61.1-1999 Safety Requirements for the Storage and Handling of Anhydrous Ammonia.

ANSI/UL 913-2003 Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1, Hazardous (Classified) Locations.

ASTM D3176-1989 (2002) Standard Practice for Ultimate Analysis of Coal and Coke.

ASTM D3180-1989 (2002) Standard Practice for Calculating Coal and Coke Analyses from As-Determined to Different Bases.

NFPA 20-2003 Standard for the Installation of Stationary Pumps for Fire Protection.

NFPA 30-2003 Flammable and Combustible Liquids Code.

NFPA 32-2004 Standard for Drycleaning Plants.

NFPA 33-2003 Standard for Spray Application Using Flammable or Combustible Materials.

NFPA 34-2003 Standard for Dipping and Coating Processes Using Flammable or Combustible Liquids.

NFPA 35-2005 Standard for the Manufacture of Organic Coatings.

NFPA 36-2004 Standard for Solvent Extraction Plants.

NFPA 40-2001 Standard for the Storage and Handling of Cellulose Nitrate Film.

NFPA 58-2004 Liquefied Petroleum Gas Code.

NFPA 59-2004 Utility LP-Gas Plant Code.

NFPA 70-2002 National Electrical Code. (See also NFPA 70-2005.)

NFPA 70E-2000 Standard for Electrical Safety Requirements for Employee Workplaces. (See also NFPA 70E-2004.)

NFPA 77-2000 Recommended Practice on Static Electricity.

NFPA 80-1999 Standard for Fire Doors and Fire Windows.

NFPA 88A-2002 Standard for Parking Structures.

NFPA 91-2004 Standard for Exhaust Systems for Air Conveying of Vapors, Gases, Mists, and Noncombustible Particulate Solids.

NFPA 101-2006 Life Safety Code.

NFPA 496-2003 Standard for Purged and Pressurized Enclosures for Electrical Equipment.

NFPA 497-2004 Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas.

NFPA 505-2006 Fire Safety Standard for Powered Industrial Trucks Including Type Designations, Areas of Use, Conversions, Maintenance, and Operation.

NFPA 820-2003 Standard for Fire Protection in Wastewater Treatment and Collection Facilities.

NMAB 353-1-1979 Matrix of Combustion-Relevant Properties and Classification of Gases, Vapors, and Selected Solids.

NMAB 353-2-1979 Test Equipment for Use in Determining Classifications of Combustible Dusts.

NMAB 353-3-1980 Classification of Combustible Dust in Accordance with the National Electrical Code.

Appendices B and C [Removed]

Appendix D

29 CFR 1910.34

This appendix contains the text of 29 CFR 1910.34, Coverage and Definitions, which is a part of Subpart E, Exit Routes, Emergency Action Plans, and Fire Prevention Plans. The format is similar to what is presented at *http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=12886.*

Coverage and definitions. - 1910.34

1910.34(a)

Every employer is covered. Sections 1910.34 through 1910.39 apply to workplaces in general industry except mobile workplaces such as vehicles or vessels.

1910.34(b)

Exits routes are covered. The rules in §§ 1910.34 through 1910.39 cover the minimum requirements for exit routes that employers must provide in their workplace so that employees may evacuate the workplace safely during an emergency. Sections 1910.34 through 1910.39 also cover the minimum requirements for emergency action plans and fire prevention plans.

1910.34(c)

Definitions.

Electroluminescent : means a light-emitting capacitor. Alternating current excites phosphor atoms when placed between the electrically conductive surfaces to produce light. This light source is typically contained inside the device.

Exit : means that portion of an exit route that is generally separated from other areas to provide a protected way of travel to the exit discharge. An example of an exit is a two-hour fire resistance-rated enclosed stairway that leads from the fifth floor of an office building to the outside of the building.

Exit access : means that portion of an exit route that leads to an exit. An example of an exit access is a corridor on the fifth floor of an office building that leads to a two-hour fire resistance-rated enclosed stairway (the Exit).

Exit discharge : means the part of the exit route that leads directly outside or to a street, walkway, refuge area, public way, or open space with access to the outside. An example of an exit discharge is a door at the bottom of a two-hour fire resistance-rated enclosed stairway that discharges to a place of safety outside the building.

Exit route : means a continuous and unobstructed path of exit travel from any point within a workplace to a place of safety (including refuge areas). An exit route consists of three parts: The exit access; the exit; and, the exit discharge. (An exit route includes all vertical and horizontal areas along the route.)

High hazard area : means an area inside a workplace in which operations include high hazard materials, processes, or contents.

Occupant load : means the total number of persons that may occupy a workplace or portion of a workplace at any one time. The occupant load of a workplace is calculated by dividing the gross floor area of the workplace or portion of a workplace by the occupant load factor for that particular type of workplace occupancy. Information regarding "Occupant load" is located in NFPA 101-2000, Life Safety Code.

Refuge area: means either:

1910.34(c)(1)

A space along an exit route that is protected from the effects of fire by separation from other spaces within the building by a barrier with at least a one-hour fire resistance-rating; or

1910.34(c)(2)

A floor with at least two spaces, separated from each other by smoke-resistant partitions, in a building protected throughout by an automatic sprinkler system that complies with § 1910.159 of this part.

Self-luminous : means a light source that is illuminated by a self-contained power source (e.g., tritium) and that operates independently from external power sources. Batteries are not acceptable self-contained power sources. The light source is typically contained inside the device.

[FR 67 67962, Nov. 7, 2002]

Appendix E

29 CFR 1910.219

This appendix contains the text of 29 CFR 1910.219, Mechanical power-transmission apparatus, which is a part of Subpart O, Machinery and Machine Guarding. It can be found online at *http://osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9847*.

Mechanical power-transmission apparatus. - 1910.219

1910.219(a) General requirements.

1910.219(a)(1)

This section covers all types and shapes of power-transmission belts, except the following when operating at two hundred and fifty (250) feet per minute or less:

1910.219(a)(1)(i): Flat belts one (1) inch or less in width,

1910.219(a)(1)(ii): flat belts two (2) inches or less in width which are free from metal lacings or fasteners,

1910.219(a)(1)(iii): round belts one-half (1/2) inch or less in diameter; and

1910.219(a)(1)(iv): single strand V-belts, the width of which is thirteen thirty-seconds (13/32) inch or less.

1910.219(a)(2)

Vertical and inclined belts (paragraphs (e) (3) and (4) of this section) if not more than two and one-half (2 1/2) inches wide and running at a speed of less than one thousand (1,000) feet per minute, and if free from metal lacings or fastenings may be guarded with a nip-point belt and pulley guard.

1910.219(a)(3)

For the Textile Industry, because of the presence of excessive deposits of lint, which constitute a serious fire hazard, the sides and face sections only of nip-point belt and pulley guards are required, provided the guard shall extend at least six (6) inches beyond the rim of the pulley on the in-running and off-running sides of the belt and at least two (2) inches away from the rim and face of the pulley in all other directions.

1910.219(a)(4)

This section covers the principal features with which power transmission safeguards shall comply.

1910.219(b) Prime-mover guards -

1910.219(b)(1) Flywheels.

Flywheels located so that any part is seven (7) feet or less above floor or platform shall be guarded in accordance with the requirements of this subparagraph:

1910.219(b)(1)(i): With an enclosure of sheet, perforated, or expanded metal, or woven wire;

1910.219(b)(1)(ii): With guard rails placed not less than fifteen (15) inches nor more than twenty (20) inches from rim. When flywheel extends into pit or is within 12 inches of floor, a standard toeboard shall also be provided;

1910.219(b)(1)(iii): When the upper rim of flywheel protrudes through a working floor, it shall be entirely enclosed or surrounded by a guardrail and toeboard.

1910.219(b)(1)(iv): For flywheels with smooth rims five (5) feet or less in diameter, where the preceding methods cannot be applied, the following may be used: A disk attached to the flywheel in such manner as to cover the spokes of the wheel on the exposed side and present a smooth surface and edge, at the same time providing means for periodic inspection. An open space, not exceeding four (4) inches in width, may be left between the outside edge of the disk and the rim of the wheel if desired, to facilitate turning the wheel over. Where a disk is used, the keys or other dangerous projections not covered by disk shall be cut off or covered. This subdivision does not apply to flywheels with solid web centers.

1910.219(b)(1)(v): Adjustable guard to be used for starting engine or for running adjustment may be provided at the flywheel of gas or oil engines. A slot opening for jack bar will be permitted.

1910.219(b)(1)(vi): Wherever flywheels are above working areas, guards shall be installed having sufficient strength to hold the weight of the flywheel in the event of a shaft or wheel mounting failure.

1910.219(b)(2) Cranks and connecting rods.

Cranks and connecting rods, when exposed to contact, shall be guarded in accordance with paragraphs (m) and (n) of this section, or by a guardrail as described in paragraph (o)(5) of this section.

1910.219(b)(3) Tail rods or extension piston rods.

Tail rods or extension piston rods shall be guarded in accordance with paragraphs (m) and (o) of this section, or by a guardrail on sides and end, with a clearance of not less than fifteen (15) nor more than twenty (20) inches when rod is fully extended.

1910.219(c) Shafting -

1910.219(c)(1) Installation.

1910.219(c)(1)(i): Each continuous line of shafting shall be secured in position against excessive endwise movement.

1910.219(c)(1)(ii): Inclined and vertical shafts, particularly inclined idler shafts, shall be securely held in position against endwise thrust.

1910.219(c)(2) Guarding horizontal shafting.

1910.219(c)(2)(i): All exposed parts of horizontal shafting seven (7) feet or less from floor or working platform, excepting runways used exclusively for oiling, or running adjustments, shall be protected by a stationary casing enclosing shafting completely or by a trough enclosing sides and top or sides and bottom of shafting as location requires.

1910.219(c)(2)(ii): Shafting under bench machines shall be enclosed by a stationary casing, or by a trough at sides and top or sides and bottom, as location requires. The sides of the trough shall come within at least six (6) inches of the underside of table, or if shafting is located near floor within six (6) inches of floor. In every case the sides of trough shall extend at least two (2) inches beyond the shafting or protuberance.

1910.219(c)(3) Guarding vertical and inclined shafting.

Vertical and inclined shafting seven (7) feet or less from floor or working platform, excepting maintenance runways, shall be enclosed with a stationary casing in accordance with requirements of paragraphs (m) and (o) of this section.

1910.219(c)(4) Projecting shaft ends.

1910.219(c)(4)(i): Projecting shaft ends shall present a smooth edge and end and shall not project more than one-half the diameter of the shaft unless guarded by nonrotating caps or safety sleeves.

1910.219(c)(4)(ii): Unused keyways shall be filled up or covered.

1910.219(c)(5) Power-transmission apparatus located in basements.

All mechanical power transmission apparatus located in basements, towers, and rooms used exclusively for power transmission equipment shall be guarded in accordance with this section, except that the requirements for safeguarding belts, pulleys, and shafting need not be complied with when the following requirements are met:

1910.219(c)(5)(i): The basement, tower, or room occupied by transmission equipment is locked against unauthorized entrance.

1910.219(c)(5)(ii): The vertical clearance in passageways between the floor and power transmission beams, ceiling, or any other objects, is not less than five feet six inches (5 ft. 6 in.).

1910.219(c)(5)(iii): The intensity of illumination conforms to the requirements of ANSI A11.1-1965 (R-1970), which is incorporated by reference as specified in Sec. 1910.6.

1910.219(c)(5)(iv): [Reserved]

1910.219(c)(5)(v): The route followed by the oiler is protected in such manner as to prevent accident.

1910.219(d) Pulleys -

1910.219(d)(1) Guarding.

Pulleys, any parts of which are seven (7) feet or less from the floor or working platform, shall be guarded in accordance with the standards specified in paragraphs (m) and (o) of this section. Pulleys serving as balance wheels (e.g., punch presses) on which the point of contact between belt and pulley is more than six feet six inches (6 ft. 6 in.) from the floor or platform may be guarded with a disk covering the spokes.

1910.219(d)(2) Location of pulleys.

1910.219(d)(2)(i): Unless the distance to the nearest fixed pulley, clutch, or hanger exceeds the width of the belt used, a guide shall be provided to prevent the belt from leaving the pulley on the side where insufficient clearance exists.

1910.219(d)(2)(ii): [Reserved]

1910.219(d)(3) Broken pulleys.

Pulleys with cracks, or pieces broken out of rims, shall not be used.

1910.219(d)(4) Pulley speeds.

Pulleys intended to operate at rim speed in excess of manufacturers normal recommendations shall be specially designed and carefully balanced for the speed at which they are to operate.

1910.219(e) Belt, rope, and chain drives -

1910.219(e)(1) Horizontal belts and ropes.

1910.219(e)(1)(i): Where both runs of horizontal belts are seven (7) feet or less from the floor level, the guard shall extend to at least fifteen (15) inches above the belt or to a standard height, except that where both runs of a horizontal belt are 42 inches or less from the floor, the belt shall be fully enclosed in accordance with paragraphs (m) and (o) of this section.

1910.219(e)(1)(ii): In powerplants or power-development rooms, a guardrail may be used in lieu of the guard required by subdivision (i) of this subparagraph.

1910.219(e)(2) Overhead horizontal belts.

1910.219(e)(2)(i): Overhead horizontal belts, with lower parts seven (7) feet or less from the floor or platform, shall be guarded on sides and bottom in accordance with paragraph (o)(3) of this section.

1910.219(e)(2)(ii): Horizontal overhead belts more than seven (7) feet above floor or platform shall be guarded for their entire length under the following conditions:

1910.219(e)(2)(ii)(a) If located over passageways or work places and traveling 1,800 feet or more per minute.

1910.219(e)(2)(ii)(b) If center to center distance between pulleys is ten (10) feet or more.

1910.219(e)(2)(ii)(c) If belt is eight (8) inches or more in width.

1910.219(e)(2)(iii): Where the upper and lower runs of horizontal belts are so located that passage of persons between them would be possible, the passage shall be either:

1910.219(e)(2)(iii)(a) Completely barred by a guardrail or other barrier in accordance with paragraphs (m) and (o) of this section; or

1910.219(e)(2)(iii)(b) Where passage is regarded as necessary, there shall be a platform over the lower run guarded on either side by a railing completely filled in with wire mesh or other filler, or by a solid barrier. The upper run shall be so guarded as to prevent contact therewith either by the worker or by objects carried by him. In powerplants only the lower run of the belt need be guarded.

1910.219(e)(2)(iv): Overhead chain and link belt drives are governed by the same rules as overhead horizontal belts and shall be guarded in the same manner as belts.

1910.219(e)(3) Vertical and inclined belts.

1910.219(e)(3)(i): Vertical and inclined belts shall be enclosed by a guard conforming to standards in paragraphs (m) and (o) of this section.

1910.219(e)(3)(ii): All guards for inclined belts shall be arranged in such a manner that a minimum clearance of seven (7) feet is maintained between belt and floor at any point outside of guard.

1910.219(e)(4) Vertical belts.

Vertical belts running over a lower pulley more than seven (7) feet above floor or platform shall be guarded at the bottom in the same manner as horizontal overhead belts, if conditions are as stated in paragraphs (e)(2)(ii) (a) and (c) of this section.

1910.219(e)(5) Cone-pulley belts.

1910.219(e)(5)(i): The cone belt and pulley shall be equipped with a belt shifter so constructed as to adequately guard the nip point of the belt and pulley. If the frame of the belt shifter does not adequately guard the nip point of the belt and pulley, the nip point shall be further protected by means of a vertical guard placed in front of the pulley and extending at least to the top of the largest step of the cone.

1910.219(e)(5)(ii): If the belt is of the endless type or laced with rawhide laces, and a belt shifter is not desired, the belt will be considered guarded if the nip point of the belt and pulley is protected by a nip point guard located in front of the cone extending at least to the top of the largest step of the cone, and formed to show the contour of the cone in order to give the nip point of the belt and pulley the maximum protection.

1910.219(e)(5)(iii): If the cone is located less than 3 feet from the floor or working platform, the cone pulley and belt shall be guarded to a height of 3 feet regardless of whether the belt is endless or laced with rawhide.

1910.219(e)(6) Belt tighteners.

1910.219(e)(6)(i): Suspended counterbalanced tighteners and all parts thereof shall be of substantial construction and securely fastened; the bearings shall be securely capped. Means must be provided to prevent tightener from falling, in case the belt breaks.

1910.219(e)(6)(ii): Where suspended counterweights are used and not guarded by location, they shall be so encased as to prevent accident.

1910.219(f) Gears, sprockets, and chains -

1910.219(f)(1) Gears.

Gears shall be guarded in accordance with one of the following methods:

1910.219(f)(1)(i): By a complete enclosure; or

1910.219(f)(1)(ii): By a standard guard as described in paragraph (o) of this section, at least seven (7) feet high extending six (6) inches above the mesh point of the gears; or

1910.219(f)(1)(iii): By a band guard covering the face of gear and having flanges extended inward beyond the root of the teeth on the exposed side or sides. Where any portion of the train of gears guarded by a band guard is less than six (6) feet from the floor a disk guard or a complete enclosure to the height of six (6) feet shall be required.

1910.219(f)(2) Hand-operated gears.

Paragraph (f)(1) of this section does not apply to hand-operated gears used only to adjust machine parts and which do not continue to move after hand power is removed. However, the guarding of these gears is highly recommended.

1910.219(f)(3)

Sprockets and chains. All sprocket wheels and chains shall be enclosed unless they are more than seven (7) feet above the floor or platform. Where the drive extends over other machine or working areas, protection against falling shall be provided. This subparagraph does not apply to manually operated sprockets.

1910.219(f)(4) Openings for oiling.

When frequent oiling must be done, openings with hinged or sliding self-closing covers shall be provided. All points not readily accessible shall have oil feed tubes if lubricant is to be added while machinery is in motion.

1910.219(g) Guarding friction drives.

The driving point of all friction drives when exposed to contact shall be guarded, all arm or spoke friction drives and all web friction drives with holes in the web shall be entirely enclosed, and all projecting belts on friction drives where exposed to contact shall be guarded.

1910.219(h) Keys, setscrews, and other projections.

1910.219(h)(1)

All projecting keys, setscrews, and other projections in revolving parts shall be removed or made flush or guarded by metal cover. This subparagraph does not apply to keys or setscrews within gear or sprocket casings or other enclosures, nor to keys, setscrews, or oilcups in hubs of pulleys less than twenty (20) inches in diameter where they are within the plane of the rim of the pulley.

1910.219(h)(2)

It is recommended, however, that no projecting setscrews or oilcups be used in any revolving pulley or part of machinery.

1910.219(i) Collars and couplings -

1910.219(i)(1) Collars.

All revolving collars, including split collars, shall be cylindrical, and screws or bolts used in collars shall not project beyond the largest periphery of the collar.

1910.219(i)(2)

Couplings. Shaft couplings shall be so constructed as to present no hazard from bolts, nuts, setscrews, or revolving surfaces. Bolts, nuts, and setscrews will, however, be permitted where they are covered with safety sleeves or where they are used parallel with the shafting and are countersunk or else do not extend beyond the flange of the coupling.

1910.219(j) Bearings and facilities for oiling.

All drip cups and pans shall be securely fastened.

1910.219(k) Guarding of clutches, cutoff couplings, and clutch pulleys -

1910.219(k)(1) Guards.

Clutches, cutoff couplings, or clutch pulleys having projecting parts, where such clutches are located seven (7) feet or less above the floor or working platform, shall be enclosed by a stationary guard constructed in accordance with this section. A "U" type guard is permissible.

1910.219(k)(2) Engine rooms.

In engine rooms a guardrail, preferably with toeboard, may be used instead of the guard required by paragraph (k)(1) of this section, provided such a room is occupied only by engine room attendants.

1910.219(l) Belt shifters, clutches, shippers, poles, perches, and fasteners -

1910.219(l)(1) Belt shifters.

1910.219(l)(1)(i): Tight and loose pulleys on all new installations made on or after August 31, 1971, shall be equipped with a permanent belt shifter provided with mechanical means to prevent belt from creeping from loose to tight pulley. It is recommended that old installations be changed to conform to this rule.

1910.219(l)(1)(ii): Belt shifter and clutch handles shall be rounded and be located as far as possible from danger of accidental contact, but within easy reach of the operator. Where belt shifters are not directly located over a machine or bench, the handles shall be cut off six feet six inches (6 ft. 6 in.) above floor level.

1910.219(l)(2) Belt shippers and shipper poles.

The use of belt poles as substitutes for mechanical shifters is not recommended.

1910.219(l)(3) Belt perches.

Where loose pulleys or idlers are not practicable, belt perches in form of brackets, rollers, etc., shall be used to keep idle belts away from the shafts.

1910.219(l)(4) Belt fasteners.

Belts which of necessity must be shifted by hand and belts within seven (7) feet of the floor or working platform which are not guarded in accordance with this section shall not be fastened with metal in any case, nor with any other fastening which by construction or wear will constitute an accident hazard.

1910.219(m) Standard guards-general requirements -

1910.219(m)(1) Materials.

1910.219(m)(1)(i): Standard conditions shall be secured by the use of the following materials. Expanded metal, perforated or solid sheet metal, wire mesh on a frame of angle iron, or iron pipe securely fastened to floor or to frame of machine.

1910.219(m)(1)(ii): All metal should be free from burrs and sharp edges.

1910.219(m)(2) Methods of manufacture.

1910.219(m)(2)(i): Expanded metal, sheet or perforated metal, and wire mesh shall be securely fastened to frame.

1910.219(n) [Reserved]

1910.219(o) Approved materials -

1910.219(o)(1) Minimum requirements.

The materials and dimensions specified in this paragraph shall apply to all guards, except horizontal overhead belts, rope, cable, or chain guards more than seven (7) feet above floor, or platform.

1910.219(o)(1)(i): [Reserved]

> **1910.219(o)(1)(i)(a)** All guards shall be rigidly braced every three (3) feet or fractional part of their height to some fixed part of machinery or building structure. Where guard is exposed to contact with moving equipment additional strength may be necessary.

1910.219(o)(2) Wood guards.

1910.219(o)(2)(i): Wood guards may be used in the woodworking and chemical industries, in industries where the presence of fumes or where manufacturing conditions would cause the rapid deterioration of metal guards; also in construction work and in locations outdoors where extreme cold or extreme heat make metal guards and railings undesirable. In all other industries, wood guards shall not be used.

1910.219(o)(3) Guards for horizontal overhead belts.

1910.219(o)(3)(i): Guards for horizontal overhead belts shall run the entire length of the belt and follow the line of the pulley to the ceiling or be carried to the nearest wall, thus enclosing the belt effectively. Where belts are so located as to make it impracticable to carry the guard to wall or ceiling, construction of guard shall be such as to enclose completely the top and bottom runs of belt and the face of pulleys.

1910.219(o)(3)(ii): [Reserved]

1910.219(o)(3)(iii): Suitable reinforcement shall be provided for the ceiling rafters or overhead floor beams, where such is necessary, to sustain safely the weight and stress likely to be imposed by the guard. The interior surface of all guards, by which is meant the surface of the guard with which a belt will come in contact, shall be smooth and free from all projections of any character, except where construction demands it; protruding shallow roundhead rivets may be used. Overhead belt guards shall be at least one-quarter wider than belt which they protect, except that this clearance need not in any case exceed six (6) inches on each side. Overhead rope drive and block and roller-chain-drive guards shall be not less than six (6) inches wider than the drive on each side. In overhead silent chain-drive guards where the chain is held from lateral displacement on the sprockets, the side clearances required on drives of twenty (20) inch centers or under shall be not less than one-fourth inch from the nearest moving chain part, and on drives of over twenty (20) inch centers a minimum of one-half inch from the nearest moving chain part.

1910.219(o)(4) Guards for horizontal overhead rope and chain drives.

Overhead-rope and chain-drive guard construction shall conform to the rules for overhead-belt guard.

1910.219(o)(5) Guardrails and toeboards.

1910.219(o)(5)(i): Guardrail shall be forty-two (42) inches in height, with midrail between top rail and floor.

1910.219(o)(5)(ii): Posts shall be not more than eight (8) feet apart; they are to be permanent and substantial, smooth, and free from protruding nails, bolts, and splinters. If made of pipe, the post shall be one and one-fourth (1 1/4) inches inside diameter, or larger. If made of metal shapes or bars, their section shall be equal in strength to that of one and one-half (1 1/2) by one and one-half (1 1/2) by three-sixteenths (3/16) inch angle iron. If made of wood, the posts shall be two by four (2 X 4) inches or larger. The upper rail shall be two by four (2 X 4) inches, or two one by four (1 X 4) strips, one at the top and one at the side of posts. The midrail may be one by four (1 X 4) inches or more. Where panels are fitted with expanded metal or wire mesh the middle rails may be omitted. Where guard is exposed to contact with moving equipment, additional strength may be necessary.

1910.219(o)(5)(iii): Toeboards shall be four (4) inches or more in height, of wood, metal, or of metal grill not exceeding one (1) inch mesh.

1910.219(p) Care of equipment -

1910.219(p)(1) General.

All power-transmission equipment shall be inspected at intervals not exceeding 60 days and be kept in good working condition at all times.

1910.219(p)(2) Shafting.

1910.219(p)(2)(i): Shafting shall be kept in alignment, free from rust and excess oil or grease.

1910.219(p)(2)(ii): Where explosives, explosive dusts, flammable vapors or flammable liquids exist, the hazard of static sparks from shafting shall be carefully considered.

1910.219(p)(3) Bearings.

Bearings shall be kept in alignment and properly adjusted.

1910.219(p)(4) Hangers.

Hangers shall be inspected to make certain that all supporting bolts and screws are tight and that supports of hanger boxes are adjusted properly.

1910.219(p)(5) Pulleys.

1910.219(p)(5)(i): Pulleys shall be kept in proper alignment to prevent belts from running off.

1910.219(p)(6) Care of belts.

1910.219(p)(6)(i): [Reserved]

1910.219(p)(6)(ii): Inspection shall be made of belts, lacings, and fasteners and such equipment kept in good repair.

1910.219(p)(7) Lubrication.

The regular oilers shall wear tight-fitting clothing. Machinery shall be oiled when not in motion, wherever possible.

[39 FR 23502, June 27, 1974, as amended at 43 FR 49750, Oct. 24, 1978; 43 FR 51760; Nov. 7, 1978; 49 FR 5323, Feb. 10, 1984; 61 FR 9227, March 7, 1996; 69 FR 31882, June 8, 2004]

Appendix F

29 CFR 1926 Subpart O

This appendix contains the text of 29 CFR 1926 Subpart O, Motor Vehicles, Mechanized Equipment, and Marine Operations. It can be found online at *http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10929*.

1926.600

1926.600(a) General requirements.

1926.600(a)(1)

All equipment left unattended at night, adjacent to a highway in normal use, or adjacent to construction areas where work is in progress, shall have appropriate lights or reflectors, or barricades equipped with appropriate lights or reflectors, to identify the location of the equipment.

1926.600(a)(2)

A safety tire rack, cage, or equivalent protection shall be provided and used when inflating, mounting, or dismounting tires installed on split rims, or rims equipped with locking rings or similar devices.

1926.600(a)(3)

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1926.600(a)(3)(i) : Heavy machinery, equipment, or parts thereof, which are suspended or held aloft by use of slings, hoists, or jacks shall be substantially blocked or cribbed to prevent falling or shifting before employees are permitted to work under or between them. Bulldozer and scraper blades, end-loader buckets, dump bodies, and similar equipment, shall be either fully lowered or blocked when being repaired or when not in use. All controls shall be in a neutral position, with the motors stopped and brakes set, unless work being performed requires otherwise.

1926.600(a)(3)(ii) : Whenever the equipment is parked, the parking brake shall be set. Equipment parked on inclines shall have the wheels chocked and the parking brake set.

1926.600(a)(4)

The use, care and charging of all batteries shall conform to the requirements of Subpart K of this part.

1926.600(a)(5)

All cab glass shall be safety glass, or equivalent, that introduces no visible distortion affecting the safe operation of any machine covered by this subpart.

1926.600(a)(6)

All equipment covered by this subpart shall comply with the requirements of 1926.550(a)(15) when working or being moved in the vicinity of power lines or energized transmitters.

1926.600(a)(7)

"Rolling railroad cars." Derail and/or bumper blocks shall be provided on spur railroad tracks where a rolling car could contact other cars being worked, enter a building, work or traffic area.

1926.600(b) Specific requirements. [Reserved]

[44 FR 8577, Feb. 9, 1979; 44 FR 20940, Apr, 6, 1979, as amended at 58 FR 35183, June 30, 1993]

1926.601

1926.601(a) Coverage.

Motor vehicles as covered by this part are those vehicles that operate within an off-highway jobsite, not open to public traffic. The requirements of this section do not apply to equipment for which rules are prescribed in 1926.602.

1926.601(b) General requirements.

1926.601(b)(1)

All vehicles shall have a service brake system, an emergency brake system, and a parking brake system. These systems may use common components, and shall be maintained in operable condition.

1926.601(b)(2)

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1926.601(b)(2)(i) : Whenever visibility conditions warrant additional light, all vehicles, or combinations of vehicles, in use shall be equipped with at least two headlights and two taillights in operable condition.

1926.601(b)(2)(ii) : All vehicles, or combination of vehicles, shall have brake lights in operable condition regardless of light conditions.

1926.601(b)(3)

All vehicles shall be equipped with an adequate audible warning device at the operator's station and in an operable condition.

1926.601(b)(4)

No employer shall use any motor vehicle equipment having an obstructed view to the rear unless:

1926.601(b)(4)(i) : The vehicle has a reverse signal alarm audible above the surrounding noise level or:

1926.601(b)(4)(ii) : The vehicle is backed up only when an observer signals that it is safe to do so.

1926.601(b)(5)

All vehicles with cabs shall be equipped with windshields and powered wipers. Cracked and broken glass shall be replaced. Vehicles operating in areas or under conditions that cause fogging or frosting of the windshields shall be equipped with operable defogging or defrosting devices.

1926.601(b)(6)

All haulage vehicles, whose pay load is loaded by means of cranes, power shovels, loaders, or similar equipment, shall have a cab shield and/or canopy adequate to protect the operator from shifting or falling materials.

1926.601(b)(7)

Tools and material shall be secured to prevent movement when transported in the same compartment with employees.

1926.601(b)(8)

Vehicles used to transport employees shall have seats firmly secured and adequate for the number of employees to be carried.

1926.601(b)(9)

Seat belts and anchorages meeting the requirements of 49 CFR Part 571 (Department of Transportation, Federal Motor Vehicle Safety Standards) shall be installed in all motor vehicles.

1926.601(b)(10)

Trucks with dump bodies shall be equipped with positive means of support, permanently attached, and capable of being locked in position to prevent accidental lowering of the body while maintenance or inspection work is being done.

1926.601(b)(11)

Operating levers controlling hoisting or dumping devices on haulage bodies shall be equipped with a latch or other device which will prevent accidental starting or tripping of the mechanism.

1926.601(b)(12)

Trip handles for tailgates of dump trucks shall be so arranged that, in dumping, the operator will be in the clear.

1926.601(b)(13)

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1926.601(b)(13)(i) : All rubber-tired motor vehicle equipment manufactured on or after May 1, 1972, shall be equipped with fenders. All rubber-tired motor vehicle equipment manufactured before May 1, 1972, shall be equipped with fenders not later than May 1, 1973.

1926.601(b)(13)(ii) : Mud flaps may be used in lieu of fenders whenever motor vehicle equipment is not designed for fenders.

1926.601(b)(14)

All vehicles in use shall be checked at the beginning of each shift to assure that the following parts, equipment, and accessories are in safe operating condition and free of apparent damage that could cause failure while in use: service brakes, including trailer brake connections; parking system (hand brake); emergency stopping system (brakes); tires; horn; steering mechanism; coupling devices; seat belts; operating controls; and safety devices. All defects shall be corrected before the vehicle is placed in service. These requirements also apply to equipment such as lights, reflectors, windshield wipers, defrosters, fire extinguishers, etc., where such equipment is necessary.

1926.602(a) Earthmoving equipment; General.

1926.602(a)(1)

These rules apply to the following types of earthmoving equipment: scrapers, loaders, crawler or wheel tractors, bulldozers, off-highway trucks, graders, agricultural and industrial tractors, and similar equipment. The promulgation of specific rules for compactors and rubber-tired "skid-steer" equipment is reserved pending consideration of standards currently being developed.

1926.602(a)(2) Seat belts.

1926.602(a)(2)(i) : Seat belts shall be provided on all equipment covered by this section and shall meet the requirements of the Society of Automotive Engineers, J386-1969, Seat Belts for Construction Equipment. Seat belts for agricultural and light industrial tractors shall meet the seat belt requirements of Society of Automotive Engineers J333a-1970, Operator Protection for Agricultural and Light Industrial Tractors.

1926.602(a)(2)(ii) : Seat belts need not be provided for equipment which is designed only for standup operation.

1926.602(a)(2)(iii) : Seat belts need not be provided for equipment which does not have roll-over protective structure (ROPS) or adequate canopy protection.

1926.602(a)(3) Access roadways and grades.

1926.602(a)(3)(i) : No employer shall move or cause to be moved construction equipment or vehicles upon any access roadway or grade unless the access roadway or grade is constructed and maintained to accommodate safely the movement of the equipment and vehicles involved.

1926.602(a)(3)(ii) : Every emergency access ramp and berm used by an employer shall be constructed to restrain and control runaway vehicles.

1926.602(a)(4) Brakes.

All earthmoving equipment mentioned in this 1926.602(a) shall have a service braking system capable of stopping and holding the equipment fully loaded, as specified in Society of Automotive Engineers SAE-J237, Loader Dozer-1971, J236, Graders-1971, and J319b, Scrapers-1971. Brake systems for self-propelled rubber-tired off-highway equipment manufactured after January 1, 1972 shall meet the applicable minimum performance criteria set forth in the following Society of Automotive Engineers Recommended Practices:.

Self-Propelled Scrapers	SAE J319b-1971
Self-Propelled Graders	SAE J236-1971
Trucks and Wagons	SAE J166-1971
Front End Loaders and Dozers	SAE J237-1971

1926.602(a)(5) Fenders.

Pneumatic-tired earth-moving haulage equipment (trucks, scrapers, tractors, and trailing units) whose maximum speed exceeds 15 miles per hour, shall be equipped with fenders on all wheels to meet the requirements of Society of Automotive Engineers SAE J321a-1970, Fenders for Pneumatic-Tired Earthmoving Haulage Equipment. An employer may, of course, at any time seek to show under 1926.2, that the uncovered wheels present no hazard to personnel from flying materials.

1926.602(a)(6) Rollover protective structures (ROPS).

See Subpart W of this part for requirements for rollover protective structures and overhead protection.

1926.602(a)(7) Rollover protective structures for off-highway trucks.

The promulgation of standards for rollover protective structures for off-highway trucks is reserved pending further study and development.

1926.602(a)(8) Specific effective dates-brakes and fenders.

1926.602(a)(8)(i) : Equipment mentioned in paragraph (a)(4) and (5) of this section, and manufactured after January 1, 1972, which is used by any employer after that date, shall comply with the applicable rules prescribed therein concerning brakes and fenders. Equipment mentioned in paragraphs (a) (4) and (5) of this section, and manufactured before January 1, 1972, which is used by any employer after that date, shall meet the applicable rules prescribed herein not later than June 30, 1973. It should be noted that, as permitted under 1926.2, employers may request variations from the applicable brakes and fender standards required by this subpart. Employers wishing to seek variations from the applicable brakes and fenders rules may submit any requests for variations after the publication of this document in the Federal Register. Any statements intending to meet the requirements of 1926.2(b)(4), should specify how the variation would protect the safety of the employees by providing for any compensating restrictions on the operation of equipment.

1926.602(a)(8)(ii) : Notwithstanding the provisions of paragraphs (a)(5) and (a)(8)(i) of this section, the requirement that fenders be installed on pneumatic-tired earthmoving haulage equipment, is suspended pending reconsideration of the requirement.

1926.602(a)(9) Audible alarms.

1926.602(a)(9)(i) : All bidirectional machines, such as rollers, compacters, front-end loaders, bulldozers, and similar equipment, shall be equipped with a horn, distinguishable from the surrounding noise level, which shall be operated as needed when the machine is moving in either direction. The horn shall be maintained in an operative condition.

1926.602(a)(9)(ii) : No employer shall permit earthmoving or compacting equipment which has an obstructed view to the rear to be used in reverse gear unless the equipment has in operation a reverse signal alarm distinguishable from the surrounding noise level or an employee signals that it is safe to do so.

1926.602(a)(10) Scissor points.

Scissor points on all front-end loaders, which constitute a hazard to the operator during normal operation, shall be guarded.

1926.602(b) Excavating and other equipment.

1926.602(b)(1)

Tractors covered in paragraph (a) of this section shall have seat belts as required for the operators when seated in the normal seating arrangement for tractor operation, even though back-hoes, breakers, or other similar attachments are used on these machines for excavating or other work.

1926.602(b)(2)

For the purposes of this subpart and of Subpart N of this part, the nomenclatures and descriptions for measurement of dimensions of machinery and attachments shall be as described in Society of Automotive Engineers 1970 Handbook, pages 1088 through 1103.

1926.602(b)(3)

The safety requirements, ratios, or limitations applicable to machines or attachment usage covered in Power Crane and Shovel Associations Standards No. 1 and No. 2 of 1968, and No. 3 of 1969, shall be complied with, and shall apply to cranes, machines, and attachments under this part.

1926.602(c) Lifting and hauling equipment (other than equipment covered under Subpart N of this part).

1926.602(c)(1)

Industrial trucks shall meet the requirements of 1926.600 and the following:

1926.602(c)(1)(i) : Lift trucks, stackers, etc., shall have the rated capacity clearly posted on the vehicle so as to be clearly visible to the operator. When auxiliary removable counterweights are provided by the manufacturer, corresponding alternate rated capacities also shall be clearly shown on the vehicle. These ratings shall not be exceeded.

1926.602(c)(1)(ii) : No modifications or additions which affect the capacity or safe operation of the equipment shall be made without the manufacturer's written approval. If such modifications or changes are made, the capacity, operation, and maintenance instruction plates, tags, or decals shall be changed accordingly. In no case shall the original safety factor of the equipment be reduced.

1926.602(c)(1)(iii) : If a load is lifted by two or more trucks working in unison, the proportion of the total load carried by any one truck shall not exceed its capacity.

1926.602(c)(1)(iv) : Steering or spinner knobs shall not be attached to the steering wheel unless the steering mechanism is of a type that prevents road reactions from causing the steering handwheel to spin. The steering knob shall be mounted within the periphery of the wheel.

1926.602(c)(1)(v) : All high lift rider industrial trucks shall be equipped with overhead guards which meet the configuration and structural requirements as defined in paragraph 421 of American National Standards Institute B56.1-1969, Safety Standards for Powered Industrial Trucks.

1926.602(c)(1)(vi) : All industrial trucks in use shall meet the applicable requirements of design, construction, stability, inspection, testing, maintenance, and operation, as defined in American National Standards Institute B56.1-1969, Safety Standards for Powered Industrial Trucks.

1926.602(c)(1)(vii) : Unauthorized personnel shall not be permitted to ride on powered industrial trucks. A safe place to ride shall be provided where riding of trucks is authorized.

1926.602(c)(1)(viii) : Whenever a truck is equipped with vertical only, or vertical and horizontal controls elevatable with the lifting carriage or forks for lifting personnel, the following additional precautions shall be taken for the protection of personnel being elevated.

1926.602(c)(1)(viii)(A) Use of a safety platform firmly secured to the lifting carriage and/or forks.

1926.602(c)(1)(viii)(B) Means shall be provided whereby personnel on the platform can shut off power to the truck.

1926.602(c)(1)(viii)(C) Such protection from falling objects as indicated necessary by the operating conditions shall be provided.

1926.602(d) Powered industrial truck operator training.

Note: The requirements applicable to construction work under this paragraph are identical to those set forth at §1910.178(l) of this chapter.

[44 FR 8577, Feb. 9, 1979; 44 FR 20940, Apr. 6, 1979, as amended at 58 FR 35183, June 30, 1993; 63 FR 66274, Dec. 1, 1998]

1926.603

1926.603(a) General requirements.

1926.603(a)(1)

Boilers and piping systems which are a part of, or used with, pile driving equipment shall meet the applicable requirements of the American Society of Mechanical Engineers, Power Boilers (section I).

1926.603(a)(2)

All pressure vessels which are a part of, or used with, pile driving equipment shall meet the applicable requirements of the American Society of Mechanical Engineers, Pressure Vessels (section VIII).

1926.603(a)(3)

Overhead protection, which will not obscure the vision of the operator and which meets the requirements of Subpart N of this part, shall be provided. Protection shall be the equivalent of 2-inch planking or other solid material of equivalent strength.

1926.603(a)(4)

Stop blocks shall be provided for the leads to prevent the hammer from being raised against the head block.

1926.603(a)(5)

A blocking device, capable of safely supporting the weight of the hammer, shall be provided for placement in the leads under the hammer at all times while employees are working under the hammer.

1926.603(a)(6)

Guards shall be provided across the top of the head block to prevent the cable from jumping out of the sheaves.

1926.603(a)(7)

When the leads must be inclined in the driving of batter piles, provisions shall be made to stabilize the leads.

1926.603(a)(8)

Fixed leads shall be provided with ladder, and adequate rings, or similar attachment points, so that the loft worker may engage his safety belt lanyard to the leads. If the leads are provided with loft platforms(s), such platform(s) shall be protected by standard guardrails.

1926.603(a)(9)

Steam hose leading to a steam hammer or jet pipe shall be securely attached to the hammer with an adequate length of at least 1/4-inch diameter chain or cable to prevent whipping in the event the joint at the hammer is broken. Air hammer hoses shall be provided with the same protection as required for steam lines.

1926.603(a)(10)

Safety chains, or equivalent means, shall be provided for each hose connection to prevent the line from thrashing around in case the coupling becomes disconnected.

1926.603(a)(11)

Steam line controls shall consist of two shutoff valves, one of which shall be a quick-acting lever type within easy reach of the hammer operator.

1926.603(a)(12)

Guys, outriggers, thrustouts, or counterbalances shall be provided as necessary to maintain stability of pile driver rigs.

1926.603(b) Pile driving from barges and floats.

Barges or floats supporting pile driving operations shall meet the applicable requirements of 1926.605.

1926.603(c) Pile driving equipment.

1926.603(c)(1)

Engineers and winchmen shall accept signals only from the designated signalmen.

1926.603(c)(2)

All employees shall be kept clear when piling is being hoisted into the leads.

1926.603(c)(3)

When piles are being driven in an excavated pit, the walls of the pit shall be sloped to the angle of repose or sheet-piled and braced.

1926.603(c)(4)

When steel tube piles are being "blown out", employees shall be kept well beyond the range of falling materials.

1926.603(c)(5)

When it is necessary to cut off the tops of driven piles, pile driving operations shall be suspended except where the cutting operations are located at least twice the length of the longest pile from the driver.

1926.603(c)(6)

When driving jacked piles, all access pits shall be provided with ladders and bulkheaded curbs to prevent material from falling into the pit.

1926.604

1926.604(a) General requirements.

1926.604(a)(1)

Employees engaged in site clearing shall be protected from hazards of irritant and toxic plants and suitably instructed in the first aid treatment available.

1926.604(a)(2)

All equipment used in site clearing operations shall be equipped with rollover guards meeting the requirements of this subpart. In addition, rider-operated equipment shall be equipped with an overhead and rear canopy guard meeting the following requirements:

1926.604(a)(2)(i) : The overhead covering on this canopy structure shall be of not less than 1/8-inch steel plate or 1/4-inch woven wire mesh with openings no greater than 1 inch, or equivalent.

1926.604(a)(2)(ii) : The opening in the rear of the canopy structure shall be covered with not less than 1/4-inch woven wire mesh with openings no greater than 1 inch.

1926.604(b) Specific requirements. [Reserved]

1926.605

1926.605(a) Material handling operations.

1926.605(a)(1)

Operations fitting the definition of "material handling" shall be performed in conformance with applicable requirements of Part 1918, "Safety and Health Regulations for Longshoring" of this chapter. The term "longshoring operations" means the loading, unloading, moving, or handling of construction materials, equipment and supplies, etc. into, in, on, or out of any vessel from a fixed structure or shore-to-vessel, vessel-to-shore or fixed structure or vessel-to-vessel.

1926.605(b) Access to barges.

1926.605(b)(1)

Ramps for access of vehicles to or between barges shall be of adequate strength, provided with side boards, well maintained, and properly secured.

1926.605(b)(2)

Unless employees can step safely to or from the wharf, float, barge, or river towboat, either a ramp, meeting the requirements of paragraph (b)(1) of this section, or a safe walkway, shall be provided.

1926.605(b)(3)

Jacob's ladders shall be of the double rung or flat tread type. They shall be well maintained and properly secured.

1926.605(b)(4)

A Jacob's ladder shall either hang without slack from its lashings or be pulled up entirely.

1926.605(b)(5)

When the upper end of the means of access rests on or is flush with the top of the bulwark, substantial steps properly secured and equipped with at least one substantial hand rail approximately 33 inches in height, shall be provided between the top of the bulwark and the deck.

1926.605(b)(6)

Obstructions shall not be laid on or across the gangway.

1926.605(b)(7)

The means of access shall be adequately illuminated for its full length.

1926.605(b)(8)

Unless the structure makes it impossible, the means of access shall be so located that the load will not pass over employees.

1926.605(c) Working surfaces of barges.

1926.605(c)(1)

Employees shall not be permitted to walk along the sides of covered lighters or barges with coamings more than 5 feet high, unless there is a 3-foot clear walkway, or a grab rail, or a taut handline is provided.

1926.605(c)(2)

Decks and other working surfaces shall be maintained in a safe condition.

1926.605(c)(3)

Employees shall not be permitted to pass fore and aft, over, or around deckloads, unless there is a safe passage.

1926.605(c)(4)

Employees shall not be permitted to walk over deckloads from rail to coaming unless there is a safe passage. If it is necessary to stand at the outboard or inboard edge of the deckload where less than 24 inches of bulwark, rail, coaming, or other protection exists, all employees shall be provided with a suitable means of protection against falling from the deckload.

1926.605(d) First-aid and lifesaving equipment.

1926.605(d)(1)

Provisions for rendering first aid and medical assistance shall be in accordance with Subpart D of this part.

1926.605(d)(2)

The employer shall ensure that there is in the vicinity of each barge in use at least one U.S. Coast Guard-approved 30-inch lifering with not less than 90 feet of line attached, and at least one portable or permanent ladder which will reach the top of the apron to the surface of the water. If the above equipment is not available at the pier, the employer shall furnish it during the time that he is working the barge.

1926.605(d)(3)

Employees walking or working on the unguarded decks of barges shall be protected with U.S. Coast Guard-approved work vests or buoyant vests.

1926.605(e) Commercial diving operations.

Commercial diving operations shall be subject to Subpart T of Part 1910, 1910.401-1910.441, of this chapter.

[39 FR 22801, June 24, 1974, as amended at 42 FR 37674, July 22, 1977]

1926.606

1926.606(a)

"Apron" - The area along the waterfront edge of the pier or wharf.

1926.606(b)

"Bulwark" - The side of a ship above the upper deck.

1926.606(c)

"Coaming" - The raised frame, as around a hatchway in the deck, to keep out water.

1926.606(d)

"Jacob's ladder" - A marine ladder of rope or chain with wooden or metal rungs.

1926.606(e)

"Rail", for the purpose of 1926.605, means a light structure serving as a guard at the outer edge of a ship's deck.

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