RECLAMATION

Managing Water in the West

Reclamation Safety and Health Standards

U.S. Department of the Interior
Bureau of Reclamation

July 2014

Mission Statements

The U.S. Department of the Interior protects America's natural resources and heritage, honors our cultures and tribal communities, and supplies the energy to power our future.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Instructions for Updating the 2009 Edition of Reclamation Safety and Health Standards

The following title page should be removed:

- Reclamation Safety and Health Standards (October 2009)

The following title page should be inserted in its place:

- Reclamation Safety and Health Standards (July 2014)

The following page should be inserted behind the title page:

- This errata sheet (July 2014)

The following sections should be removed in their entirety:

- Section 8 – Personal Protective Equipment (October 2009)
- Section 16 - Fall Protection and Rope-Supported Work (October 2009)
- Section 18 – Slings, Chains, and Accessories (October 2009)
- Section 19 – Hoisting Equipment, Piledrivers, and Conveyors (October 2009)

The following sections should be inserted in their place:

- Section 8 – "Personal Protective Equipment" (August 2013)
- Section 16 – "Fall Protection and Rope-Access Work" (August 2013)
- Section 18 – "Slings and Rigging Hardware" (May 2014)
- Section 19 – "Hoisting and Pile Driving Equipment" (May 2014)

The following page should be inserted into Appendix E - Slings:

- Page E-23, Table E-22 – "Safe working loads for forged alloy steel shackles"

Note: This errata sheet; the revised title page; revised sections 8, 16, 18, and 19; and revised table E-22 can also be accessed on the Reclamation Safety and Health Standards Web site: http://www.usbr.gov/ssle/safety/RSHS/rshs.html.

Foreword

A contemporary water management agency, the Bureau of Reclamation is the largest wholesale water supplier in the United States, with operations and facilities in the 17 Western States. Today, these facilities include 348 reservoirs with the capacity to store 245 million acre-feet of water. Reclamation projects supply one out of five western farmers with irrigation water for approximately 10 million farmland acres.

Reclamation facilities also provide water to about 31 million people for municipal and industrial uses. In addition, Reclamation is the Nation's second largest producer of hydroelectric power, generating more than 42 billion kilowatthours of energy each year from 58 hydroelectric powerplants. Its facilities also provide substantial flood control, recreation, and fish and wildlife benefits.

Though the times and needs have changed, one goal has remained constant—Reclamation is committed to maintaining a safe place for employees, visitors, and the public. Procedures, processes, and regulations have changed with technology, but the commitment and value of safety excellence has not. This mission requires safety to be at the forefront of every job, in all phases of planning and operations, and of highest priority at all times. Excellence in safety is a core value that must be consistently emphasized and maintained.

Most activities involve risk, but using a systematic process of identifying hazards, developing and implementing countermeasures, and evaluating and overseeing the activity reduces accident potential. The Reclamation Safety and Health Standards, the foundation of the safety program, will be used for all activities in Reclamation to perform work safely and maintain safe working conditions.

By incorporating safe work procedures in all activities, safety becomes more than mere compliance. Safety is a lifetime value.

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Section 1

Authority, Purpose, and Scope

This section sets forth the authority, purpose, and scope of Reclamation Safety and Health Standards.

1.1 Authority for Reclamation Safety and Health Standards

Federal law and departmental regulations provide the authority to expend funds and manpower to develop and implement programs that protect the safety and health of Federal and contractor employees and prevent accidental damage of Government property. (See 5 United States Code [U.S.C.] 7902; Sections 6 and 19 of Public Law 91-596, Occupational Safety and Health Act of 1970; 29 U.S.C. 651 et. seq., 43 U.S.C. 1457, Executive Order 12196, 29 Code of Federal Regulations [CFR] 1960; Contract Work Hours and Safety Standards Act; and Departmental Manual, 485 DM.)

These standards are incorporated into the Reclamation Manual by reference through SAF 01-01, Safety and Occupational Health – General, Para. 3.E. under a waiver authorized by the Commissioner dated December 22, 2009.

1.2 Purpose and Scope

The standards prescribe the safety and health requirements for all Bureau of Reclamation (Reclamation) activities and operations.

All contracts or agreements for performance of work on Reclamation facilities must incorporate provisions for compliance with these standards. These standards are consistent with the health and safety standards prevalent in industry, the Occupational Safety and Health Act of 1970, Public Law 91-596, and Department of the Interior regulations.

This section sets forth the authority, purpose, and scope of Reclamation Safety and Health Standards.

Section 2

General Requirements

This section sets forth the general requirements of Reclamation Safety and Health Standards. The section applies to all operations on Reclamation facilities and lands.

2.1 General Duty Requirements

2.1.1 Organization Duty. The operating organization must provide employees a safe and healthful work environment. This responsibility includes, but is not limited to, implementing and enforcing all applicable program elements and provisions of these standards. Equipment and facilities must conform fully with the standards contained and referenced in these standards.

2.1.2 Employee Duty. Employees must observe all safety and health regulations and comply with instructions issued to them by their supervisors. Employees must promptly correct unsafe working conditions or report them to their supervisor or other proper authority.

2.2 Other Codes and Statutes

In addition to the requirements set forth in these standards, all operations on Reclamation facilities and operations utilizing Reclamation equipment must comply with applicable provisions of Federal, State, and municipal safety, health, and sanitary statutes and codes. If there is a difference between the provisions of these standards and the safety and health regulations promulgated by the U.S. Department of Labor in Title 29 CFR, Parts 1910 and 1926, Occupational Safety and Health Act of 1970, or approved State plans, the more stringent provision will prevail.

2.3 Variances

No variance to the provisions of these standards must be approved that endangers the health and safety of any person, is not consistent with the intent of the provisions of these standards, or would be a variance to Federal or State regulations. If a literal application of a Reclamation provision of these standards is impractical or creates conflicts, the appropriate office head or contracting officer (CO), in consultation with safety and health professionals, may authorize a variation to the provision. All requests for a variance must be in writing and directed to the appropriate office head or contracting officer's representative (COR). The written request must include: (a) a reference to the specific provision of the standard, (b) an explanation as to why the provision is considered impractical, and (c) the proposed adaptation to the standard. The request must contain pertinent technical data, drawings, material or equipment specifications, and other information that will enable the office head or CO to make a decision. The operation in question must not proceed until the Reclamation office head or CO provides written approval.

2.4. Requirements for Accident, Injury, and Illness Investigation and Reporting

2.4.1 Reclamation. Investigate and report accidents and incidents using the Department of the Interior Safety Management Information System. Any accident involving a fatality must be reported to the appropriate Occupational Safety and Health Administration (OSHA) office within 8 hours.

2.4.2 Non-Federal Operators of Reclamation Facilities. Operators must report to the appropriate Reclamation office all third party injuries, deaths, or substantial property losses that result or could result in claims against the Government.

2.4.3 Contractor. Contractors must report and investigate injuries and incidents in accordance with the section entitled, "Contractor Requirements."

2.5. Alcohol, Drugs, and Firearms

Using intoxicating beverages and narcotics on Government property is not permitted. No one under the influence of alcohol or narcotics is permitted on the jobsite. Employees using medication(s) must ensure that their performance will not be impaired. Unauthorized firearms are not permitted on Reclamation property.

2.6. Public Safety

Reclamation facilities must be operated and maintained in a manner that poses no excessive risk to the public.

2.7 Training

2.7.1. General. All employees must receive training about hazards and hazard control methods specific to their jobs. The employer is responsible for providing these instructions, together with ensuring that employees possess the necessary qualifications, licenses, and permits required to perform such work.

2.7.2 Employee Orientation. All employees must receive an orientation on provisions of the safety and health program. The orientation must include applicable requirements of safety and health policies, reporting accidents and injuries, first aid and medical care, emergency response, applicable safety and health standards, and sources of information on safety and health questions.

2.7.3 Documentation. Document all training with, at least, the title, date, and length of training, instructor or provider, and names of employees completing the training.

2.8 Work Site Requirements

All work sites and areas must be maintained to avoid potential hazards introduced by poor housekeeping and shoddy work practices.

2.8.1 Housekeeping. Good housekeeping, including provisions for routine scrap and debris removal, must be maintained in all areas.

2.8.2 Environmental Stewardship. Handling, storing, using, and disposing of waste must not contaminate or pollute water, air, or ground. Disposal must comply with Federal, State, and local regulations.

Section 3

Contractor Requirements

This section sets forth requirements for contractors. It specifically addresses contractor responsibilities, certification requirements, safety programs, required meetings, safety and health professional support, inspection requirements, accident and incident investigating and reporting, monthly accident summary report, training requirements, dismissal of employees who refuse to comply with occupational safety and health requirements, and dispute resolution. The requirements of this section apply to Reclamation contractors.

3.1 Contractor Responsibilities

The contractor is responsible for ensuring that all work under contract meets or exceeds the OSHA standards in addition to complying with the Reclamation Safety and Health Standards contained herein. The contractor is responsible for ensuring safe work performance of employees and subcontractors. These standards also apply to offsite activities, equipment, and facilities that primarily support the contract work. Contractors must include provisions for coordination with the safety and health requirements of these standards in the terms and conditions of all contracts, subcontracts, and supply contracts.

3.2 Certification Requirements

The manufacturer or a professional engineer (PE) must certify that the design of major or critical facilities, equipment, support structures, or systems, embankments, shoring systems, and formwork (falsework) is structurally suitable for the intended use. This certification must be in writing and submitted to the Contracting Officer’s Representative (COR) before construction or use of such facilities, equipment, or support systems.

3.3 Required Safety Programs

The contractor must submit a comprehensive written safety program covering all aspects of onsite and applicable offsite operations and activities associated with the contract. (See appendix entitled, "Contractor Safety Program.") Unless adequately covered in the original plan, the contractor must submit a supplementary detailed plan before starting each major phase of work or when requested by the COR. Onsite work must not begin until the COR has accepted the program or appropriate supplementary submittals. Initial and supplementary submittals must include a timetable for completing required, detailed, job hazard analysis (JHAs). Accepting contractor initial and supplementary programs only signifies that the contractor has provided adequate documentation to perform the work safely. It does not relieve the contractor of the responsibility for providing employees with a safe and healthful work environment or compliance with stated requirements and applicable specification paragraphs.

3.4 Required Meetings

3.4.1 Contractor Safety Program Review. After the contractor submits the written safety program requirements, a meeting must be held to review the program. The contractor must be prepared to discuss in detail the procedures to control the hazards likely to happen during major phases of the work, and the organizational assignments involved in administering the program. The contractor's principal onsite representative, general superintendent, the COR, and the safety representative must attend this meeting.

3.4.2 Joint Safety Policy Meeting. The COR, the contractor's principal onsite representative, and designated members of respective staffs must participate in scheduled monthly safety meetings. These meetings must review the effectiveness of the contractor's safety effort, resolve health and safety problems relating to current operations, and provide a forum for planning safe future activities. The contractor must prepare and maintain meeting minutes in a manner prescribed by the COR.

3.4.3 Supervisory Safety Meetings. The contractor must conduct regularly scheduled (at least monthly) supervisory safety meetings for all levels of job supervision. The contractor must maintain a summary report containing subject matter and signatures of all attendees and make it available for review by the COR.

3.4.4 Tool Box Safety Meetings. Each field supervisor or foreman must conduct at least one *on-the-job* or *toolbox* safety meeting each week, and all employees under their supervision must attend. The field supervisor or foreman must maintain a record of each meeting, including signatures of attendees, and make it available for review by the COR.

3.5 Safety and Health Professional Support

When the contract does not require the services of a full-time safety professional, the contractor must designate, in writing, a competent supervisory employee, acceptable to the COR, to administer the safety program. However, if the CO considers the contractor's safety effort inadequate, the CO may require the contractor to employ a full-time qualified safety professional in place of a safety representative. These standards make further provisions for using safety and health specialists where special or technical expertise is required.

3.6 Required Inspections

The contractor must ensure competent employees conduct frequent and regular (at least weekly) safety inspections of the worksites, materials, and equipment. The contractor must maintain detailed written inspection records and make them available for review by the COR. The contractor must prohibit the use of any machinery, tool, material, or equipment that is not safe and/or does not comply with applicable requirement of these standards. The contractor must identify such machine, tool, material, or equipment as unsafe, by tagging or locking the controls to make them inoperable or by physically removing it from its place of operation.

3.7 Accident and Incident Investigating and Reporting

3.7.1 Report accidents and incidents immediately to the COR and appropriate contractor personnel. The contractor is responsible for providing and obtaining appropriate medical and emergency assistance and notifying the coroner, fire and law enforcement agencies, the Occupational Safety and Health Administration, and family members. Except for rescue and emergency measures, do not disturb the scene of the accident or incident, and do not resume the operation until authorized by COR. The contractor must assist and cooperate fully with the COR in conducting the investigations of the accident/incident and ensure availability of all information, personnel, and data pertinent to the investigation. When ordered by the COR, the contractor must conduct a separate and complete independent investigation of the accident or incident and submit a comprehensive report of findings and recommendations to the COR. The contractor must arrange, and be financially responsible for, the independent investigation and any equipment or material inspections or tests, or diagnostic studies required by the Government or contractor investigators. Further, for each injured person, the contractor must complete Reclamation form 7-2077, *Contractor's Report of Recordable Injury/Illness,* and submit it to the COR. See figure 3-1.

3.7.2 The contractor must report nonserious accidents or incidents immediately to the contractor's supervisor delegated authority to arrange for medical assistance and to investigate the accident or incident. After arranging for required medical assistance, the responsible supervisor must investigate the accident/incident. Within 3 working days following the accident, the contractor must submit to the COR a completed Reclamation form 7-2077, *Contractor's Report of Recordable Injury/Illness*, for all personal injuries, and a comprehensive narrative report for property damage accidents.

3.7.3 The contractor must report potentially serious accidents or incidents immediately to the COR. The contractor's involved equipment and worksite must remain secured until the contractor has completed a comprehensive investigation, acceptable to the COR, and the COR has given permission to resume work. Within 5 days following the investigation, the contractor must submit a detailed, written investigation report to the COR.

3.8 Contractor Monthly Accident Summary Report

By the first day of each month, the contractor must submit a completed Reclamation reporting form 7-2218, *Contractor Recordable Accident Experience,* or equivalent, acceptable to the COR. See figure 3-2.

3.9 Training Requirements

3.9.1 Orientation. The contractor must give each new contractor employee a written notice containing pertinent provisions of the safety and health program. The notice must indicate general policy and set forth procedures and regulations applying to the work environment, accident reporting, and first aid and medical care. Each employee must acknowledge receiving these instructions. The contractor must file this acknowledgment and make it available for review.

3.9.2 First Aid and CPR Training. Every contractor foreman must possess a current first aid and CPR certificate from a recognized provider.

3.9.3 Contractor Supervisor Training. All contractor onsite supervisors, including foremen, must attend a classroom review of applicable safety and health requirements within 30 days after construction begins and annually thereafter. Supervisors and foremen who begin work between formal training sessions must receive initial instructions from the contractor's safety representative and attend all subsequent annual reviews. Use these standards and the contractor's safety program as a text for all training sessions. The contractor must maintain records detailing course content and names of attendees and make them available for review by the COR. A Reclamation safety professional will be available for the formal classroom reviews to assist with safety and health standards. The COR may grant exceptions to supervisory training requirements for short-term contracts or other discretionary reasons.

3.10 Refusal to Comply With Occupational Safety and Health Requirements

The contractor must remove employees who refuse or repeatedly fail to comply with safe work practices and standards, or supervisors who fail to enforce compliance, from the associated work assignments.

3.11 Dispute Resolution

If disputes involve safety issues, the work must not proceed until the dispute is resolved.

7-2077 (8-86)
Bureau of Reclamation

CONTRACTOR'S REPORT OF RECORDABLE INJURY/ILLNESS

~~Refer to Section 2 of Construction Safety Standards~~

Each work related fatality, injury/illness, first aid cases excepted, shall be reported on this form. The completed form will be submitted to the contracting officer's representative within 3 working days from the date of the incident or onset of illness. Responsibility for completion and submission of this form for all onsite injury/illness to contractor, subcontractor, or supplier forces rests with the prime contractor. All form terms are as defined on the reverse side.

CONTRACT SPECIFICATIONS *(Number and Feature)*		DATE OF THIS REPORT
EMPLOYER		
INJURED EMPLOYEE'S NAME	SOCIAL SECURITY NO.	OCCUPATION
AGE	DATE EMPLOYED	DATES OF PREVIOUS INJURIES

DESCRIBE INJURY/ILLNESS

DATE OF INJURY	TIME	ATTENDING PHYSICIAN	INJURY CLASSIFICATION MEDICAL ONLY ☐ OTHER ☐

STARTED LOSING TIME *(Never Date of Injury)*	DID INJURY RESULT IN DEATH OR PROBABLE PERMANENT DISABILITY?
RETURN TO WORK *(Date)**	DATE OF DEATH
WORKDAYS LOST TIME*	DAYS OF RESTRICTED WORK OR TRANSFER TO OTHER JOB

*Estimate date of return to full duty to avoid delay in submitting report *(See reverse side for estimating instructions)*.

DESCRIBE ACCIDENT *(Include Who, What, When, Where, and How)*

SUPERVISORY OPINION

HOW COULD ACCIDENT HAVE BEEN PREVENTED?

(Signature) ______________________
FOREMAN OR IMMEDIATE SUPERVISOR

PREVENTIVE ACTION TAKEN

ACTION TAKEN TO PREVENT A RECURRENCE

(Signature) ______________________
PROJECT MANAGER OR SUPERINTENDENT

(NOTE: Information in this report is to be used for the prevention of accidents and is not intended as a basis for injury claims. Recordable injuries/illnesses and workdays lost and injury classification shall be as defined on reverse side of this form.)

Figure 3-1.—Contractor's report of recordable injury/illness.

DEFINITION OF TERMS

Work-related Injury/Illness: All injuries/illnesses to contractor, subcontractor, or supplier employees that result from an event or exposure on any contractor controlled worksite associated with the respective contract.

Medical Cases: Injuries/illnesses are defined as medical cases if: (1) they can be treated only by a physician or licensed medical personnel, (2) they result in damage or harm to physical structure of a nonsuperficial nature (e.g., hairline fractures), (3) they impair bodily functions (i.e., normal use of senses, limbs, etc.), (4) they involve complications requiring follow-up medical treatment.

The following are generally considered medical treatment:

- Treatment of **INFECTION**
- Application of **ANTISEPTICS** during second or subsequent visits to medical personnel
- Treatment of **SECOND OR THIRD DEGREE BURN(S)**
- Application of **BUTTERFLY ADHESIVE DRESSING(S)** or **STERISTRIPS** in lieu of sutures
- Application of **SUTURES** (stitches)
- Removal of **FOREIGN BODIES EMBEDDED IN EYE**
- Removal of **FOREIGN BODIES** from wound; if procedure is **COMPLICATED** because of depth of embedment, size, or location
- Use of **PRESCRIPTION MEDICATIONS** (except a single dose administered on first visit for minor injury or discomfort)
- Use of hot or cold **SOAKING THERAPY** during second or subsequent visit to medical personnel
- Application of hot or cold **COMPRESS(ES)** during second or subsequent visit to medical personnel
- **CUTTING AWAY DEAD SKIN** (surgical debridement)
- Application of **HEAT THERAPHY** during second or subsequent visit of medical personnel
- Use of **WHIRLPOOL BATH THERAPY** during second or subsequent visit of medical personnel
- **POSITIVE X-RAY DIAGNOSIS** (fractures, broken bones, etc.)
- **ADMISSION TO A HOSPITAL** or equivalent medical facility for treatment or prolonged observation

First Aid Cases: Cases (1) limited to one-time treatment and subsequent observation and (2) involve treatment of only minor injuries, not emergency treatment of serious injuries. Further, any one-time treatment and followup visit for the sole purpose of observation of minor scratches, cuts, burns, splinters and so forth, which do not ordinarily require medical care are classified as first aid treatment. Such one-time treatment and followup visit for the purpose of observation is considered first aid even though provided by a physician or registered professional personnel. Visits to a doctor for an examination or other diagnostic procedure to determine whether the employee has an injury is classified as a first aid case if no injury is discovered or medical treatment is rendered. Conversely, if treatment is described and medical care is provided even by someone other than a physician or registered medical personnel, injury is classified as medical. Other examples of first aid cases not requiring reporting unless they result in loss of consciousness, restriction of work, or motion, or transfer to another job are:

- Application of **ANTISEPTICS** during first visit to medical personnel
- Treatment of **FIRST DEGREE BURN(S)**
- Application of **BANDAGE(S)** during first visit to medical personnel
- Use of **ELASTIC BANDAGE(S)** during first visit to medical personnel
- Removal of **FOREIGN BODIES NOT EMBEDDED IN EYE** if only irrigation is required
- Removal of **FOREIGN BODIES** from wound, if procedure is **UNCOMPLICATED**, and is, for example, by tweezers or other simple technique
- Use of **NONPRESCRIPTION MEDICATIONS AND administration of single dose of PRESCRIPTION MEDICATION** on first visit for minor injury or discomfort
- **SOAKING THERAPY ON INITIAL VISIT** to medical personnel or removal of bandages by **SOAKING**
- Application of hot or cold **COMPRESS(ES)** during first visit to medical personnel
- Application of **OINTMENTS** to abrasions to prevent drying or cracking
- Application of **HEAT THERAPY** during first visit to medical personnel
- Use of **WHIRLPOOL BATH THERAPY** during first visit to medical personnel
- **NEGATIVE X-RAY DIAGNOSIS**
- **BRIEF OBSERVATION** of injury during visit to medical personnel

Note: The administration of a **TETANUS SHOT** or **BOOSTER**, by itself, is not considered medical treatment. However, these shots are often given in conjunction with the more serious injuries. Therefore, injuries requiring tetanus shots may be reportable for other reasons.

Illness Cases: Occupational illness of an employee is any abnormal condition or disorder, other than one resulting from an occupational injury caused by exposure to environmental factors associated with employment. It includes acute and chronic illnesses or diseases which may be caused by inhalation, absorption, ingestion, or direct contact.

Some conditions may be classified as either an injury or illness (but not both), depending upon the nature of the event that produced the condition. For example, a loss of hearing resulting from an explosion (an instantaneous event) is classified as an injury; the same condition arising from exposure to industrial noise over a period of time would be classified as an occupational illness. Similarly, irritation of the throat from exposure to chlorine fumes would be classified as an injury if it resulted from a ruptured tank and an illness if the exposure occurred over a period of time. The determination of illness or injury is based on the original event. Adverse reaction to a tetanus shot given for a laceration would be classified as an injury. Back cases should always be recorded as an injury. It should be noted that all occupational illnesses are reportable and recordable incidents regardless of the type of treatment provided.

Fatalities: Work-related fatalities are reportable and recordable regardless of the time between the injury and the death or the length of the illness. Lost workdays attributable to the incident are not counted and any charged should be removed from the record.

Lost Workdays: Lost workdays are defined as the number of workdays (consecutive or not), beyond the day of injury or onset of illness, the employee was away from work or limited to restricted work activity. The number of days away from work or days of restricted work activity does not include the day of injury or onset of illness or any days on which the employee would not have worked even though able to work, e.g., vacation days, days off, or holidays are not counted. Termination of employment may stop the count of lost workdays if unrelated to the employee's injury or illness. If termination is related to injury/illness, an estimate of actual workdays lost shall be made. Retirements unrelated to injury or illness stop the count of lost workdays. Otherwise days lost are estimated. Lost workday counts cease when injury or illness is determined as totally disabling. Lost workday count stops when position employee was in when injured is abolished due to work completion, e.g., a dozer operator lost workdays count would not continue beyond last day of dozer operations on the project even if the operator still could not perform the operator functions.

Restricted work: The number of workdays on which because of injury or illness: (1) the employee was assigned to another job on a temporary basis; or (2) the employee worked at a permanent job less than full time; or (3) the employee worked at a permanently assigned job but could not perform all duties normally connected with it. Lost workday count stops when employee is permanently transferred to another permanently established position.

Contractor Controlled Worksite Associated with the Contract: The following and similar locations are considered contractor controlled worksites:

All areas within the boundaries of the construction site including shops, plants, storage areas, haul roads, borrow and fill areas.

All offsite locations (plants, shops, rock quarries, borrow areas, erection sites, etc.) used exclusively for supporting construction activities. All roads where traffic control is a contractor responsibility.

GPO 851-690

Figure 3-1.—Contractor's report of recordable injury/illness (continued).

7-2218 (7-96)
Bureau of Reclamation

CONTRACTOR MONTHLY SUMMARY OF OCCUPATIONAL INJURIES/ILLNESSES EXPERIENCE

The prime contractor will submit this completed form to the contracting officer's representative by the first day of each month. Included on the form will be the contractors, subcontractors, and suppliers onsite injury/illness experience for the previous reporting period. Reporting period cutoff dates can coincide with appropriate pay periods as long as the ending date of this current report is the beginning date of the next report. All form terms are defined in Appendix DD of *Reclamation Safety and Health Standards* or elsewhere on this form.

REPORTING PERIOD – STARTING					ENDING					
					RECORDABLE CASES			INCIDENT RATES		
CONTRACTOR, SUBCONTRACTOR SUPPLIER – SPEC. NO.	TYPE OF CONSTRUCTION	NO. EMPLOYEES	MAN-HOURS EXPOSURE	LOST WORKDAYS	TOTAL	DEATHS	LOST WORKDAY CASES	TOTAL CASES	DEATH AND LOST WORKDAY CASES	LOST WORKDAYS
1	2	3	4	5	6	7	8	9	10	11
PRIME CONTRACTOR NAME SPEC. NO. SUBCONTRACTORS SUPPLIERS										
TOTAL										
CUMULATIVE TOTAL										

Column 1. Name of General Contractor and General Specification No. only. Combine all subcontractor and/or supplier data under respective headings. Cumulative totals start from first day of onsite work under the specification.

Column 2. Major classification or type of work for contractor (earth dam, concrete dam, canals, tunnel, pumping plant, power facilities, etc.). Minor classification for supplier or subcontractor (concrete work, earthwork, repair work, etc.).

Column 3. Average number of employees during reporting period. Include only onsite personnel. Number of subcontractor or supplier employees can be estimated by dividing number of estimated man-hours by 8 x number of days in reporting period $\left(\frac{\text{Number of man-hours}}{\text{8 x number days of reporting period}}\right)$

Column 4. Actual man-hours of onsite exposure. Do not include vacation time, holidays, down periods, etc.

Column 5. Lost workdays includes actual days from work, restricted workdays, and days worked in another assigned position. (See Appendix DD of *Reclamation Safety and Health Standards* for detailed explanation of lost workdays and restricted work.)

Column 6. Total of fatalities, lost workday cases, restricted work cases or transfer to other job cases, and medical cases reported on all forms 7-2077, *Contractor's Report of Recordable Injury/Illness*, submitted during the reporting period covered by this form.

Column 7. Fatalities are charged to date of injury or onset of illness regardless of date of death.

Column 8. Includes all cases submitted during this reporting period on forms 7-2077, *Contractor's Report of Recordable Injury/Illness*, that show figures under headings entitled, "Workdays lost time," or "Days of restricted work or transfer to other job." (See Appendix DD of *Reclamation Safety and Health Standards*.)

Figure 3-2.—Contractor monthly summary of occupational injuries/illnesses experience.

Columns 9, 10, 11. Incident rates are defined as the number of injuries/illnesses or lost workdays related to a common exposure base–100 full-time workers or 200,000 man-hours of exposure (100 workmen x 40 hrs/week x 50 weeks/year = 200,000). These rates are calculated as follows:

$$\text{Total Cases (column 9)} = \frac{\text{Total cases (column 6)} \times 200{,}000}{\text{Man-hours of Exposure (column 4)}}$$

$$\text{Death and lost workday cases (column 10)} = \frac{\text{Deaths (column 7) and lost workday cases (column 8)} \times 200{,}000}{\text{Man-hours of exposure (column 4)}}$$

$$\text{Lost workdays (column 11)} = \frac{\text{Lost workdays (column 5)} \times 200{,}000}{\text{Man-hours of exposure (column 4)}}$$

Figure 3-2.—Contractor monthly summary of occupational injuries/illnesses experience (continued).

Section 4

Work Planning

This section sets forth the requirements of work planning. It includes hazard assessment, job hazard analysis, communications, emergency response plan, and lightning hazards. This section applies to all Reclamation and contractor activities.

4.1 Hazard Assessments

The responsible supervisor, consulting with a safety or health professional if needed, must assess the workplace and work activities to determine if hazards are present or are likely to be present. The supervisor must develop a written Job Hazard Analysis (JHA) if warranted by identified or potential hazards. If there is potential exposure to any chemical, physical, or biological agent which may have a detrimental effect, the supervisor must ensure that a health hazard assessment is included in the JHA.

4.2 Requirements for Job Hazard Analysis

4.2.1 Requirement. The responsible supervisor, consulting with employees who will perform the work and a safety and health representative, if needed, must develop a written JHA if required by the hazard assessment. The supervisor and employees must review the JHA at the Tool Box Safety meeting before performing the work. A copy of the JHA must be available at the work site.

4.2.2 Written Procedure. Written procedures for selected operations must prescribe how actions should be accomplished, the proper sequence, equipment required, specific instructions or limitations, potential hazards with preventive measures, and instructions. Written procedures also must reference appropriate codes, standards, and regulations.

4.2.3 Basic Elements of JHA. Record developed written procedures in narrative form or on a standard printed form. See example in the "Job Hazard Analysis" appendix.

At a minimum, the JHA must include the following basic elements:

a. Title: Identifies project and specifies operation.

b. Number: Used for recording and indexing.

c. Date: Required to ensure procedure is current. Include annual or biennial revision dates with reviewer's initials.

d. Description of work to be performed.

e. Equipment, tools, and facilities involved.

f. Employee knowledge, skills, physical ability, and certification required.

g. Principal steps of operation in sequence: break down operations only into the sequence of significant steps necessary to ensure adequate consideration of important items.

h. Identification of hazards:

1. Physical
2. Chemical
3. Biological

i. Identification of hazard control measures:

1. Engineering controls
2. Administrative controls
3. Safety equipment and apparel

j. References: Reference to codes, standards, or regulations.

k. Signatures of the supervisor and the reviewing official.

4.2.4 As work is performed under a JHA, reassess the JHA to ensure that hazards have been addressed and adequate hazards controls have been implemented. Job site monitoring and observation of work activities must be a basis for assessment and revision. Where controls are determined to be insufficient, halt work until adequate controls can be developed.

4.3 Employee Training and Physical Qualifications

4.3.1 Training Qualifications. Do not assign any work until the employee has been adequately trained to perform the task.

4.3.2 Physical Qualifications. All employees must be physically and medically qualified, as appropriate, for performing their assigned duties.

4.4 Working Alone

When employees must work alone and when the possibility of injury and inability to provide medical treatment could create life-threatening situations, supervisors must implement protective measures. The JHA process will determine appropriate measures and will address the specific situations and hazards.

4.4.1 Communication. An effective means of communication must be available. This communication could include cellular phone, two-way radios, hard line telephones, and check-in and check-out procedures. Selected communication must be tested prior to start of operation to verify that equipment will operate efficiently in the environment.

When an employee is working alone in an isolated location, make frequent checks to ensure the employee's safety.

In some instances, employees (dam tenders) are stationed in isolated work areas and generally perform their duties alone. At a minimum, daily communication identifying activities and locations for that day are required.

4.4.2 Emergency Response Procedures. An emergency response plan must be written and all employees informed about the plan and procedures. Employees working alone must have an effective way to obtain emergency assistance. If an employee misses a pre-determined check-in, initiate emergency procedures.

4.4.3 Emergency Response Plan. Emergency response plan must include provisions for emergency medical care and treatment. Include arrangements for ambulance service, emergency treatment, and maintain a list of phone numbers. The plan must be submitted to and approved by the COR prior to the start of operation.

4.5 Requirements for Lightning Hazard Plan

When outdoor work is performed where a lightning hazard has been identified, a lightning hazard plan shall be developed. This plan shall contain, as a minimum, the following items:

- A designated person(s) responsible to monitor the weather to initiate the evacuation process when appropriate.
- A protocol to notify all persons at risk from the lightning threat. Depending on the number of individuals involved, a team of people may be needed to coordinate the evacuation plan.
- Safer sites identified beforehand, along with a means to route the people to those locations.
- An "All Clear" signal identified that is considerably different than the "Warning" signal.

Section 5

Medical Services and First Aid

5.1 General Requirements

This section sets forth the requirements for medical services and first aid.

5.1.1 Requirement. Emergency medical services must be readily available for employees and employees must know how and where to access the services or supplies. Adequately train employees to render first aid and cardiopulmonary resuscitation (CPR). Provide adequate first aid supplies to address medical emergencies.

5.1.2 Communication. Make reliable means of communication to contact emergency medical facilities. Provide specific guidance on actions to take when a medical emergency occurs. Conspicuously post emergency numbers (such as 911).

5.1.3 Signs. Post signs to clearly indicate the location of a first aid station and first aid kits.

5.2 Requirements for Medical Services

5.2.1 Minimum requirements for medical first aid stations are as follows:

a. In the absence of readily available medical services, facility locations with more than 99 employees (total number of employees on the largest shift) must have a first aid station equipped as directed by a consulting physician, preferably one specializing in occupational health medicine. The first aid station must have, at least, a stretcher, blanket, eye wash solutions, and supplies to treat anticipated hazards.

b. A registered nurse (RN), an emergency medical technician (EMT), or a paramedic must be on duty at the on-site first aid station, except when on emergency call.

5.2.2 Make an assessment to determine the number of employees to be trained to administer first aid and CPR, but at least one employee per shift. The assessment must include analysis of the injury and illness log experience, hazardous operations, work environment, and consultation with a health care professional.

5.2.3 In isolated or remote work locations, all employees must be qualified to administer first aid and CPR. Where the job hazard analysis indicates significant risks, the job planning must include provisions for first aid assistance. Employee training intervals for first aid and CPR must be in accordance with the American Red Cross or the American Heart Association.

5.3 Requirements for First Aid Kits

On projects with less than 100 people, first aid supplies will be provided and accessible. At least one full kit must be provided for every 25 employees.

5.3.1 Consensus standard ANSI Z308.1, *Minimum Requirements for Industrial Unit-Type First Aid Kits*, lists and establishes a minimum assortment of first aid treatment packages that first aid kits should contain. The basic fill kit must include the following:

a. Absorbent compress (32 square inches, with no side smaller than 4 inches)

b. Adhesive bandages

c. Adhesive tape

d. Antiseptic applications (0.5 gram per application, total 0.14 fluid ounces)

e. Burn treatment applications (0.5 gram per application, total 0.14 fluid ounces)

f. Two pairs of medical exam gloves, and two additional pairs of latex gloves

g. Sterile pads (3 by 3 inches)

h. Triangular bandage (40 by 40 by 56 inches)

i. Mouth protective valve for CPR

j. Disinfectant

k. Biohazard disposal receptacle

However, when larger operations or multiple operations occur at the same location, supervisors must determine the need for additional first aid kits at the work site, additional types of first aid equipment and supplies, and additional quantities and types of supplies and equipment in first aid kits. The supervisor must choose first aid supplies in consultation with a health care professional or by a person competent in first aid and knowledgeable about the hazards of that workplace.

5.3.2 Government-owned motor vehicles, aircraft, and watercraft must carry a first aid kit.

5.3.3 Inspect first aid kits monthly (and weekly for construction activities). The label inside the kit lid must include an inventory of the kit’s contents. The inspector must verify that the listed items are available and that the sterile packaging is intact. Record the date of the last inspection.

5.4 Ambulance Services

Provisions for ambulance or emergency services must be planned prior to operations. Acceptable ambulance service may be provided by a licensed agency that renders service or a standby emergency vehicle for that purpose at the jobsite.

Section 6

Emergency Plans

This section describes emergency plans, including general requirements, what they must include, employee orientation, alert systems, emergency communications, and actions to resume normal operations.

6.1 General Requirements of Emergency Plans

Emergency plans must ensure employee and public safety, protection of property, and continuity of essential operations. These plans must address foreseeable emergency events, employee responsibilities, emergency response procedures, training, and equipment; must be in writing; and must be reviewed with all affected employees. Test emergency plans at least once every 12-month period to ensure effectiveness.

6.1.1 Where outside emergency services are used, provide at least the following information to the outside responders:

- Facility plans that provide the physical layout of the facility
- Locations of hazardous chemicals
- Locations of hazardous equipment
- Conduct periodic tours of the facility to familiarize the responders
- Function of the alarm, elevators, and communication systems
- Location and function of emergency equipment in the facility

6.1.2 Requirements for emergency responders include at least the following:

- Specialized training commensurate with actual tasks
- Specialized protective equipment and periodic drills with the equipment
- Specialized rescue equipment and periodic drills with the equipment
- Medical evaluations
- At least four employees to conduct an initial entry by two individuals
- Specialized, tested communications procedures and equipment
- A detailed written plan

6.2 Emergency Plans

Plans must include:

- Lines of authority for emergency procedures
- Training requirements, including PPE, for all assisting in the emergency evacuation of personnel

- Training requirements for communicating the plan to affected personnel
- Requirements for emergency equipment
- Escape procedures and routes
- Critical facility operations
- Employee accounting following an emergency evacuation
- Rescue and medical duties
- Means of reporting emergencies
- Contacts for information or clarification
- Communication systems and procedures

6.3 Employee Orientation

Review the plan with all affected employees when first developed, whenever employees' responsibilities change, when the plan changes, and periodically. Upon initial assignment, brief new employees.

6.4 Alert Systems for Emergency Situations

Alert systems are alarms or procedures designed to warn of existing or imminent emergency situations. They must be developed and tested to ensure all persons likely to be affected by emergency situations are familiar with the systems and will receive adequate warning to take appropriate actions. Alert systems may also be designed to alert and summon emergency response personnel.

6.5 Emergency Communications

Conspicuously post emergency telephone numbers and reporting instructions for ambulance, medical services, hospital, fire, and police. Familiarize all personnel with emergency communications procedures. Telephone lines and radio frequencies must be kept clear for use by those in charge during an emergency.

6.6 Resuming Normal Operations

Normal operations may resume only after appropriate actions have been taken to ensure that safe conditions exist before resuming normal operations. Do not jeopardize the safety of employees, the public, or property because of the urgency to resume operations or to restore service.

6.7 Emergency Response to Hazardous Substance Releases

In general, Reclamation requires a strategy for dealing with uncontrolled releases of hazardous substances. You are provided a choice which will determine the program elements and the complexity of implementation necessary to meet the requirements of these standards. You need to address whether or not you expect your employees to respond to emergency hazardous material spills.

Emergency response is a response effort by employees from outside the immediate release area or by other designated responders to an occurrence that results, or is likely to result, in an uncontrolled release of a hazardous substance.

Incidental releases, where the substance can be absorbed, neutralized, or otherwise controlled at the point of release by employees in the immediate release area or by maintenance personnel, are not considered to be emergency responses within the scope of this standard, as long as there is no potential safety or health hazard.

6.7.1 General Requirements When Employees Are Expected to Respond. If you expect employees to respond to hazardous substance releases at locations other than identified hazardous waste sites which fall under the requirements of the hazardous waste site operations section, you are required to develop an Emergency Response Plan and ensure that employees are designated, trained, and equipped to safely deal with the emergency.

a. Pre-planning. You must identify the types, quantities, and locations of hazardous substances; determine the relative hazard of each substance; and develop response procedures and training for worst-case scenarios.

b. Emergency Response Plan. You must have a written plan in place prior to commencement of emergency response operations. This plan will be incorporated into the broader Emergency Action Plan developed for your site, covering responses by all employees to a broad range of potential emergencies. The plan must include at least all the following elements:

- Pre-emergency planning and coordination with outside parties
- An outline of personnel roles, lines of authority, training, and communication
- Emergency recognition and prevention procedures
- Details about safe distances and places of refuge
- Site security and control procedures
- Evacuation routes and procedures
- Emergency alerting and response procedures
- Decontamination procedures
- Emergency medical treatment and first aid procedures
- Methods for evaluation of response and followup procedures

- Information on the location of Material Safety Data Sheets (MSDS), personal protective equipment (PPE), and emergency equipment

c. Incident Command System. You must develop a system that identifies your senior emergency response official (Incident Commander) who has ultimate site control responsibility and authority. Responsibilities of the commander include:

- Identifying, to the extent possible, all hazardous substances or conditions present
- Addressing site analysis, use of engineering controls, maximum exposure limits, hazardous substance handling procedures, and use of new technologies
- Implementing appropriate emergency operations
- Determining, through monitoring, when PPE or respiratory protection is required
- Assuring that PPE worn is appropriate for the hazards encountered during emergencies

d. Training. You are required to provide specialized training for responders based upon their duties and functions within your plan. The skill and knowledge levels required for all new responders must be conveyed to them through training before they are permitted to take part in actual emergency operations. There are a minimum of five types of responders, each with specific training expectations to be met. They are:

- First responder awareness level
- First responder operations level
- Hazardous materials technician
- Hazardous materials specialist
- Onsite incident commander

A *first responder awareness level* employee is an individual who is likely to witness or discover a hazardous substance release and who, through training, is expected to initiate a response sequence by notifying appropriate authorities of the release. They are not expected to take further action.

A *first responder operations level* employee is an individual who is expected to respond to releases as part of initial actions to protect nearby personnel, property, or the environment from the effects of the release. They are trained to respond defensively to a release without necessarily being expected to stop the release.

A *hazardous materials technician level* employee is an individual who is expected to stop the release. They assume a more aggressive role, perhaps approaching the point of release in order to plug, patch, or otherwise stop the release of hazard substance.

A *hazardous material specialist level* employee is an individual who is expected to respond with and provide support to technician level responders. They require more specific knowledge of the substances they may be called upon to contain. They act as a liaison with other outside authorities in regard to site activities.

An *onsite incident commander* is an individual who is expected to assume control of the incident scene upon notification of release.

You must provide training which meets the following minimum expectations associated with each type of responder.

1. **First responder awareness level.** Training enabling the individual to demonstrate:

    - Understanding of hazardous substances and their risks
    - Ability to identify hazardous substances in an emergency
    - Understanding of their role in the plan
    - How to notify appropriate entities

2. **First responder operations level.** A minimum 8 hours of training enabling the individual to demonstrate:

    - Knowledge of basic hazard and risk assessment techniques
    - How to select and use proper personal protective equipment
    - Understanding of basic hazardous materials terminology
    - How to perform basic control, containment, and/or confinement operations within the capabilities of the resources and equipment available
    - How to implement basic decontamination procedures
    - Understanding of the established standard operating procedures

3. **Hazardous materials technician.** A minimum 24 hours of training enabling the individual to demonstrate:

    - How to implement the emergency response plan
    - Knowledge of the classification, identification, and verification of known and unknown material by using field survey instruments and equipment
    - Ability to function within the assigned role in the incident command system
    - Knowledge to select and use proper specialized chemical personal protective equipment provided

- Knowledge of hazard and risk assessment techniques
- Performance of advance control, containment, and/or confinement operations within the capabilities of the resources available
- Understanding of implementation of decontamination procedures
- Understanding of termination procedures
- Understanding of basic chemical and toxicological terminology

4. Hazardous materials specialist. A minimum 24 hours of training enabling the individual to demonstrate:

- How to implement the emergency response plan
- Knowledge of the classification, identification, and verification of known and unknown material by using field survey instruments and equipment
- Knowledge of the State emergency response plan
- Knowledge on selecting and using proper specialized chemical personal protective equipment provided
- Knowledge of in-depth hazard and risk assessment techniques
- Performing advance control, containment, and/or confinement operations within the capabilities of the resources available
- Understanding of implementation of decontamination procedures
- Understanding of termination procedures
- Understanding of basic chemical and toxicological terminology

5**. Onsite incident commander.** A minimum 24 hours of training with elements included meeting first responder training as well as enabling the individual to demonstrate:

- How to implement the incident command system
- How to implement the site emergency response plan
- Knowledge of the hazards and risks associated with employees working in chemical protective clothing
- How to implement local, State, and Federal emergency response plans
- Knowledge of decontamination procedures

e. Annual refresher training. You must annually provide training to maintain individual competencies and substantiate that employees can demonstrate competency in their level of emergency response. If time periods lapse regarding these demonstrated competencies for more than 2 years, individuals must be provided training meeting the initial training requirements.

6.7.2 General Requirements When Employees Are Not Expected to Respond. If you do not permit employees to respond to hazardous substance releases, and you will evacuate the employees from the danger area when an emergency occurs, you are required to specify this in the comprehensive emergency action plan (employee emergency and fire prevention plans) as required in other parts of this section.

Section 7

Occupational Health

This section sets forth the requirements and standards for Reclamation's occupational health programs. It covers the following specific areas:

- Employee Exposure Standards
- Health Hazard Assessments
- Exposure Control
- Hazard Control Plans
- Recordkeeping
- Medical Surveillance
- Hazard Communication Program
- Respiratory Protection
- Noise Exposure and Hearing Conservation
- Sanitation
- Exposure to Hazardous Chemicals in Laboratories
- Bloodborne Pathogens
- Heat Stress and Cold Stress
- Ionizing and Non-ionizing Radiation
- Asbestos
- Lead
- Illumination

7.1 Employee Exposure Standards

An employee exposure measures dose, toxicity, and route of entry to an employee for a specified period of time. Maintain employee exposures to airborne contaminants at or below the more protective requirements of the OSHA permissible exposure limits (PELs) or the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs) for Chemical Substances and Physical Agents.

7.2 Requirements for Health Hazard Assessments

A health hazard assessment is a study of the worksite, including identification of potential to hazardous materials or atmospheres, equipment, and work procedures.

7.2.1 Exposure Assessment. The exposure assessment is a process that determines the magnitude (including dose and toxicity), duration, and route of entry of a potential health threat. Conduct health hazard assessments for all facilities and operations to determine the extent of existing, as well as introduced, health hazards (physical, chemical, and biological).

7.2.2 Exposure Monitoring. Conduct exposure monitoring when hazardous materials or physical agents are present in the workplace. Also use exposure monitoring to:

- Evaluate new processes and establish baselines
- Evaluate engineering controls
- Investigate employee complaints
- Comply with Federal, State, and local regulations
- Conduct investigations or research

Periodically monitor exposure when employees wear respiratory protection, use hearing protection devices, are exposed to radiation sources, or when monitoring is required by specific standards. A qualified person must direct and supervise employee exposure monitoring.

7.3 Requirements for Exposure Control

7.31 Engineering Controls. Use engineering controls as the primary means to minimize workplace health hazards. Engineering controls may include, but are not limited to, the use of enclosures, isolation, substitution of materials, or ventilation.

7.3.2 Administrative Control Measures. Use administrative controls such as scheduling reduced work times in high exposure areas, erecting signs, training employees, and specific job procedures to reduce personnel exposures.

7.3.3 Personal Protective Equipment. Use personal protective equipment to protect employees from their environment when engineering and administrative controls are not adequately protective.

7.3.4 Assessment. Complete a written assessment on the feasibility of engineering controls when either of the following occurs:

a. The air contaminant concentrations meet or exceed an action level (which is 50 percent of the more stringent of OSHA PEL's, ACGIH TLVs, or other specific occupational-based exposure standard in effect).

b. The source noise level meets or exceeds 85 dBA.

7.4 Requirements for the Hazard Control Plans

7.4.1 Air Contaminant Control Plan. Establish an air contaminant control plan when an air contaminant is produced by stationary or portable sources at concentrations that reach an Action Level. An Action Level is defined as one-half of an established PEL or TLV, unless otherwise stated in a specific standard. The plan will reflect the means and processes used to:

a. Identify all contaminant sources.

b. Track corrective actions associated with contaminant sources.

c. Conduct area monitoring to determine the effectiveness of the controls applied.

d. Complete job hazard analyses for operations with air contaminant exposure.

e. Provide exposure control through the use of administrative controls or use of the personal protective devices when engineering control is infeasible.

f. Implement a medical surveillance program, when necessary.

7.4.2 Noise Control Plan. Establish a noise control plan when noise is produced by stationary or portable sources expose personnel to 85 or more decibels (dBA). The plan will reflect the means and processes used to:

a. Conduct noise surveys to identify, inventory, and label all sources that expose personnel to 85 dBA or more.

b. Track corrective actions associated with noise sources.

c. Conduct area monitoring to determine the effectiveness of the controls applied.

d. Complete job hazard analyses for operations with noise source exposure.

e. Provide exposure control through the use of administrative controls or the use of personal protective devices when engineering control is infeasible.

f. Implement a hearing conservation program, when necessary.

7.5 Recordkeeping Requirements

Maintain employee medical, exposure monitoring, and training records in accordance with OSHA 29 CFR 1910.1020, the Privacy Act of 1974 (P.L.93-579), and FPM 293. Follow the employee medial records maintenance guidance found in the Department of the Interior's *Occupational Medicine Program Handbook*. Medical and exposure monitoring records must be maintained for the duration of employment plus 30 years.

7.6 Requirements for Medical Surveillance

7.6.1 Requirements for Medical Surveillance are Determined by Exposure or Risk. Include an employee in a medical surveillance program after an initial hazard assessment for certain high demand jobs; where required by specific Federal regulations; after exposure monitoring verifies the necessity; or when employees are exposed to or exhibit symptoms of exposure to chemicals, dust, noise, and other workplace hazards as determined by credible exposure monitoring.

7.6.2 Medical Administration. When medical surveillance is required, it must be conducted under the direction of a physician who specializes in occupational medicine. The medical surveillance program must be based on a comprehensive evaluation of the workforce, worksites, and job duties. Provide the examining physician with a description of duties that relate to the hazardous workplace, results of employee exposure monitoring, a description of personal protective equipment used, and information from previous medical examinations.

7.6.3 Notification. Notify employees of their inclusion in the program and educate them as to the program's goals, benefits, and procedures. Provide employees with a written summary of any examination, as well as laboratory tests results. Recommendations for any additional tests relating to the medical surveillance program and information on non work-related problems requiring further medical evaluation must be conveyed to the employee in a timely manner. The medical provider will provide the employer with the physician's opinion concerning: (1) any detected medical conditions that place the employee at increased risk of harm from continued performance on the job, (2) any recommended work modifications, and (3) a statement that the employee has been informed of the results and any other matters requiring further medical followup.

7.7 Hazard Communication Program Requirements

7.7.1 General Requirements. Obtain Material Safety Data Sheet (MSDS) for any substance possessing combustible, flammable, corrosive, explosive, or toxic properties. Make MSDS readily available and accessible by employees. All persons who use hazardous materials must receive training.

7.7.2 Written Program. Establish a written hazard communication program wherever employees use, store, or produce substances with hazardous properties. Exceptions to this requirement include laboratories where the chemical hygiene plan is required. The OSHA 29 CFR 1910.1200 mandatory Appendices A, B, and D shall be included in all written programs.

7.7.3 Program Requirements. The written program must identify the means used and the individuals responsible for performing the following:

a. Maintaining an inventory of all hazardous substances that are available to employees and regulatory officials at the point of use or storage.

b. Maintaining an MSDS for each inventoried substance that is available to employees and regulatory officials at the point of use or storage.

c. Legibly and prominently label all containers of hazardous substances. The label must identify the material link it to other required information resources (inventory and MSDS), identify the primary hazard(s), and state appropriate precautions such as “Do not use near open flame.”

d. Providing and documenting hazard communication training for each employee who uses or stores inventoried substances. The training must cover the following issues:

1. Terminology used in, and elements of, an MSDS.

2. Location(s) of written program, hazardous substance inventory, and MSDS files.

3. Individuals responsible for hazard communication program.

4. The physical and health hazards of substances used and stored in the workplace and specific protective measures.

5. How to use the labeling system.

6. How to recognize tasks that may lead to hazard exposure.

7. How to use work practice, engineering controls, and PPE to limit exposure.

8. How to obtain information on the types, selection, proper use, location, removal, handling, decontamination, and disposal of PPEs.

9. Who to contact (and what to do) in an emergency.

e. Responding to hazardous substance spills/emergencies.

f. Annually assessing and reporting the status of implementation of the program elements.

7.8 Requirements for Respiratory Protection

Reclamation requires using respiratory protective equipment when inhalation hazards are anticipated to meet or exceed 50 percent of the PEL, TLV, or other accepted exposure limit. Reclamation requires written programs for respirator use.

7.8.1 General Requirements for Respiratory Protection. If the worksite has respiratory hazards, measure the atmospheric contaminants and require employees to use protective equipment properly.

a. Job Hazard Analysis. Provide a written job hazard analysis (JHA) for every operation during which a respirator of any type is used. The JHA must assess the perceived respiratory hazard. Measuring or estimating airborne contaminant concentrations with confidence allows for the determination of whether respirators are required and what respirator type will provide adequate protection. These determinations are generally based on the relationship of the airborne contaminant concentration to an established exposure limit such as a permissible exposure limit (PEL) established by OSHA.

b. Failure to Measure Airborne Contaminants. If you do not measure air contaminant concentrations or estimate based on supporting studies, you must consider the atmosphere to be "immediately dangerous to life or health" (IDLH). This assumption forces the use of the most stringent respiratory protection program requirements. The absence of a JHA that appropriately characterizes the workplace atmosphere requires the use of more restrictive, burdensome, and costly equipment, as well as additional personnel, to enter the contaminated atmosphere. (See the subsection on IDLH entry.)

c. Written Program Requirement. Respiratory protective equipment will not be used by any person until a written program meeting the minimum requirements of these standards is established and all of the requirements of the program have been met. Base program requirements on the type of respirator used and whether respirator use is exclusively voluntary at a site.

d. Delegation of Responsibility and Authority. Identify a program coordinator responsible for implementing the respiratory protection program for all sites where respiratory protection is used. Delegate this coordinator sufficient authority to implement the program. Select a coordinator who is qualified by appropriate training or by experience commensurate with the complexity of the program and the respirator use requirements.

e. Mandatory Records. Maintain the following documents in a manner that allows for efficient program administration and evaluation:

- Pertinent job hazard analysis
- Written voluntary use requests
- Respirator selection criteria
- Medical evaluations
- Fit testing documentation
- Training records
- Program evaluation records

Keep the following available onsite:

- Respirator selection criteria
- Record of completion for medical qualification of all respirator users
- Record of completion for fit testing of all respirator users

- Record of completion for required respiratory protection training of all respirator users
- Workplace airborne contaminant monitoring records

Maintain the following records in the employee medical folder:

- Results of personal physicals
- Personal exposure monitoring results
- Personal medical surveillance records

7.8.2 Requirements for the Written Program. If you require personnel to use respiratory protection of any kind, provide a written program (except for the voluntary use of a filtering facepiece type).

a. Program Elements for Sites Where Respirator Use is Required. Write your own site-specific program if respirators are required at your site. The written program will contain or reference all the applicable JHA(s) that indicate respirator use. The JHA will include exposure monitoring data and clarify the scope of the hazard and the need for respiratory protection. Include these elements in your site program:

- Respirator selection
- Respirator-user medical qualification
- Fit testing
- Program evaluation
- User training
- Respirator maintenance
- Recordkeeping

1. Selecting respirators. Use only respirators certified by the National Institute for Occupational Safety and Health (NIOSH).

(a) Selection criteria. Base your selection of respirators for required use on known or anticipated atmospheric conditions, contaminant warning properties, worksite physical limitations, established respirator protection factors and user factors affecting respirator performance.

(b) Protection against gases and vapors. Select an air-supplying respirator unless the respirator (air-purifying) is equipped with an end-of-service-life indicator (ESLI) or a change schedule for the cartridges or canisters is included in the program, which is based upon objective information, data, or experience.

(c) Protection against particulates. Select an air supplying respirator unless the respirator (air-purifying) has a filter with one of the following qualifications:

- Certified by NIOSH as a high efficiency particulate air (HEPA) filter according to 30 CFR part 11

- Certified as a particulate filter according to 42 CFR part 84
- The primary particulate contaminants have a mass median aerodynamic diameter (MMAD) greater than 2 micrometers(□), in which case, a respirator (air-purifying) may be equipped with any particulate filter certified by NIOSH.

2. Providing medical determinations. Allow respirator use only when there is no negative impact on the health of the employee using the respirator. Provide medical evaluations for employees before they are allowed to use respirators to determine their ability to wear a respirator without suffering adverse effects.

(a) Medical evaluator. The evaluator must be a physician or licensed health care provider with the appropriate knowledge to make a judgement. Before the medical evaluation, employees must complete the OSHA Respirator Medical Evaluation Questionnaire, 29 CFR 1910.134, Appendix C for the medical evaluator.

(b) Employee information. Before any evaluation, provide the medical evaluator the following information about the conditions of respirator use:

- Type and weight of respirators to be used
- Duration and frequency of use
- Expected physical effort during use
- Expected use of additional personal protective equipment
- Expected temperature and humidity to be encountered
- Anticipated workplace hazards and potential exposures

(c) Medical evaluator information. The medical evaluator must furnish to the employer information that:

- States the employee's ability to wear the identified respirator types under the specified conditions without adverse effect
- Specifies limitations on respirator use or provides another type respirator which would mitigate existing medical condition
- Identifies any need and time limit for a followup examination
- States that the employee has been given a copy of the recommendations

(d) Additional medical evaluations. Provide subsequent medical evaluations or consultations not specified by the medical examiner when:

- An employee using a respirator requires an explanation or consultation regarding the evaluation results
- An employee using a respirator reports medical signs or symptoms related to his ability to use a respirator
- A supervisor or program coordinator determines a need for reevaluation
- Workplace conditions or expectations change and substantially increase the employee's physiological burden

3. Fit testing. Before using a respirator, provide a complete test for each individual that verifies a satisfactory fit of the selected tight-fitting facepiece. This test will include each of the following:

(a) Facepiece selection. Provide a suitable number of facepiece choices that allow a proper fit and acceptable comfort for the user.

(b) Test protocol. Use the OSHA protocol, which may be found in 29 CFR 1910.134.

(c) Test type. Require quantitative tests except where the negative pressure air-purifying respirator must achieve a fit factor of 100 or less, or where the tight fitting facepiece is used with an atmosphere-supplying or powered air-purifying system and is tested in the negative mode.

(d) Retesting. Provide subsequent testing annually or when:

- The use of a different facepiece configuration (size, style, model, or make) is required
- The employee requests testing
- A change in the user's physical condition could affect facepiece fit
- Specific OSHA standards require more frequent testing

4. Providing respirator training. Before respirator use, provide training that enables the user to demonstrate the following respirator knowledge:

- Understanding of the nature and degree of the respiratory hazard
- How to select a respirator based on the hazard and the respirator's capabilities and limitations
- How to don the respirator and use the seal check procedures

- How to use the respirator
- Limitations of the respirator
- How to care for, maintain, clean, and store the respirator

5. Providing retraining. Retrain respirator users in respiratory protection practices annually or in response to:

- Changes in the workplace or type of respirator used
- A supervisor's or program coordinator's determination of an individual's need of retraining

6. Providing respirator maintenance, cleaning, and inspection. You will:

- Maintain respirators with all labeling and markings intact and in a sanitary condition.
- Clean respirators frequently and in a manner that prevents the spread of any harmful agent to users.
- Use either procedures recommended by the respirator manufacturer or specified in 29 CFR 1910.134.
- Provide storage that protects against respirator damage or contamination.
- Inspect all respirators for damage during cleaning and before each use.
- Inspect emergency respirators in accordance with manufacturer's recommendations at least monthly and before providing an escape-only respirator to an employee for his or her specific use. Document all emergency respirator inspections. Include identification of the respirator, the date of inspection, the name of the inspector, deficiencies found, and corrective actions taken in the documentation. Take cylinders of emergency respirators out of service when the pressure falls below 90 percent of manufacturer's recommended pressure level.
- Remove defective respirators from service until repairs are completed in a manner that maintains the integrity of the NIOSH certification.

7. Entry into IDLH atmospheres. In addition to complying with the other parts of this section, implement the following requirements for any entry into an area classified as immediately dangerous to life or health (IDLH).

(a) The atmosphere will be considered IDLH when any of the following apply:

- A JHA has not been completed
- The contaminant concentration has not been measured or estimated with confidence
- The atmospheric contaminant exceeds an established IDLH concentration
- The atmosphere contains less than 16 percent O_2
- The atmosphere contains more than 16 percent but less than 19.5 percent O_2 (oxygen-deficient atmosphere), and it can not be demonstrated that the atmosphere can be maintained within the parameters set forth in CFR 1910.134, table II, under all foreseeable conditions.

(b) All entries into IDLH atmospheres require that:

- One employee or, when needed, more than one employee be located outside the IDLH atmosphere
- Visual, voice, or signal line communication be maintained between the employee(s) in the IDLH atmosphere and the employee(s) located outside the IDLH atmosphere
- The employee(s) located outside the IDLH atmosphere be trained and equipped to provide or activate effective emergency rescue
- The employer or designee be notified before the employee(s) located outside the IDLH atmosphere enter the IDLH atmosphere to activate or provide emergency rescue
- The employer or designee authorized to do so by the employer, once notified, provide necessary assistance appropriate to the situation
- The employee(s) located outside the IDLH atmospheres be equipped with:
    - Pressure demand or other positive pressure SCBAs or a pressure demand or other positive pressure supplied-air respirator with auxiliary SCBA, and either
    - Appropriate retrieval equipment for removing the employee(s) who enter(s) these hazardous atmospheres where retrieval equipment would contribute to the rescue of the employee(s) and would not increase the overall risk resulting from entry, or
    - Equivalent means for rescue where retrieval equipment is not required under the previous paragraph.

8. Supplied air respirators

(a) Compressed breathing air odor and oxygen content. Compressed breathing air must have no noticeable odor and an oxygen content in the range of 19.5 to 23.5 percent. The supplied air must have no more than 5 milligrams per cubic meter condensed hydrocarbon, 10 parts per million (ppm) carbon monoxide (CO), or 1,000 ppm carbon dioxide (CO_2).

(b) Purchasing cylinders of breathing air. Purchased cylinders containing breathing air must have an analytical certificate verifying the quality of the breathing air (must meet Type 1, Grade D breathing air specifications) and verifying that the moisture content in the cylinder does not exceed a dew point of -50 degrees F at 1 atmosphere pressure. Ensure that all cylinders used to supply breathing air are hydrostatically tested and maintained according to 49 CFR Part 173 and Part 178 and marked in accordance with 42 CFR Part 84.

(c) Compressor use and maintenance. Use and maintain compressors (see figures 7-1 and 7-2) that are used to supply breathing air in a manner to:

(1) Control moisture content so that a dew point at 1 atmosphere pressure is 10 degrees F below the ambient temperature

(2) Replace or maintain sorbent beds and filters according to manufacturer's recommendation, and tag the compressor with the most recent change date, printed name, and signature of the employee performing the test.

(3) Equip oil-lubricated compressors with a carbon monoxide and/or a high temperature alarm that is audible or otherwise detectable to the employee wearing the respirator.

- Set carbon monoxide alarms to activate at or below 10 ppm
- Set high temperature alarms to activate according to the manufacturer's specification, and, if used exclusively as the compressor monitor, conduct periodic monitoring to prevent carbon monoxide in the breathing air from exceeding 10 ppm

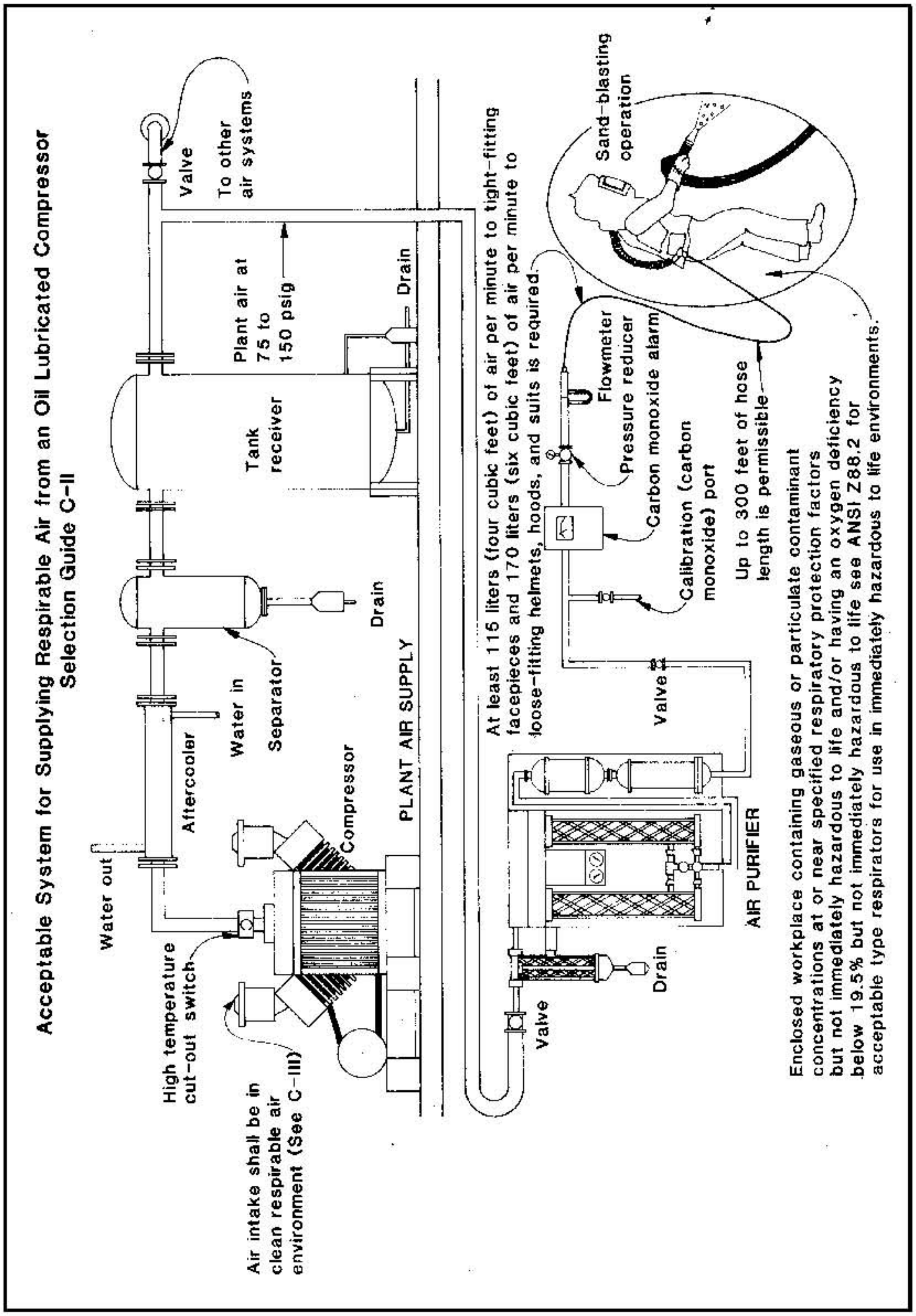


Figure 7-1.—Respirator and respirable air system selection guide C-II.

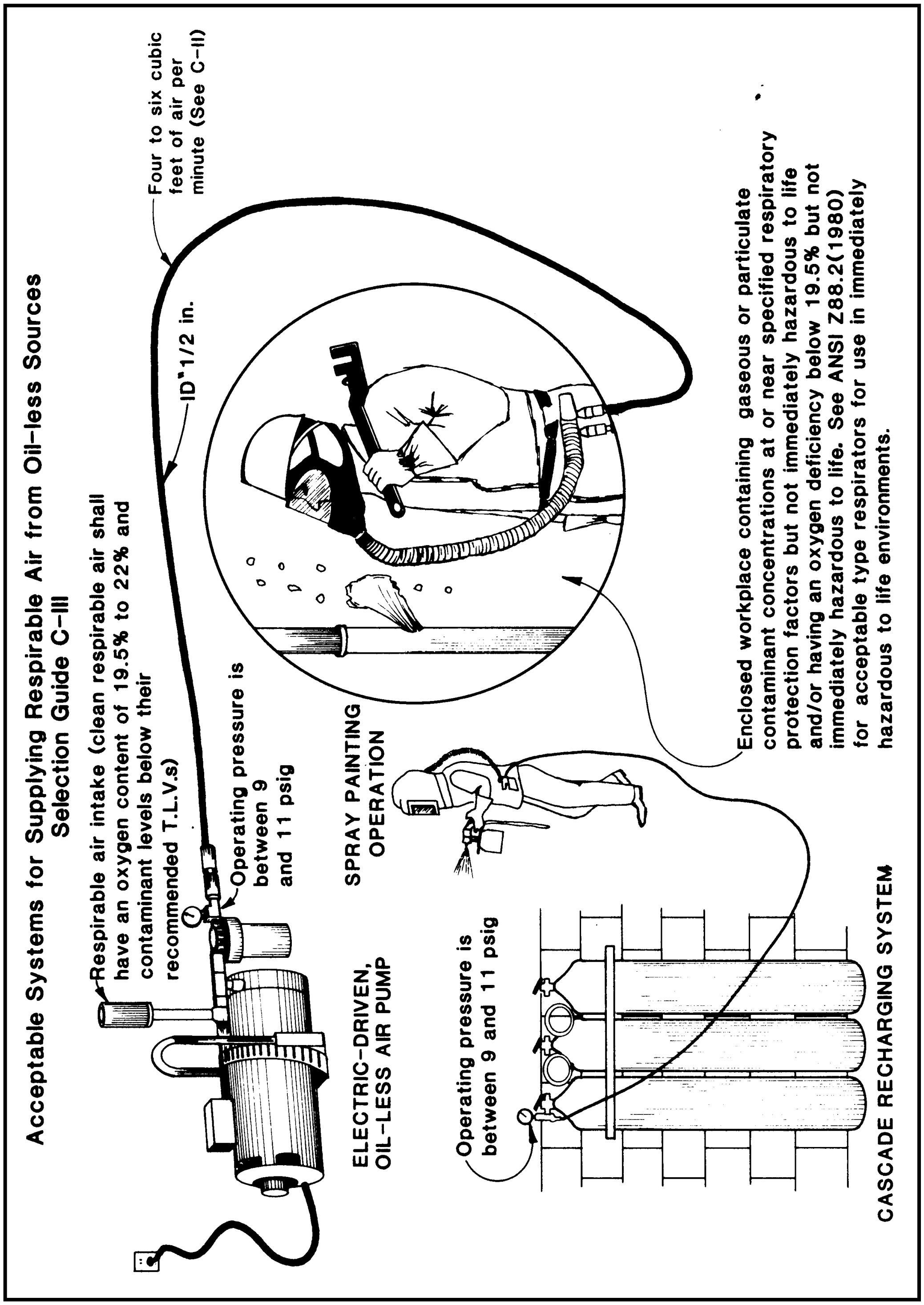


Figure 7-2.—Respirator and respirable air system selection guide C-III.

(4) Prevent the use of couplings that allow attachment to non-respirable worksite air or other gas systems.

(5) Locate the air intake of the compressor in respirable quality air.

(6) Ensure that compressors, hoses, vortex heater/coolers, connectors, filters, and valves are stored so as to prevent contamination with dust, mist, vapor, fume, toxic gases, heat, and intense light such as from welding operations.

(d) Testing breathing air quality. Test the quality of breathing air at least every 6 months to ensure that the air meets Grade D quality as specified in ANSI-CGA G.7-1-1997 when non-vendor breathing air is produced or when breathing air is transferred from compressors, cascade system cylinders, storage receivers, and other breathing air manufacturing or storage equipment.

9. Program Evaluation. Conduct evaluations of the implementation of the elements of the program. Workplace observation, document review, and consultation with employees will be used for this purpose. Conduct evaluations annually or more frequently when management determines it is necessary. Complete an abatement schedule when deficiencies are identified.

10. Record Retention. Retain all records for time periods that meet specific records management requirements. The program will identify the locale of the following records:

- Pertinent job hazard analyses
- Medical evaluation
- Training
- Respiratory selection criteria
- Fit testing
- Program evaluations

b. Program Elements for Sites With Exclusive Voluntary Use of Respirators. Write a site-specific program if there is exclusive voluntary use of any respirator other than a filtering facepiece at your site. The written program will contain or reference all the applicable JHAs that indicate respirator use. Your written program will contain or reference all the applicable JHAs, processes, and procedures that address the following minimum requirements:

1. Have the employee submit a written request establishing a record for voluntary use of the respirator.

2. Complete a written JHA that assesses the perceived hazard and indicates that respirator use is of a "voluntary" nature. The JHA will also assess the possibility of introduced hazards associated with respirator use.

3. Provide basic training on respirators (appendix D of 29 CFR 1910.134 may be used) and record the date and the content outline used to satisfy this element.

4. The use of respirators will be allowed only if there is no negative impact on the health and well being of the user. Therefore, prior to use and periodically thereafter, provide a medical evaluation of the respirator user to determine the user's ability to wear a respirator without being adversely affected. The evaluation must include the following items:

(a) The evaluator will be a physician or licensed health care provider with the appropriate knowledge to render judgment. The evaluator will use the questionnaire in appendix C to 29 CFR 1910.134, or an equivalent, as an element of each employee's evaluation.

(b) Before any evaluation or recommendation, provide the following workplace information relative to the respirator user to the physician or licensed health care provider:

- Type and weight of respirator to be used
- Duration and frequency of use
- Expected physical effort during respirator use
- Expected use of additional personal protective equipment
- Expected temperature and humidity encountered

(c) The medical evaluator will provide the following:

- An evaluation of the individual's ability to wear the identified respirator under the specified conditions without adverse effect.
- Any limitations on respirator use or any other type of respirator that would mitigate any existing medical condition, when necessary
- The need and time for follow-up examinations
- A statement that the employee has been furnished a copy of the medical evaluator's recommendations.

5. Clean the respirator according to manufacturer's recommendations or by disassembling, thoroughly washing in warm (a maximum of

110 degrees Fahrenheit) water with a combination detergent or disinfectant, thoroughly rinsing, air drying, and reassembling.

6. Inspect the respirator to ensure that all parts are working properly and are in good condition.

7. Conduct evaluations of the implementation of the elements of the program. Use workplace observation, document review, and consultation with employees for this purpose. Conduct evaluations annually or more frequently when it is necessary. Complete an abatement plan when deficiencies are identified.

8. Retain all records for time periods that meet specific records management requirements. The plan will identify the locale of the following records:

- Pertinent job hazard analyses
- Medical evaluation and physician name
- Training
- Respiratory selection criteria
- Fit testing
- Program evaluations

c. Program Elements for Sites With Exclusive Voluntary Use of Filtering Facepiece Respirators. Exclusive voluntary use of filtering facepiece respirators (a negative pressure particulate respirator with a filter as an integral part of the facepiece or with the entire facepiece composed of the filtering media) necessitates the following minimum requirements:

1. Require the employee to submit a written request establishing a record for voluntary use of the respirator.

2. Complete a written Job Hazard Analysis (JHA) that assesses the perceived hazard and indicates the determination that the respirator use is of a “voluntary” nature. The JHA will also assess the possibility of introduced hazards associated with respirator use.

3. Provide the user with basic training on respirators (Appendix D of 29 CFR 1910.134 may be used) and record the date and outline of the content used to satisfy this element.

4. The program coordinator will retain the request, associated JHA’s, and training records.

7.9 Requirements for Noise Exposure And Hearing Conservation

7.10.1 General Requirements. Do not expose personnel to noise in excess of the limits indicated in table 7-1.

Table 7-1.—Permissible noise exposures[1]

Duration per day (hours)	Sound level, dBA, slow response
8	90
6	92
4	95
3	97
2	100
1.5	102
1	105
0.5	110
0.25	115

[1] When the daily noise exposure is composed of two or more periods of noise exposure of different levels, their combined effect should be considered, rather than the individual effect of each. If the sum of the following fractions: C(1)/T(1) + C(2)/T(2) + ... + C(n)/T(n) exceeds unity, the mixed exposure should be considered to exceed the limit value. Cn indicates the total time of exposure at a specified noise level and Tn indicates the total time of exposure permitted at that level. Do not allow exposure to continuous, intermittent, or impact noise in excess of a peak of 140 dB.

a. Noise Monitoring Program. Establish a noise monitoring program, primarily based on dosimetry whenever information indicates that personal exposure is likely to exceed an 8-hour time weighted average of 85 dBA. Integrate all continuous, intermittent, and impulsive sound levels from 80 decibels to 130 decibels into the noise measurement. Use representative personal monitoring for highly mobile workers if sound levels vary significantly or impulse noise is present. Calibrate instrumentation used in measuring the sound pressure levels in accordance with the manufacturer's recommendations, allow employees to observe the monitoring procedures, and notify employees of the results of any exposure monitoring. Conduct the program in a manner that allows identification of individuals for inclusion in the hearing conservation program and enables the proper selection of hearing protective devices. Repeat monitoring when changes in the process, equipment, or controls increase noise levels.

b. Hearing Protective Devices. When engineering and/or administrative controls do not reduce noise levels below 85 dBA, provide and ensure personal protective equipment (PPE) that it is used. The hearing protective device(s) provided must reduce the noise exposure to less than 90 dBA TWA or to less than 85 dBA TWA for those enrolled in the hearing conservation program or who have experienced a standard threshold shift. In addition, hearing protective devices must be worn by employees until a baseline audiogram is obtained.

Employees must decide, with the help of a person who is trained in fitting hearing protectors, which size and type protector is most suitable for their working environment. The protector selected must be comfortable to wear and offer sufficient attenuation. The manufacturer's NRR (noise reduction rating) for hearing protectors is used to calculate the attenuated level based on the equation:

Attenuated Level = measured sound level - [(NRR-7) / 2]

When single protection does not provide the desired level of attenuation, use double hearing protection. For double hearing protection, add 5 dBA to the attenuated value.

7.9.2 Hearing Conservation Program Requirements. When it is determined that noise levels exceed the 85 dBA 8-hour TWA, implement a written hearing conservation program.

a. Enrollment. Enroll any employee whose noise exposure exceeds the action level of 85 dBA 8-hour TWA in a hearing conservation program. Dosimetry will be the means for substantiating exposure. Base continuing enrollment on dosimetry results from subsequent periodic monitoring.

b. Audiometric Program.

(1) Audiometric Testing. A qualified technician may give the audiogram, but the results must be reviewed by a qualified professional. A licensed or certified audiologist (specialist dealing with an individual having impaired hearing), an otolaryngologist (physician specializing in the diagnosis and treatment of disorders of the ear, nose, and throat), or a physician must be responsible for the program. The professional's responsibilities include overseeing the program and the work of the technicians, reviewing problem audiograms, and determining whether referral is necessary.

(2) Baseline Audiogram. The baseline audiogram is the reference audiogram against which future audiograms are compared. Provide baseline audiograms within 6 months of an employee's first exposure at or above an 8-hour TWA of 85 dB. Do not expose employees to workplace noise for 14 hours preceding the baseline test unless appropriate hearing protectors are worn during this period. Instruct employees to avoid high, non-occupational noise levels in the 14 hours preceding the baseline audiometric examination.

(3) Annual audiogram. Audiograms must be conducted yearly for employees enrolled in the hearing conservation program. Routinely compare annual audiograms to baseline audiograms to determine whether the audiogram is valid and to determine whether the employee has lost hearing ability, i.e., if a standard threshold shift (STS) has occurred. STS is an average shift in either ear of 10 dB or more at 2,000, 3,000, and 4,000 hertz. If an STS is detected, the employee may be retested within 30 days and the better of the two tests used. If an STS is identified, fit the employee or refit employees with adequate hearing protectors, show how to use them, and require the employees to wear them. Notify employees within 21 days from the time the determination is made that their audiometric test results showed an STS. A confirmed threshold shift is a reportable occupational illness in the OSHA 200 Log and electronic Safety Management Information System (SMIS).

c. Training. Enrolled employees must receive training at least annually about the effects of noise; the purpose, advantages, and disadvantages of various types of hearing protectors; the selection, fit, and care of protectors; and the purpose and procedures of audiometric testing.

d. Recordkeeping. Maintain records of audiometric test results for enrolled employees for the duration of employment of the affected employee. Audiometric test records must include the name and job classification of the employee, the date, the examiner's name, the date of the last acoustic or exhaustive calibration, and measurements of the background sound pressure levels in audiometric test rooms. All area noise measurements must be retained for at least 2 years.

7.9.3 Warnings and Labels. Post or label all areas and equipment which emit noise levels of 85 dBA or greater. Post areas where noise levels are of 85 to 99 dBA and equipment that produces noise levels of 85 to 99 dBA in black lettering on a yellow background with wording such as:

CAUTION
High Intensity Noise
Hearing Protection Required

Post areas where noise levels are 100 dBA or greater and equipment that produces noise levels of 100dBA or greater in black lettering on a red and white background with wording such as:

DANGER
High Intensity Noise
Hearing Protection Required

7.10 Requirements for Sanitation

7.10.1 General Requirements. Employers shall establish and maintain basic sanitation provisions for all employees in all places of employment. These provisions include, but are not limited to, a potable water, toilet, and waste collection and removal system. Provide washroom, showers, and separate eating facilities, as appropriate.

7.10.2 Potable Water. An adequate supply of potable water must be provided in all places of employment. Cool water must be provided during hot weather. Supply drinking water from sources that meets the quality standards prescribed in the U.S. Public Health Service Drinking Water Standards that are published in 42 CFR Part 72 that is approved for drinking purposes by the State or local authority having jurisdiction. Keep portable containers used to dispense drinking water tightly closed, equipped with a dispensing tap, labeled as "DRINKING WATER," and in a sanitary condition. Water must not be dipped from any portable water container. Drinking directly from the container is prohibited unless a properly installed drinking fountain with guarded orifice is provided. Do not use containers used to dispense or distribute drinking water for any other purpose. Use of breakable cups or glasses is prohibited. Also provide fountain-type dispensers or one-use cups at each dispenser and a waste receptacle. Conspicuously post outlets dispensing nonpotable water:

CAUTION
WATER UNSAFE FOR DRINKING,
WASHING OR COOKING

7.10.3 Toilet Facilities.

a. Portable Toilet Facilities. When sewage disposal systems are not available, provide one or more of the following type toilet facilities unless they are prohibited by local codes:

1. Chemical toilets
2. Recirculating toilets
3. Combustion toilets
4. Other toilet systems as approved by State/local governments

b. Design of Portable Toilets. Equip each toilet facility with a toilet seat and toilet seat cover. Design toilets to provide privacy and protection from weather and falling objects. Cracks must be sealed and the door tight-fitting, self-closing, and must be capable of being latched from the inside. Toilets must have adequate ventilation and light, and all windows and vents must be screened.

c. Chemical Toilets. Provide for routine servicing and disposing of the sewage in accordance with Federal, State, and local health regulations.

d. Toilets at Temporary Jobsites. Toilets will be provided at each temporary jobsite in accordance with table 7-2.

Toilets must be within easy access to the worksite unless they are for a mobile crew and transportation is readily available.

Table 7-2.—Toilets at temporary jobsites

Number of employees	Minimum number of units (per gender)[1]
1 to 20	1 toilet
21 to 199	1 additional toilet and urinal for each additional 40 employees
200 or more	1 additional toilet and urinal for each additional 50 employees

[1] Where toilet rooms may be occupied by no more than one person at a time, provide the doors with locks so that they can be locked from the inside, and provide the toiletrooms with at least one toilet seat. Separate toilet rooms for each gender are not needed.

e. Permanent facilities. Toilets at permanent facilities will be provided in accordance with table 7-3. The number of units to be provided for each gender must be based on the number of employees of that gender for whom the facilities are furnished.

Table 7-3.—Toilets at permanent facilities

Number of employees	Minimum water closets (per gender)[1]
1 to 15	1
16 to 35	2
36 to 55	3
56 to 80	4
81 to 110	5
111 to 150	6
over 150	one for each additional 40 persons

[1] Where toilet rooms may be occupied by no more than one person at a time, provide the doors with locks so that they can be locked from the inside, and provide the toiletrooms with at least one toilet seat. Separate toilet rooms for each gender are not needed.

f. Sanitation. Provide frequent inspections and maintenance at all toilet facilities to keep them clean and sanitary. Maintain an adequate supply of toilet paper with holder for each seat.

7.10.4 Washing Facilities. Provide adequate washing facilities for all employees to maintain healthful and sanitary conditions. Such facilities must be near the worksite and furnished with cleaning materials that will remove the specific type of contaminant. Maintain each washing facility with water (either hot and cold running water or tepid running water), soap, and individual means of drying.

7.10.5 Food Consumption. Designate a clean area for consuming food and drink at each work location. Also, establish the following minimum conditions:

- Do not consume or store food or beverage in a toilet room or in any area exposed to biological or chemical hazard
- Provide an adequate number of waste receptacles in the food consumption area. Construct receptacles of corrosion resistant or disposable material provided with solid, tight-fitting covers. Empty receptacles at least daily and maintain them in a sanitary condition.

7.10.6 Sleeping Facilities. Sleeping quarters will comply with all applicable Federal, State, and local sanitation and fire protection codes. Sleeping quarters constructed on the jobsite must comply with the NFPA 101, Life Safety Code.

7.10.7 Waste Disposal. Keep decomposing or foul-smelling waste in substantial, closed insect- and rodent-tight containers that are constructed to prevent leakage and to allow thorough cleaning and sanitary maintenance. Remove solid and liquid in a way that does not create a menace to health. Remove waste as often as necessary to maintain a sanitary environment. Dispose of garbage and similar refuse in designated areas.

7.10.8 Vermin Control. Construct and maintain enclosed workplaces to prevent, to the extent practicable, the entrance and harborage of rodents, insects, and other vermin. If the presence of such vermin is detected, implement a control program.

7.11 Exposure to Hazardous Chemicals in Laboratories

7.11.1 Hazardous Chemicals. Laboratories where employees may be exposed to hazardous chemicals must develop and implement a written chemical hygiene plan and designate a chemical hygiene officer to ensure compliance with OSHA standard 1910.1450. This standard generally applies to all chemical laboratory activities and specifies that employee exposures to hazardous chemicals be at or below the PELs and TLVs.

7.11.2 Employee Exposure Determination. Measure the employee's exposure to any regulated substance if there is reason to believe that exposure levels for that substance routinely exceed the action level. Events or circumstances that might reasonably constitute overexposure include (1) an uncontrolled hazardous chemical leak or spill, (2) direct skin or eye contact with a hazardous chemical, (3) physical symptoms that disappear when the person is removed from the area but reappear soon after the person returns to work with the same hazardous chemical, and (4) two or more people in the same laboratory have similar complaints. Employees must be notified within 15 working days after receipt of the monitoring results.

7.11.3 Chemical Hygiene Plan. Where hazardous chemicals are used in a laboratory, develop and implement a written Chemical Hygiene Plan. The Chemical Hygiene Plan must include a chemical inventory, the necessary work practices, procedures, and policies to ensure that employees are protected from all potentially hazardous chemicals in use in their work area. Keep the plan readily available.

7.11.4 Employee Training and Information. Provide employees with information and training to ensure that they are aware of the hazards of chemicals in their work areas before their initial assignments and as any new substances are introduced.

a. Inform employees of (1) the contents of the OSHA Laboratory Standard (29 CFR 1910.1450), (2) location of the Chemical Hygiene Plan, (3) PELs and TLVs for the chemicals used, (4) the signs and symptoms associated with exposures to these chemicals, (5) the location of known reference material on the hazards, safe handling, storage, and instructions for disposing of hazardous chemicals, including the MSDS, and (6) spill cleanup procedures.

b. Educate employees about: (1) methods and observations that may be used to detect the presence or release of a hazardous chemical, (2) physical and health hazards of chemicals in the work area, and (3) the measures the employees can take to protect themselves from these hazards. Include appropriate work practices, emergency procedures, personal protective equipment to be used in these specific procedures, and the applicable details of the Chemical Hygiene Plan.

7.11.5 Hazard Identification. Do not remove or deface labels on incoming containers of hazardous chemicals. Retain MSDSs on incoming hazardous chemicals and make them available to laboratory employees. Label all solutions prepared in-house with the name of the chemical, the date of preparation, hazardous properties, emergency procedures, and the preparer's name.

7.11.6 Medical Consultation and Examinations. Give laboratory employees who have experienced events or circumstances that might reasonably constitute overexposure the opportunity for medical consultation. For these employees and those included in a medical surveillance program, provide the physician with (1) the identity of the hazardous chemical(s) to which the employee may have been exposed, (2) a description of the conditions of exposure and any quantitative exposure data available, and (3) a description of any signs and symptoms of exposure that the employee is experiencing.

The examining physician will provide, in writing, (1) recommendations for follow-up, if warranted; (2) a record of the results of the consultation and, if applicable, the examination and any tests that were conducted; (3) conclusions concerning any other medical condition noted that could put the employee at risk; and (4) a statement that the employee has been informed both of the results of the consultation or examination and of any medical condition that may require further examination or treatment. These written statements and records must only address the occupational exposure.

7.11.7 Records and Recordkeeping. All memos, notes, and reports related to a complaint of actual or possible exposure to hazardous chemicals must be maintained as part of the record. Retain monitoring data and medical records.

7.11.8 Laboratory Equipment. Provide an emergency eyewash fountain or safety shower and ensure that it is immediately available where corrosive materials are used. Conduct work that involves hazardous and noxious materials that are toxic, odoriferous, volatile, or harmful within a laboratory hood. If there is a need to refrigerate a substance that is flammable, refrigerate it in an explosion-proof refrigerator that is either U.L. listed or approved by an accredited laboratory.

7.12 Bloodborne Pathogens

Blood pathogens are pathogenic microorganisms that are present in human blood and can cause disease in humans. These pathogens include, but are not limited to, hepatitis B virus (HBV) and human immuno-deficiency virus (HIV) and are regulated by 29 CFR 1910.1030 for workplace exposures.

7.12.1 Exposure Determination. Identify employees whose job duties place them at risk of exposure to bloodborne pathogens and develop and implement an exposure control program. Make this exposure determination without regard to personal protective clothing or equipment.

7.12.2 Exposure Control Plan. Develop and implement a written exposure control plan where employees are determined to have an occupational exposure. The exposure control plan must include (1) the exposure determination based on the tasks, procedures, and job classifications; (2) the schedule and methods of compliance; and (3) procedures for evaluating circumstances surrounding exposure incidents. Review and update the plan at least annually.

7.12.3 Universal Precautions. Universal precautions must be observed when any contact with blood or potentially infectious materials is possible. These precautions are applicable to all employees. Treat all body fluids and materials as if they are infectious. Use the following methods to eliminate or reduce risk for transmission of bloodborne pathogens:

- Wash hands frequently and use disposable garments
- Select gloves for the hazards of a specific job
- Avoid spray or splash of bloodily fluids
- Label and package contaminated wastes properly

After administering emergency care, wash hands and other skin surfaces immediately and thoroughly with warm water and soap. Wash hands immediately after removing protective gloves, even if the gloves appear to be intact.

7.12.4 Personal Protective Equipment (PPE). Provide PPE to employees and ensure that they are used properly to eliminate or minimize the risk of infectious material entering the employees' bodies. It is appropriate only if it prohibits potentially infectious materials from reaching the employees' outer clothing, skin, eyes, mouth, or other mucous membranes under normal conditions of use.

a. Gloves. Provide hand protection whenever contact with blood or other potentially infectious materials is possible. Disposable (single-use) gloves, if possible.

b. Masks, Eye Protection and Face Shields. Use masks, eye protection, and face shields in combination whenever splashes, spray, or droplets of infectious materials are generated.

c. Gowns, Aprons, and Other Protective Clothing. Wear gowns, aprons, and other protective clothing when splashing of body fluid on skin or clothing is possible.

d. Resuscitation Equipment. Provide CPR mouthpieces, pocket masks, resuscitation bags, or other ventilation equipment to eliminate the need for direct mouth to mouth contact.

7.12.5 Cleanup of Contaminated Areas. Use personal protective equipment when disinfecting areas. Presoak any spills of body fluid with an antibacterial/viral solution (one part chlorine bleach to 8 parts water). Clean up methods must prevent physical injury from direct handling of broken glass, needles, or other sharps.

7.12.6 Handling Contaminated Materials. Waste handlers must not press down, smash, step on, or otherwise compress any biohazard waste containers.

7.12.7 Hepatitis B Vaccination. Within 10 working days of assignment, the Hepatitis B vaccine and vaccination series will be made available to all employees who have occupational exposure. Make available post-exposure evaluation and follow-up to all employees who have an exposure incident. Prompt reporting of incidents is necessary for exposed employees to be offered the vaccination series in a timely manner.

Figure 7-3.—Biohazard symbol.

7.12.8 Container Labeling. Use an approved biohazard container for blood, other potentially infectious material, or regulated waste a fluorescent orange or orange-red background label with lettering and biohazard symbol in a contrasting color (see figure 7-3). Infectious waste must be disposed of by an approved contractor in accordance with Federal, State, and local regulations.

7.12.9 Training

a. General Training. All employees must receive basic information about bloodborne pathogens and ways to reduce risks of exposure. The training must include those tasks identified with increased risk, the universal precautions about self-protection in the event of an incident, and determining where to find more information in the local exposure control plan.

b. Employees With Increased Risk of Exposure. Employees with occupational exposure must have initial and annual training on the 29 CFR 1910.1030 bloodborne pathogen standard, bloodborne diseases and their transmissions (a general discussion), exposure control plan, engineering and work practice controls, personal protective equipment, hepatitis B vaccine, response to emergencies involving blood, how to handle exposure incidents, proper handling and disposal methods of infectious waste, the post-exposure evaluation and follow-up program, and the signing and labeling program. There must be an opportunity for questions and answers about the bloodborne pathogen program.

7.12.10 Recordkeeping

a. Medical Records. Medical records for each employee with occupational exposure must be kept for the duration of employment plus 30 years. Keep medical records confidential and include the name and social security number, hepatitis B vaccination status (including dates), results of any examinations, a copy of the health care professional's written opinion, and a copy of information provided to the health care professional. Make medical records available to the subject employee or anyone with written consent of the employee, but not to the employer.

b. Training Records. Training records must include dates, contents of the training program or a summary, trainer's name and qualifications, and the names and job titles of all people attending.

c. Sharps Record Log. A sharps injury log must be maintained at healthcare facilities for recording injuries resulting from contaminated sharps penetrating the skin. The information in the sharps injury log must be recorded and maintained in such manner as to protect the confidentiality of the injured employee. The log must contain the type and brand of device involved in the incident, the department or work area where the exposure incident occurred, and an explanation of how the incident occurred.

d. SMIS (Safety Management Information System) Incident Report. Report bloodborne pathogen exposures as personal injuries in the automated SMIS. Information must include the method of injury, the work area and activity when incident occurred, and what post-exposure action followed.

7.13 Heat Stress

The combination of three risk factors (climatic conditions of the environment, work demands, and clothing) causes heat stress is evidenced by an increase in heat stress body temperature, heart rate, and sweating.

7.13.1 Assessment. Conduct an assessment of the working conditions, if the environment is subjectively judged as being hot or the physiological markers of increased body temperature, increased heart rate, or excessive water loss are noted. Use a qualified individual who follows the guidelines stated in the latest ACGIH Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices to conduct the assessment.

7.13.2 Training. Conduct training for employees and supervisors working on heat-related jobs. Training will include a description of heat stress; a recognition of the physiological symptoms of dehydration, heat exhaustion, fainting, heat cramps, and heat stroke; first-aid measures; personal hygiene practices such as the need to replace fluids and the importance of diet, life-style, general health and acclimation; and the specific engineering and administrative control measures used to manage the hot work environment.

7.13.3 Controls. If the assessment concludes that employees may be at risk of heat stress, implement one or more of the various control measures listed in table 7-4 lists.

Table 7-4.—Heat stress control measures

Fluid replacement	Medical surveillance	Reduce radiant heat
Self-determination	Reduce physical work demands	Pacing work
Diet	Reduce air temperature	Sharing work
Life style	Reduce air humidity	Scheduling of work
Acclimation	Change clothing	Circulating air systems
Circulating water systems	Reflective clothing	Ice garments

7.14 Cold Stress

Exposure to cold temperatures increases the likelihood and potential for worker disorders or conditions that could result in injury or illness. Cold stress is evidenced by the body trying to conserve body heat by reducing blood circulation through the skin and by shivering to increase the rate of metabolism. Extreme low temperatures or strong wind accompanied by cold temperatures can lead to hypothermia or localized tissue damage.

7.14.1 Recognition of Cold Stress. Subjective responses of workers provide a good tool for the recognition of cold stress. Behaviors such as seeking warm locations, adding layers of clothing, or increasing work rate are common indicators. Other behaviors are loss of manual dexterity, shivering, accidents, and unsafe behaviors.

7.14.2 Evaluation of Cold Stress. When temperatures fall below 39 °F, begin workplace monitoring. Below 30 °F, the dry bulb temperature and air speed must be measured and recorded at least every 4 hours. When air speed is greater than 5 miles per hour (mph), determine the equivalent chill temperature from table 7-5. Do not expose employees to equivalent wind chill temperatures (ECT) below -25 °F dry bulb.

Table 7-5.—Equivalent Chill Temperature (ECT) in degrees Fahrenheit for different combinations of temperature and air speed (also called Windchill Index)

	Actual temperature reading (°F)									
Estimated wind speed (in mph)	**50**	**40**	**30**	**20**	**10**	**0**	**-10**	**-20**	**-30**	**-40**
	Equivalent Chill Temperature (°F)									
calm	50	40	30	20	10	0	-10	-20	-30	-40
5	48	37	27	16	6	-5	-15	-26	-36	-47
10	40	28	16	4	-9	-24	-33	-46	-58	-70
15	36	22	9	-5	-18	-32	-45	-58	-72	-85
20	32	18	4	-10	-25	-39	-53	-67	-82	-96
25	30	16	0	-15	-29	-44	-59	-74	-88	-104
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109
35	27	11	-4	-20	-35	-51	-67	-82	-98	-113
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116
Winds greater than 40 mph have little additional effect.	Little Danger in < hr with dry skin. Maximum danger of false sense of security.				Increasing Danger. Danger from freezing exposed flesh within one minute.			Great Danger. Flesh may freeze within 30 seconds.		

7.14.3 Control of Cold Stress. General controls of cold stress include training, hygiene practices, and medical surveillance. When the temperature falls below 39 °F in the work environment, workers must be informed that cold stress is a hazard and what clothing is proper, what they should do to practice cold stress hygiene (such as replacing fluid with warm drinks, and proper diet), and how to self- monitor for discomfort or symptoms of hypothermia. When work is performed at or below 10 °F ECT, include safe work practices, recognition and treatment of hypothermia, and other cold-related disorders in the training. Initiate medical surveillance on those who are routinely exposed below -11 °F ECT, and those workers who cannot properly thermoregulate. Other methods of controlling cold exposures include:

a. Engineering controls to reduce loss of body heat such as general or spot heating, hand warming, minimizing air movement, reducing heat transfer, providing warming shelters where ECT is 20 °F or less, or using thermal insulating material on equipment handles when temperature drops below 30 °F.

b. Administrative controls to reduce exposure time, such as establishing work-rest cycles; moving work to warmer areas; allowing individual control over work, such as self-pacing and extra breaks if requested; providing for mutual observation (buddy system); and adjusting for productivity reductions when wearing extra clothing.

c. Protective clothing with proper insulating values, wind barriers, water barriers, and eye protection for snow or ice covered terrain.

7.15 Ionizing Radiation

- Anyone who procures, uses, possesses, transports, transfers, or disposes of regulated radioactive materials or radiation generating devices must:
- Notify, in writing, the Designated Authority of the nature of the material or device and provide a description of the intended use, the location of use and storage, and all transportation and disposal requirements.
- Secure appropriate authorization or a permit if a licensed or regulated radiological device or radioactive material is to be used on Reclamation property.

7.15.1 Qualified Personnel

a. Operations involving ionizing radiation hazards or use of radioactive material or radiation generating devices must be performed under the direct supervision of a person, designated in writing by the Radiation Safety Officer (RSO), who is qualified and responsible for radiological safety. This person will conduct surveys and evaluate and secure any specialized assistance needed to ensure compliance with radiation protection standards.

b. The RSO must be technically qualified and meet the experience, training, and education requirements listed below:

(1) Formally trained in radiation protection including the following topics: physics of radiation; radiation’s interaction with matter; mathematics necessary for the subject matter; biological effects of radiation; type and use of instruments for detection, monitoring, and surveying radiation; radiation safety techniques and procedures; and use of time, distance, shielding, engineering controls, and PPE to reduce radiation exposure.

(2) Hands-on training regarding all the equipment, instrumentation, procedures, and theory used.

(3) Knowledge of regulations (NRC, EPA, Department of Energy (DOE), DOT, and DOI) pertaining to radioactive materials, radiation generating devices, and radioactive and mixed waste.

(4) Knowledge of the standards and recordkeeping requirements for work with radioactive materials and radiation generating devices.

7.15.2 Radiation Safety Program

a. Operations involving regulated radiation hazards and users of radioactive material or radiation generating devices must develop and implement a Radiation Safety Program. The RSO must manage the program and base it on sound radiation safety principles that keep occupational doses and doses to the public ALARA (as low as reasonably acceptable). Review the program at least annually.

b. Instruct all personnel entering an area where radioactive material or radiation generating devices are used and where there is a potential for an individual to receive a Total Effective Dose Equivalent (TEDE) of 100 mrem or more in one year in:

- The presence of the material or device
- Health and safety problems associated with exposure to radiation, including the potential effects of radiation on a pregnant female, the fetus or embryo
- Precautions and controls used to control exposure
- Proper use of instrumentation and dosimetry in the area
- The Radiation Safety Program
- Their rights and responsibilities

7.15.3 Dose Limits

Occupational dose limits are based on the TEDE. See table 7-6.

No employee under 18 years of age will perform work with or around ionizing radiation.

The dose to an embryo/fetus must not exceed the monthly equivalent dose of 0.05 rem during the entire gestation period.

Table 7-6.—Exposure to ionizing radiation

Body part	Annual limits (NRC)[1]	Suggested ALARA limits[2]
Whole body	5 rem (50 mSv {millisievert})[3]	0.1 rem (1 mSv)
Lens of eye	15 rem (150 mSv)	0.15 rem (1.5 mSv)
Skin	50 rem (500 mSv)	0.5 rem (5 mSv)
Hands/feet	50 rem (500 mSv)	0.5 rem (5 mSv)

[1] An annual limit which is the more limiting of: 5 rems TEDE, 15 rems to the lens of the eye, or 50 rems shallow dose equivalent to the skin or any extremity.

[2] To keep doses ALARA, the user will set administrative action levels below the annual dose limits. These action levels must be realistic and attainable. Suggested action levels are the more limiting of: 0.1 rems TEDE, 0.15 rems to the lens of the eye, or 0.5 rems shallow dose equivalent to the skin or any extremity.

[3] 10 mSv = 1 rem.

7.15.4 Radiation Monitoring, Surveys and Dosimetry

a. Users of radioactive material or radiation generating devices must conduct surveys and monitoring to ensure occupational dose limits are not exceeded.

b. Swipte-test each sealed source, other than those exempt by size or specific regulation, for leakage at not greater than 6-month intervals and maintain records for each test. If the sample indicated a contamination activity greater than 0.005 microcuries (μCi), withdraw the source from use and notify the RSO immediately.

c. Use instruments for radiation monitoring and surveying that are appropriate for the type and intensity of radiation surveyed, calibrated to a traceable source, and operationally checked before each use.

d. Users of radioactive material or radiation generating devices and visitors or personnel performing work tasks in the area must coordinate with the RSO for appropriate dosimetry use whenever either of the following situations exist:

(1) an individual enters a Radiation Area (>5 mrem in any 1 hour)

(2) an individual has the potential to receive greater than 0.5 rem in 1 year.

All individuals must wear personnel monitoring equipment within the radiation areas as defined above. Supervisors are responsible for ensuring compliance.

e. Process all external dosimetry at a National Voluntary Laboratory Accreditation Program (NVLAP) certified laboratory.

f. Users of unsealed radioactive material sources or personnel working on a radioactive hazardous waste site must institute an internal dosimetry program approved by the RSO when there is a potential for a worker to receive an internal dose of greater than 0.5 rem per year.

7.15.5 Access, Storage, and Control

a. Design, construct, install, use, store, transport, and dispose of all radiological devices and radioactive materials in such a manner as to ensure personnel exposures are kept ALARA.

b. Users of radioactive materials or radiation generating devices must post signs and control access to radiation areas.

c. Users must use engineering controls, shielding, access time limitation, and/or physical separation to keep doses to the public ALARA where radiation levels exceed 2 mrem (20 Sv) in any one hour.

d. Users must secure radioactive material and radiation generating devices against theft or unauthorized use.

e. Storage must be in accordance with any license or permit requirements.

f. Conduct surveys to ensure that the public dose limit of 0.01 rem (0.0001 Sv) is not exceeded for operations involving regulated radiation hazards or users of regulated radioactive material or radiation generating devices.

7.15.6 Respiratory Protection and Other Controls

a. Users of radioactive material must, to the extent practicable, institute process or engineering controls to limit concentrations of radioactive materials in air.

b. Users must increase monitoring and limit intakes of radioactive materials through control of access, limitation of exposure times, use of respiratory protection equipment, or other controls where process or engineering controls are unable to control airborne radioactive material concentrations.

c. Users of respiratory protection equipment must comply with this section of the standard. Limit the use of respiratory protection equipment according to the protection factors listed in appendix A of 10 CFR 20.

7.15.7 Signs, Labels, and Posting Requirements

a. The RSO must post, in a conspicuous location, (1) a sign or signs bearing the standard radiation symbol shown in figure 7-4, and (2) the following words:

(1) “Caution, Radiation Area” - areas where the radiation field is equal to or greater than 5 mrem (0.05 mSv) in any one hour and less than 100 mrem (1 mSv) in any 1 hour

(2) “Caution, High Radiation Area” - areas where radiation field is equal to or greater than 100 mrem in any one hour (0.1 mSv) and less than 500 rads in any 1 hour

(3) “Caution, Airborne Radioactivity Area” – areas where airborne radioactive material concentrations are greater than the derived air concentration (DAC) limits listed in 10 CFR 20 appendix B.

(4) “Caution, Radioactive Material” - rooms where quantities of radioactive materials in excess of 10 times the 10 CFR 20 appendix C quantities are used or stored.

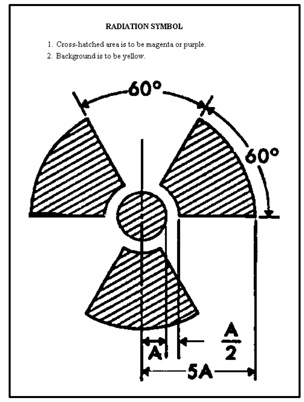


Figure 7-4.—Radiation symbol.

b. Users who receive or expect to receive a package containing radioactive material must follow the package receipt procedures listed in 10 CFR 20.1906 “Procedures for Receiving and Opening Packages.”

c. The RSO must post an NRC Form 3 “Notice to Employees” in a location visible to all employees who work with or around radioactive materials.

7.15.8 Spills and Contamination Control

a. Promptly clean up all spills of radioactive material, using appropriate PPE. Cleaning responsibility rests with the individual(s) working in the area involved and responsible for the spill. Survey the area after cleaning to verify that the cleaning has removed the radioactive material. Notify the RSO of all spills or incidents involving radioactive contamination.

b. Where hand or shoe contamination is possible, all employees working with radioactive materials are to:

(1) Accomplish decontamination before eating, smoking, applying makeup, or leaving work.

(2) Wash protective gloves before removing from hands unless radiation level requires immediate removal.

(3) Refrain from wearing protective clothing outside the radiation area if there is any possibility it has been contaminated.

7.15.9 Radioactive Waste Disposal

a. Radioactive sealed sources (and gauges), when no longer needed, may be returned (transferred) to the manufacturer. Notify the local RSO and amend or terminate any applicable licenses or permits.

b. Dispose of radioactive waste appropriately, in accordance with Federal, State, and local regulations, only after coordinating with the designated RSO.

7.15.10 Records

a. All users of radioactive material or radiation generating devices must prepare and maintain records of the Radiation Safety Program for 3 years after termination of the license or permit.

b. For any individual who frequents a restricted or controlled area and may potentially be exposed to 100 mrem (1 mSv) or more per year, the licensee must prepare and maintain records to determine that person's:

(1) occupational dose during the current year
(2) dose received, both internal and external

The licensee must also attempt to obtain records of cumulative occupational radiation exposure.

c. All users of radioactive material or radiation generating devices must prepare and maintain records of all calculated or monitored radiation doses to individual members of the public to document compliance with the section on "Radiation Monitoring, Surveys and Dosimetry."

7.15.11 Reports

a. Report immediately upon discovery, to the RSO, any spills, loss, theft, damage, or overexposure. The RSO will then file a report with NRC in accordance with the requirements of 10 CFR 20.

b. The RSO must issue annual reports and notify each individual radiation worker of the recorded or calculated dose assigned to that worker for the year or specific work project. These reports and notices must be maintained in such a manner that accumulated exposure can be determined at a future date.

7.15.12 Transportation. Transportation, interstate or intrastate, must comply with the requirements of the DOT for transportation of radioactive materials contained in 49 CFR.

7.15.13 Medical Examinations

a. Medical examinations are not routinely required before work with ionizing radiation.

b. Defer all cases of overexposure and suspected ingestion or inhalation of radioactive materials to a physician for examination.

7.16 Non-ionizing Radiation and Fields

Employers will use qualified, competent persons and appropriately calibrated monitoring equipment to assess, survey, and evaluate non-ionizing radiation and field strengths, employee exposures, and control measures.

7.16.1 Lasers. Comply with the manufacturer's requirements and restrictions in accordance with current ANSI Z136.1, American National Standard for the Safe Use of Lasers when installing and using lasers and laser systems. Table 7-7 explains the laser hazard classification system and some of the controls necessary.

Table 7-7.—Laser hazard classes

Class 1	Cannot emit laser radiation at known hazard levels (typically Continuous Wave: CW 0.4 µwatts at visible wavelengths). Users of a Class 1 laser product are generally exempt from radiation hazard controls during operation and maintenance (but not necessarily during service).
Class 2	Low power visible lasers which emit above Class 1 levels, but emit a radiant power not above 1 mW. The concept is that the human aversion reaction to bright light will protect a person. Only limited controls are specified. Class 2A is a special designation that is based on a 1,000 second exposure and applies only to lasers that are "not intended for viewing," such as a supermarket laser scanner. The upper power limit of Class 2A is 4.0 µW. These are products whose emission does not exceed the Class I limit for an emission duration of 1,000 seconds.
Class 3	CLASS 3A: intermediate power lasers (CW: 1-5 mW). Only hazardous for intrabeam viewing. Some limited controls are usually recommended. CLASS 3B: moderate power lasers (CW: 5-500 mW, pulsed: 10 J/cm(2) - or the diffuse reflection limit, which ever is lower). In general, Class 3B lasers will not be a fire hazard and are not generally capable of producing a hazardous, diffuse reflection, unless the diffuser is stored at from a short distance. Specific controls are recommended.
Class 4	High power lasers (cw: 500 mW) are hazardous to view under any condition (directly or diffusely scattered) and are a potential fire hazard and a skin hazard. Significant controls are required of Class 4 laser facilities.

a. Assign only qualified and trained employees to install, adjust, and operate laser equipment. The operator shall have proof of qualification of the laser equipment in his or her possession during operation.

b. Laser equipment (except Class 1) must bear a label to indicate make, maximum output, and beam spread.

c. Post areas in which Class 3 and Class 4 lasers are used with standard laser warning signs.

d. Provide employees whose work requires exposure to Class 3b and Class 4 laser beams with appropriate laser safety goggles that will protect for the specific wavelength of the laser and be of optical density adequate for the energy involved. Label protective goggles with the following data: the laser wavelengths for which use is intended, the optical density of those wavelengths, and the visible light transmission.

e. Use beam shutters or caps on Class 3b or Class 4, and ensure the laser is turned off when laser transmission is not required. When the laser is left unattended for a period of time (e.g., during lunch hour, overnight, or at change of shifts), turn the laser off.

f. Use only mechanical or electronic means as a detector for guiding the internal alignment of the laser (except for Class 1 and 2a).

g. Do not direct any laser beam at employees. Whenever possible, set laser units that are in operation above the heads of employees.

h. When it is raining or snowing or when there is dust or fog in the air, the operation of outdoor laser systems will be prohibited. During such weather conditions, keep employees out of range of the areas of source and target if system operations continue.

i. Keep employee exposure to laser power densities within the threshold limit values (TLVs) as specified by the ACGIH in “Threshold Limit Values and Biological Exposure Indices.”

j. Do not direct lasers used as pointing devices toward employees. Handle and store these lasers in accordance with the manufacturer’s recommendations.

7.16.2 Static Magnetic Fields. Routine occupational exposure must not exceed 60 millitesla (mT), equivalent to 600 gauss (G)**,** whole body or 600 mT (6000 G) to the limbs on a daily, time-weighted average basis [1 tesla (T) = 10^4 G]. Ceiling values are 2 T for the whole body and 5 T for the limbs. Safety hazards may exist from the mechanical forces exerted by the magnetic field upon ferromagnetic tools and medical implants. Cardiac pacemaker and similar medical electronic device wearers must not be exposed to field levels exceeding 0.5 mT (5G). Areas exceeding 0.5 mT that are assumed to affect medical devices must be labeled and access limited.

Table 7-8.—TLVs for static magnetic fields

Body part	8-hour TWA	Ceiling
Whole body	60 mT	2 T
Limbs	600 mT	5 T
Medical electronic device wearers	------	0.5 mT

7.16.3 Sub-Radio Frequency (30 kHz and below) Magnetic Fields

a. Occupational exposures in the extremely-low frequency (ELF) range from 1 Hz to 300 Hz must not exceed the ceiling value given by the equation:

$$B_{TLV} = 60 / f$$

where f is the frequency in Hz and B_{TLV} is the magnetic flux density in millitesla (mT).

b. For frequencies in the range of 300 Hz to 30 kHz (which includes the voice frequency band from 300 Hz to 3 kHz and the very-low-frequency band from 3 kHz to 30 kHz, occupational exposures must not exceed the ceiling value of 0.2 mT. These ceiling values for frequencies of 300 Hz to 30 kHz are intended for both partial-body and whole-body exposures. For frequencies below 300 Hz, the TLV for exposure of the extremities can be increased by a factor of 10 for the hands and feet and by a factor of 5 for the arms and legs. The magnetic flux density of 60 mT/f at 60 Hz corresponds to a TLV of 1 mT. At 30 kHz, the TLV is 0.2 mT. Limit the exposure of people wearing cardiac pacemakers or similar medical electronic devices to no more than 0.1 mT at power frequencies.

7.16.4 Sub-Radio Frequency (30 kHz and below) and Static Electric Fields. Occupational exposures must not exceed a field strength of 25 kV/m from 0 Hz to 100 Hz. For frequencies in the range of 100 Hz to 4 kHz, the ceiling value is given by:

$$E_{TLV} = 2.5 \times 10^6 / f$$

where f is the frequency in Hz and E_{TLV} is electric field strength in volts per meter (V/m).

A value of 625 V/m is the ceiling value for frequencies from 4 Hz to 30 Hz. These ceiling values for frequencies of 0 to 30 kHz are intended for both partial-body and whole-body exposures. Limit the exposure of people wearing cardiac pacemakers or similar medical electronic devices to no more than 0.1 kV/m.

7.16.5 Radio Frequency and Microwave Radiation. The maximum microwave power density is 10 milliwatts per square centimeter for frequencies between 3 and 300 Ghz. For exposure limits at other frequencies, refer to the latest edition of the ACGIH *TLVs and BEIs*.

7.16.6 Light and Near-Infrared and Ultraviolet Radiation. Do not operate near-infrared, visible, or ultraviolet radiation in excess of the values and indices specified in the ACGIH *TLVs and BEIs.* Although it is believed that employees may be exposed repeatedly up to these TLVs without adverse health effects, employers take all necessary measures to maintain exposures as low as reasonably achievable and prevent needless exposure to higher levels of radiation when simple measures will prevent exposure.

7.17 Asbestos

Airborne concentrations of asbestos must not exceed 0.1 fibers per cubic centimeter of air averaged over 8 hours or 1.0 fiber per cubic centimeter of air averaged over a sampling period of 30 minutes. When there is risk of exposure to asbestos in the workplace, the regulatory provisions of 29 CFR 1910.1001, 29 CFR 1926.1101, or more stringent State standards apply.

7.17.1 Exposure Assessments and Monitoring. Assess all operations conducted with or on asbestos containing materials for the potential to generate airborne fibers. Employers must use exposure monitoring data to assess employee exposures. Records of all measurements taken to monitor employee exposure to asbestos must contain the date of measurement, operation involving exposure, sampling and analytical methods used, and evidence of their accuracy; number, duration, and results of samples taken; type of respiratory protective devices worn; and name, social security number, and results of all employee exposure measurements. Retain these records for 30 years.

7.17.2 Methods of Compliance. To the extent feasible, use engineering controls to control exposures. If engineering controls are not feasible to meet the exposure limit, use them to reduce employee exposures to the lowest levels attainable and supplement them with the use of respiratory protection.

a. Control Measures. Use the following methods to reduce exposures:

- Equip local exhaust ventilation with a HEPA (high-efficiency particulate air) filter dust collection system.
- Enclose or isolate processes producing asbestos dust.
- Ventilate regulated areas to move contaminated air to a collection device with a HEPA filter.
- Control engineering and work practices to reduce exposures to the lowest possible level and supplement with respiratory protection.
- Equip vacuum cleaners with HEPA filters to collect debris and dust.
- Use wet methods or wetting agents, unless such methods would cause electrical hazards, equipment malfunction, slipping hazards or other hazards.
- Promptly clean up and dispose of asbestos-contaminated wastes and debris in leak-tight containers.

b. Prohibited Practices. Regardless of the measured exposure levels, the following practices are prohibited:

- Use of high-speed abrasive disk saws unless they are equipped with point-of-cut ventilation or they are enclosed with HEPA-filtered exhaust air.
- Use of compressed air to remove asbestos or asbestos-containing materials unless the compressed air is used with an enclosed ventilation system.
- Dry sweeping, shoveling, or other dry cleanup of dust and debris.
- Rotating employees to reduce exposure.

7.17.3 Hazard Identification. In the absence of analytical data to the contrary, inventory and treat as all thermal insulation, sprayed, or troweled-on surfacing materials, and resilient flooring material installed before 1981 asbestos containing materials. In addition, inventory all materials containing more than 1 percent asbestos. Indicate at least the material identity, location, and quantity present in the record of inventory. Maintain the records for the duration of ownership.

7.17.4 Hazard Communication. Communicate the exposure hazards and exposure control measures that were implemented to:

- All workers working with, on or adjacent to asbestos containing materials
- All prospective employers applying or bidding for work in or adjacent to areas containing asbestos
- All tenants who may occupy the areas containing asbestos

7.17.5 Signs. Post warning signs at all regulated areas. Regulated areas are established where there are or a reasonable expectation of airborne concentrations in excess of permissible exposure limits or where there is a reasonable expectation of airborne concentrations in excess of permissible exposure limits. At entrances to rooms or areas containing asbestos thermal insulation and surfacing materials, the building owner must post signs identifying the material, its location, and the work practices that ensure it is not disturbed. The warning sign must contain at least the following information:

DANGER
ASBESTOS
CANCER AND LUNG DISEASE HAZARD
AUTHORIZED PERSONNEL ONLY
RESPIRATORY EQUIPMENT AND PROTECTIVE CLOTHING ARE REQUIRED IN THIS AREA

7.17.6 Warning Labels. Warning labels with the following wording must be placed on all raw materials, mixtures, scrap, waste, debris, and other products containing asbestos fibers:

DANGER
Contains Asbestos Fibers
Avoid Creating Dust
Cancer And Lung Disease Hazard

7.17.7 Work Classification. Four classes of asbestos related work activities are defined in table 7-9.

Table 7-9.—Asbestos work classification

Class	Definition and examples of asbestos work
I	Work involves the removal of asbestos-containing or presumed-asbestos-containing thermal insulation and sprayed-on or troweled-on surfacing. Thermal insulation includes asbestos-containing materials applied to pipes, boilers, tanks, ducts, or other structural components to prevent heat loss or gain. Surfacing materials may include decorative plaster on ceilings, acoustical materials on decking, or fireproofing on structural members.
II	Work includes the removal of other types of asbestos-containing materials that are not thermal insulation, such as flooring and roofing materials. Removing intact incidental roofing materials such as cements, mastics, coatings, and flashings is not regulated as Class II. Examples of Class II work include removal of floor and ceiling tiles, siding, roofing, or transite panels.
III	Work that includes repair and maintenance operations where asbestos-containing or presumed-asbestos-containing materials are disturbed.
IV	Work includes maintenance and custodial activities in which employees contact but do not disturb asbestos-containing materials. These activities must be related to the construction project and usually result from Class I, II, or III activities.

7.17.8 Training. Train employees performing Class I through IV asbestos operations before they begin these jobs and annually thereafter. The training course must inform employees of:

- Ways to recognize asbestos
- Adverse health effects of asbestos exposure
- The relationship between smoking and asbestos in causing lung cancer
- Operations that could result in asbestos exposure and the importance of protective controls
- The purpose, proper use, fitting instructions, and limitations of respirators
- Appropriate work practices for performing asbestos jobs
- Medical surveillance program requirements
- The contents of the asbestos standard
- The names, addresses, and phone numbers of public health organizations that provide information and materials or conduct smoking-cessation programs
- The required signs and labels and their meanings

Additional training based on the work classification that is required:

a. Class I. Equivalent in curriculum, method, and length to the EPA Model Accreditation Plan asbestos worker training, (40 CFR 763, Subpart E, appendix C). Eight hours of annual refresher training is required.

b. Class II. Training must cover the elements listed above plus hands-on training and last at least 8 hours. Annual refresher is required.

c. Class III. Training must be the equivalent in curriculum and method to the 16-hour "Operations and Maintenance" course developed by EPA for maintenance and custodial workers whose work disturbs asbestos-containing materials (40 CFR 763.92). The course must include hand-on training in proper respirator use and work practices. Annual refresher training is required.

d. Class IV. Training must be equivalent in curriculum and method to EPA awareness training. Focus on training locations of asbestos-containing or presumed-asbestos-containing materials and ways to recognize damage and avoid exposure. The course must be at least 2 hours long. Annual refresher training is required.

7.17.9 Work Plans. All Class I-III operations will have a written program and plan in place before initiating activities that reflects the means implemented to meet the applicable requirements of 29 CFR 1910.1001 or 29 CFR 1926.1101. For all Class IV operations, provide a written Job Hazard Analysis and Standard Operating Procedure reflecting the safety and health protective expectations associated with the applicable operations before initiating activities.

7.18 Lead

The permissible exposure limit (PEL) for lead is 50 µg/m3, averaged over an 8-hour period. Conduct monitoring and medical surveillance at an action level of 30 µg/m3 or more. OSHA standards regulating lead are at 29 CFR 1910.1025 and 29 CFR 1926.62. The employer must ensure that no employee is exposed to lead at concentrations in excess of the PEL.

7.18.1 Written Lead Program. When work is conducted on surfaces containing lead coatings, a lead compliance program containing the following elements must be developed:

- Detailed description of work activities
- Engineering controls used to reduce or control exposures
- Work practice controls
- Decontamination procedures
- Personal hygiene practices

- Training
- A medical surveillance program and biological monitoring
- Exposure monitoring
- Respiratory protection
- Personal protective equipment
- Workplace inspections
- Signing of work area
- Recordkeeping

7.18.2 Action Level. Several provisions of the lead standard, such as periodic exposure monitoring, biologic monitoring, and initial and annual employee training, are triggered whenever exposure measurements reach or exceed the action level (30 $\mu g/m^3$). For employees exposed to lead at or above the action level for more than 30 days per year, employers are also required to provide an ongoing medical surveillance program.

7.18.3 Minimum Program Requirement if Lead Is Present. Until exposure monitoring is conducted that documents that employees are not exposed above the PEL, the employer must assume that the following tasks result in lead exposure and implement a full lead compliance program:

a. Manual demolition of structures, manual scraping, manual sanding, or use of a heat gun when lead containing coatings are present or when the composition of the coatings has not been tested

b. Abrasive blasting in an enclosure

c. Power tool cleaning

d. Lead burning

e. Using lead containing mortar or spray painting with lead-containing paint

f. Abrasive blasting, welding, cutting, or burning on any structure where lead-containing coatings or paint are present

g. Cleanup activities where dry expendable abrasives are used

h. Gouging with copper jacketed resistance rods known to contain high amounts of lead

i. Performing any other task the employer believes may cause exposures in excess of the PEL

7.18.4 Interim Measures. When an employee performs a specified task where lead is present, interim protection must at least include:

a. Appropriate respiratory protection
b. Appropriate personal protective clothing and equipment
c. Change areas
d. Hand washing facilities
e. Biological monitoring
f. Training, including hazard communication and respiratory training

7.18.5 Housekeeping

a. Maintain all surfaces as free as practicable of accumulated lead dust. Accomplish this primarily by vacuuming floors, rafters, and other surfaces or by employing methods equally effective in preventing the dispersal of lead into the workplace. Vacuuming is considered to be the most reliable method of cleaning surfaces on which dust accumulates, but equally effective methods may be used, for example, a wet floor scrubber. Where vacuuming methods are selected, the vacuums must be equipped with HEPA filters. Dry or wet sweeping, shoveling, or brushing may not be used except where vacuuming or other methods have been tried and do not work.

b. Do not allow employees to smoke, eat, apply cosmetics, or have tobacco products, food stuffs, or cosmetics in any work areas.

c. Provide separate storage facilities in change areas for street and work clothing to prevent cross-contamination between the two. Employees exposed to lead during their work shift must shower before leaving the workplace, if showers are provided, and must not leave wearing protective work clothing.

7.18.6 Medical Surveillance. If an employee's airborne lead exposure is at or above the action level for more than 30 days a year, the employer must provide a medical surveillance program to the employee consisting of routine monitoring of an employee's blood lead and ZPP (zinc protoporphyrin) levels, made available at least every 2 months for the first 6 months in the exposed job and every 6 months thereafter. If an employee's blood lead exceeds 40 µg/dl, the monitoring frequency must be increased to at least every 2 months and not reduced until two consecutive blood leads are below 40 µg/dl.

7.18.7 Medical Removal Protection. When an employee's blood lead level is at or above 50 µg/dl on a periodic and follow-up blood sampling test (within 2 weeks of the first report), remove the employee from any exposure to lead. Also remove the employee from work having an exposure to lead at or above the action level on each occasion when a final medical determination results in a medical finding, determination, or opinion that the employee has a detected medical condition that places the employee at increased risk of material impairment to health from exposure to lead.

7.18.8 Training. Employees who are exposed at or above the action level must be trained in the following:

- The content of the OSHA lead standard and its appendices
- The specific nature of the operations that could result in exposure to lead above the action level
- The purpose, proper selection, fitting, use, and limitations of respirators
- The purpose and a description of the medical surveillance program and the medical removal protection program, including information concerning the adverse health effects associated with excessive exposure to lead (with particular attention to the adverse reproductive effects on both males and females and hazards to the fetus and additional precautions for employees who are pregnant)
- The engineering controls and work practices associated with the employee's job assignment, including training of employees to follow relevant good work practices
- The contents of any compliance plan in effect
- Why chelating agents should not routinely be used to remove lead from employees' bodies and why they should not be used at all except under the direction of a licensed physician
- The employee's right of access to records under 29 CFR 1910.20.

7.18.9 Recordkeeping. Establish and maintain records of all exposure monitoring and other data used in conducting the exposure assessment. The records must include the name and job classification of employees monitored, the details of the sampling and the analytic techniques, the results, and the type of respiratory protection worn. Keep these records for 30 years in accordance with OSHA's standard 29 CFR 1910.20, Access to Exposure and Medical records. Employers must establish and maintain records of medical surveillance (biological monitoring and medical examination results). These records must include the names of employees, the physician's written opinion, exposure data provided to the physician, and any employee medical complaints associated with lead exposure. The employer is required to keep or must ensure that the examining physician keeps a record of the results of medical examinations, a description of laboratory procedures, and a copy of the results of biological monitoring. These records must be kept for at least the duration of employment plus 30 years.

7.18.10 Observation of Monitoring. Employers must provide employees or their representatives with the opportunity to observe monitoring of employee exposures to toxic materials or harmful physical agents. To ensure that this right is meaningful, observers are entitled to an explanation of the measurement procedure, to observe all steps related to the measurement procedure, and to record the results obtained. When results of the monitoring are returned by the laboratory, make them available to the employee.

7.18.11 Signing. The following warning sign must be displayed in each work area where lead hazards exist:

WARNING
LEAD WORK AREA
POISON
NO SMOKING OR EATING

7.19 Illumination

While work is in progress, provide lighting in accordance with the current ANSI/IES RP-7, Recommended Practice for Industrial Lighting; ANSI/IES RP-1, Recommended Practice for Office Lighting; and UL 924, Emergency Lighting and Power Equipment. Table 7-10 is a summary of the minimum light intensities.

7.19.1 Means of Egress. Provide a minimum of 11 lux (1 footcandle) of illumination, measured at the floor to the means of egress.

Table 7-10.—Minimum lighting requirements

Facility or function	Illuminance – lux (footcandles)
Accessways - general indoor - general outdoor - exitways, walkways, ladders, stairs	 55 (5) 33 (3) 110 (10)
Administrative areas (offices, drafting and meeting rooms, etc.)	540 (50)
Chemical laboratories	540 (50)
Construction areas - general indoor - general outdoor - tunnels and general underground - tunnel and shaft heading during drilling, mucking, and scaling	 55 (5) 33 (3) 55 (5) 110 (10)
Conveyor routes	110 (10)
Docks and loading platforms	33 (3)
Elevators, freight, and passenger	215 (20)
First aid stations and infirmaries	325 (30)
Mechanical/electrical equipment rooms	110 (10)
Parking areas	33 (3)
Toilets, wash rooms, dressing rooms	110 (10)
Visitor areas	215 (20)

Table 7-10.—Minimum lighting requirements

Facility or function	Illuminance – lux (footcandles)
Warehouses and storage rooms/areas - indoor stockroom, active/bulk storage - indoor stockroom, inactive - indoor rack storage - outdoor storage	110 (10) 55 (5) 270 (25) 33 (3)
Work areas - general (not listed above)	325 (30)

Section 8

Personal Protective Equipment

8.1 Requirements for Personal Protective Equipment

This section sets forth minimum personal protective equipment (PPE) requirements. It provides an overview of PPE requirements, including workplace assessment, PPE maintenance, and training. The supervisor will ensure that the workplace characterization is completed, and availability, proper use, and maintenance of equipment specified in this section. Section 7, "Occupational Health," details the requirements for respirator use. Additionally, Section 16, "Fall Protection and Rope-Access Work," details requirements for activities covered by that section.

8.1.1 Workplace Characterization. Assess each workplace to determine if hazards are present (or are likely to become present). Appropriate control measures will be implemented through the hierarchy of controls (i.e., eliminate, substitute, engineering controls, warnings, administrative controls, and PPE) to reduce the hazard to an acceptable level of risk. PPE will be selected based upon the actual worksite conditions, frequency, and duration of use to prevent exposure. Document the assessment in writing. Assessments are usually qualitative and document the general workplace, workforce, and the environmental agents; whereas the Job Hazard Analysis (JHA) is a process that identifies hazards associated with each step or task and develops solutions that will eliminate, mitigate, or prevent such hazards. Compliance guidelines for hazard assessment and PPE selection can be found in at 29 CFR 1910, Subpart I, App B.

8.1.2 PPE Selection and Use. Based upon the workplace characterization, appropriate PPE will be identified and selected for employee use. Employees are required to use approved PPE and safety equipment determined by their supervisor in coordination with a safety and health professional to provide acceptable levels of protection.

8.1.3 PPE Maintenance. Inspect PPE before each use. Maintain and store PPE properly. After each use, clean and sanitize PPE (as appropriate).

8.1.4 PPE Training. Provide training to each employee who wears PPE. This training will include answers to the following questions:

What are the tasks that require the use of PPE? What PPE is necessary?
How is the required PPE used?
What are the limitations of the PPE?
How is PPE properly maintained, inspected, and stored?

The employer shall retrain each employee when there is reason to believe that any affected employee does not have the understanding and skill to properly use the furnished PPE.

8.1.5 Visitor Protection. Advise visitors of the existing hazards in the area before planned visits or before permitting entrance to the area. By keeping visitors away from hazard areas and limiting access to designated routes, minimal protection will be required. Document visitor hazards with a JHA or hazard assessment of the work area, and consider providing visitors with uniquely colored vests, badges, or hard hats for easy identification.

8.2 Requirements for Head Protection

8.2.1 Required Hard Hats. Head protection is required when the work area or tasks include head trauma from falling objects, sparks, trauma from impact, and striking against hazards. All personnel, including contractors and visitors, will wear hard hats when entering or working in designated hard hat areas as determined by a hazard assessment or JHA.

8.2.2 Hard Hat Areas. Hard hat areas include all areas where a person may suffer head trauma from overhead materials, objects, or equipment, including overhead storage and striking against hazards. Areas also include any kind of construction, maintenance, or repair work unless exempted by the JHA process.

8.2.3 Posting of Hard Hat Areas. Conspicuous signs will be posted at all entrances to hard hat areas and at appropriate locations that designate the required head protection.

8.2.4 Hard Hat Design. Verify that hard hats comply with Type I, Class G or E, as specified in American National Standards Institute/ International Safety Equipment Association (ANSI/ISEA) Z89.1, "American National Standard for Industrial Head Protection." Hard hats will be appropriate for environmental hazards such as heat and cold or toxic hazards. Confirm that hard hats worn by linemen, electricians, or employees working in tunnels, shafts, or near high-voltage conductors or apparatus conform to class E requirements of ANSI/ISEA Z89.1. Hard hats will have a manufacturer's label indicating that its design complies with ANSI requirements.

8.2.5 Care and Use. No modification to the shell or suspension is allowed, except when such changes are approved by the manufacturer. No ball caps, knit caps, or other head dress will be worn under the hard hat that could interfere with the fit or stability of the hard hat. Accessories specifically designed to be used in conjunction with hard hats are permitted. Hard hats and components will be visually inspected daily in accordance with the manufacturer's instructions for signs of damage that might reduce the safety integrity originally provided. Hard hats will be periodically inspected for ozone or ultraviolet degradation as evidenced by cracking or flaking. Hard hats will be replaced as required by the manufacturer.

8.3 Requirements for Eye and Face Protection

Employees exposed to potential eye or face injury from impact, trauma, foreign bodies, heat, sparks, intense visible light, intense ultraviolet light, or collated laser light will be furnished and required to wear eye and/or face protection specifically designed for the exposure.

8.3.1 Design. Eye and face protection required by this subsection will comply with the standards published in the current ANSI/ISEA Z87.1, "Occupational and Educational Personal Eye and Face Protection Devices."

8.3.2 Safety Glasses. Safety glasses are protective devices intended to shield the wearer's eyes from a variety of hazards. While they may be used alone for primary protection, they are often used in conjunction with other protectors. Both the frames and the lenses (either plano or prescription) will meet ANSI Z87.1 and be marked with the manufacturer's monogram. Only the frames will be marked with the Z87 logo to indicate compliance with the standard. All safety glasses will have side shields or be a wraparound style. See paragraph 8.5.10.b., "Eye Protection," for additional requirements for electric arc flash protection, as well as paragraph 8.5.13, "Prohibited Articles," for electrical hazard prohibitions.

8.3.3 Corrective Lenses. Protect employees who wear corrective lenses, when required to wear eye protection, with one of the following:

a. Safety glasses with lenses that provide optical correction.

b. Protective goggles or plano safety glasses that can be worn over corrective glasses or contact lenses.

c. Goggles that incorporate corrective lenses mounted behind protective lenses.

8.3.4 Selection Guide. When selecting eye and face protection for the hazards and operations noted, use the information in tables 8-1 and 8-2.

Table 8-1.—Eye and face protector selection criteria

Hazard	Protectors	Limitations	Marking
Flying fragments, objects, large chips, particles, sand, dirt, etc.	• Safety glasses with side shields • Goggles with direct or indirect ventilation • Face shield worn over safety glasses or goggles[1] • Welding helmet	The use of metal frame protective devices in electrical hazard areas is prohibited. Metal frame protective devices could potentially cause electrical shock and electrical burn through contact with, or thermal burns from exposure to, the hazards of electrical energy, which include radiation from accidental arcs.	Impact rated: + (safety lens) Z87+ (all other lenses) Z87+ (plano frame) Z87-2+ (Rx frame)
HEAT – Furnace operations, gas cutting and welding			
Hot sparks	• Safety glasses with side protection • Goggles with direct or indirect ventilation • Face shield worn over safety glasses or goggles[1] • Full-face-piece respirator • Loose-fitting respirator worn over safety glasses	Safety glasses, and cup and cover type goggles, do not provide unlimited facial protection. Operations involving heat may also involve optical radiation. Protection from both hazards will be provided.	
Splash from molten metals	• Face shield worn over goggles • Full-face respirator • Loose-fitting respirator worn over safety glasses		
High temperature exposure	• Screen face shield over safety glasses or goggles[1] • Reflective face shield over safety glasses or goggles[1]		

Table 8-1.—Eye and face protector selection criteria

Hazard	Protectors	Limitations	Marking
CHEMICAL – Acid and chemical handling, degreasing, plating			
Splash and irritating mists	• Goggles with indirect ventilation (eyecup or cover type) • Face shield worn over safety glasses or goggles[1] • Full-face-piece respirator	Atmospheric conditions and the restricted ventilation of the protector can cause the lenses to fog. Frequent cleaning may be required.	Splash/droplet: D3
Nuisance dust	• Goggles with direct or indirect ventilation (eyecup or cover type) • Full-face-piece respirator		Dust: D4 Fine dust: D5
OPTICAL RADIATION			
Welding: electrical arc	• Welding helmet over safety glasses or goggles • Hand shield over safety glasses or goggles • Typical filter lens shade: 10-14	Protection from optical radiation is directly related to filter lens density. Select the darkest shade that allows adequate task performance. Note: Filter lenses will meet the requirements for shade designations in table 8-2.	Welding: W shade number UV: U scale number Glare: L scale number IR: R scale number Variable tint: V Special purpose: S
Welding: gas	• Welding helmet over safety glasses • Welding goggles • Welding face shield over safety glasses or goggles • Typical filter lens shade: 4-8		
Cutting	• Welding helmet over safety glasses or goggles • Welding goggles • Welding face shield		

Table 8-1.—Eye and face protector selection criteria

Hazard	Protectors	Limitations	Marking
	over safety glasses or goggles • Welding respirator • Typical filter lens shade: 3-6		
Torch brazing	• Welding helmet over safety glasses • Welding goggles • Welding face shield over safety glasses or goggles • Typical filter lens shade: 3-4	Protection from optical radiation is directly related to filter lens density. Select the darkest shade that allows adequate task performance. Note: Filter lenses will meet the requirements for shade designations in table 8-2	Welding: W shade number UV: U scale number Glare: L scale number IR: R scale number Variable tint: V Special purpose: S
Torch soldering	• Safety glasses • Welding face shield over safety glasses • Welding respirator • Typical filter lens shade: 1.5-3	Shade or special purpose lenses (per ANSI/ISEA Z87.1)	
Glare	• Safety glasses with or without side protection • Face shield over safety glasses or goggles	Shade or special purpose lenses (per ANSI/ISEA Z87.1)	

Source: ANSI/ISEA Z87.1, 2010, Annex I

[1] Face shields alone do not provide adequate eye protection and will be used in tandem with safety glasses or goggles that are impact rated.

Table 8-2.—Filter lenses for protecting against radiant energy

Operations	Electrode size in inches (millimeters)	Arc current (amperes)	Minimum[1] protective shade No.	Suggested shade No. (comfort)
Shielded metal arc welding	<3/32 (2.4) 3/32-5/32 (2.4-4.0) 5/32-1/4 (4.0-6.4) >1/4 (6.4)	<60 60-160 160-250 250-550	7 8 10 11	7 10 12 14
Gas metal arc welding and flux-cored arc welding		<60 60-160 160-250 250-500	7 10 10 10	7 11 12 14
Gas tungsten arc welding		<50 50-150 150-500	8 8 10	10 12 14
Air carbon arc cutting	(light) (heavy)	<500 500-1,000	10 11	12 14
Plasma arc welding		<20 20-100 100-400 400-800	6 8 10 11	6-8 10 12 14
Plasma arc cutting	(light)[2] (medium)[2] (heavy)[2]	<300 300-400 400-800	8 9 10	9 12 14
Torch blazing			3	3 or 4
Torch soldering			2	2
Carbon arc welding			14	14
Operations	**Plate thickness in inches**	**Plate thickness in millimeters**	**Minimum[1] protective shade**	
Gas welding: Light Medium Heavy	 <1/8 1/8-1/2 >1/2	 <3.2 3.2-12.7 >12.7	 4 5 6	 4-5 5-6 6-8
Oxygen cutting: Light Medium Heavy	 <1 1-6 >6	 <25 25-150 >150	 3 4 5	 3-4 4-5 5-6

Source: 29 CFR 1910.133(a)(5),
http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9778

[1] As a rule of thumb, start with a shade that is too dark to see the weld zone. Then, go to a lighter shade which gives a sufficient view of the weld zone without going below the minimum. In oxyfuel gas welding or cutting where the torch or flux produces a high yellow light, it is desirable to use a filter lens that absorbs the yellow or sodium line in the visible light of the operation.

[2] These values apply where the actual arc is clearly seen. Experience has shown that lighter filters may be used when the arc is hidden by the work piece.

8.3.5 Electric Welding. Employees will wear nonflammable welding helmets with lift-front or stationary-front lens when engaged in electric welding operations. Employees will wear plano or prescription safety glasses or flash goggles under the helmet to protect their eyes when raising the helmet. Helmet filter lens shades will conform to table 8-2. If autodarkening filters are incorporated into the helmet, the variable filter shade range will be marked on it as required in table 8-2. Include a special filter that blocks harmful radiation even if the main switching element fails, and meet ANSI Z87.1 for impact protection and switching index time.

8.3.6 Gas-Torch Cutting and Welding. When gas-torch cutting and welding, employees will wear eye protection having filter lenses that conform to the requirements in tables 8-1 and 8-2. Sunglasses do not meet this requirement.

8.3.7 Welder Helper or Inspector. Welder helpers or welding inspectors will wear flash goggles with a minimum lens shade of 2 in the general welding area. Helpers or inspectors observing actual welding operations will wear the same protection as the welder.

8.3.8 Laser Protection. Install and use lasers and laser systems according to the manufacturer's requirements and restrictions in ANSI Z136.1, "American National Standard for the Safe Use of Lasers." Employees whose work involves Class 3b or 4 laser beams will wear appropriate laser safety goggles.

8.4 Requirements for Hearing Protection

8.4.1 Control of Noise Exposure. Practical engineering or administrative controls will be first considered and used when personnel are subjected to sound pressure levels exceeding the limits specified in table 7-1 of Section 7, "Occupational Health." When such controls fail to reduce sound pressure levels to within the specified limit, PPE will be selected, evaluated, and used in accordance with a hearing loss prevention program.

8.4.2 Hearing Protective Devices. Use hearing protective devices (properly inserted ear plugs or ear muffs) whenever ambient noise levels equal or exceed 85 decibel amperes (dBA). Hearing protection provided will be capable of reducing employee noise exposure below an 8-hour TWA of 85 dBA. See Section 7, "Occupational Health," for additional selection and care instructions.

8.4.3 Hearing Device Labels. Use hearing protective devices labeled by the manufacturer according to U.S. Environmental Protection Agency (EPA)

40 CFR, Part 211, "Product Noise Labeling." Supervisors will verify that only appropriate hearing protective devices are used.

8.5 Requirements for Protective Clothing

8.5.1 Welding. Employees engaged in welding, gouging, cutting, or burning operations where physical contact hazards exist will wear protective equipment and clothing to prevent physical contact with sparks, slag, heat, and flame to skin and clothing. Employees engaged in these types of operations will wear flame resistant (FR) or leather gauntlet gloves, chrome-tanned leather or equivalent FR chaps and coats, or a combination that provides equal protection to prevent exposure to heat, sparks, slag, intense visible, and ultraviolet light generated during welding operations. They will wear FR or leather gloves and aprons when performing cutting, burning, gauging, plasma arc, and torch operations.

8.5.2 High-Visibility Clothing. Employees exposed to vehicular traffic on roadways or construction sites will wear high-visibility safety apparel with a label verifying that it is compliant with the appropriate performance class as defined in ANSI/ISEA 107, "American National Standard for High-Visibility Safety Apparel and Headwear." Contractor Safety Plans or Reclamation work plans will contain justification for the class of clothing provided to employees.

a. Performance Class 1. Performance Class 1 apparel will be used in activities where traffic speeds are less than 25 miles per hour, traffic is well separated from employees, and work tasks permit undivided attention to approaching traffic. Some examples include parking lot attendees, delivery drivers, sidewalk construction employees. Retroreflective material must cover at least 155 square inches.

b. Performance Class 2. Performance Class 2 apparel will be used where traffic speeds exceed 25 miles per hour, work tasks divert employee attention from traffic, or work is not well separated from traffic. Construction activities fall into this category. Some examples are survey crews, road construction crews, utility workers, construction work around heavy equipment, etc. Retroreflective material must cover at least 201 square inches.

c. Performance Class 3. Performance Class 3 apparel will be used when employees are exposed to traffic speeds that exceed 50 miles per hour or other situations where visibility from a greater distance is needed. Some examples are highway construction crews, flag crews, survey crews, etc. Retroreflective material must cover at least 310 square inches. Regardless of the area of materials used, a sleeveless garment or vest alone will not be considered Performance Class 3.

8.5.3 Chemical Protective Clothing. Chemical protective equipment will be selected for resistance to each/all of the chemicals present in the products being used. Protective clothing selected will be of the disposable single use, or provisions to launder cloth protective clothing will be developed to prevent removal of contaminants from the site.

8.5.4 Gloves. Select hand protection based on the workplace characterization. Gloves will be provided and used to prevent contact with biological, chemical, and physical hazards, including hand vibrations. Substances which may require protection include acids, caustics, solvents, herbicides, infectious materials, and other toxic materials. Employees will wear leather-palm gloves when working with steel cables, barbed wire, rough-sawn timber, or other materials capable of causing lacerations. Insulating gloves will be worn when handling materials of extreme temperatures.

8.5.5 Rubber Insulating Goods. Employees will use rubber gloves, sleeves, blankets, covers, and line hose when required by special conditions for work on energized equipment and conductors to protect from the danger of electric shock. Rubber insulating goods that are provided to protect employees who work on energized conductors and equipment will meet American Society of Testing and Materials (ASTM) specifications as shown in table 8-3. Documented inspections will be performed as specified in table 8-3, and a visual inspection will be conducted prior to each use.

Table 8-3.—Standards for rubber insulating goods

Subject	When to test	Number and title	Standard for testing
Gloves	Before first issue and every 6 months thereafter	ASTM D120, “Standard Specification for Rubber Insulating Gloves”	ASTM F496, “Standard Specification for In-Service Care of Insulating Gloves and Sleeves”
Sleeves	Before first issue and every 12 months thereafter	ASTM D1051, “Standard Specification for Rubber Insulating Sleeves”	ASTM F496, “Standard Specification for In-Service Care of Insulating Gloves and Sleeves”
Blankets	Before first issue and every 12 months thereafter	ANSI/ASTM D1048, “Standard Specification for Rubber Insulating Blankets”	ASTM F479, “Standard Specification for In-Service Care of Insulating Blankets”
Covers	If insulating value is suspect	ANSI/ASTM D1049, “Standard Specification for Rubber Insulating Covers”	ASTM F478, “Standard Specification for In-Service Care of Insulating Line Hose and Covers”
Line hoses	If insulating value is suspect	ANSI/ASTM D1050, “Standard Specification for Rubber Insulating Line Hose”	ASTM F478, “Standard Specification for In-Service Care of Insulating Line Hose and Covers”
Mats		ANSI/ASTM D178, “Standard Specification for Rubber Insulating Matting”	

8.5.6 Protective Chaps. Employees who operate chain saws will wear protective chaps that meet ASTM F1897, "Standard Specification for Leg Protection for Chain Saw Users," and ASTM F1414, "Standard Test Method for Measurement of Cut Resistance to Chain Saw in Lower Body (Legs) Protective Clothing."

8.5.7 Foot Protection. Footwear selection will be based on a foot hazard assessment. When work endangers feet or requires special foot protection, employees will wear protective footwear that meets the requirements in ASTM F2413. All footwear will meet the basic I/75 "impact," C/75 "compression" standards for the protective toe box. In addition, rubber footwear, including boots and packs, will meet the sole puncture-resistance requirements. Heavy-duty footwear will meet the MT/75 metatarsal requirements. Footwear with metatarsal guards provides protection to the metatarsal area of the foot that the safety toe box does not provide. Activities where heavy objects are lifted, or where the foot could be crushed from rolling hazards, require metatarsal protection. Employees exposed to energized electrical parts will have boots that are EH rated for "electrical hazards." Work environments that require protective footwear include construction sites and activities, industrial areas, and underground work.

8.5.8 Minimum Wearing Apparel. Unless otherwise approved as uniform apparel by a first line supervisor, in coordination with the appropriate safety and health professional, all employees who work outdoors will wear, as a minimum, long pants to protect them from environmental and physical hazards, as well as shirts with a minimum 4-inch sleeve. Short pants, cutoffs, tank tops, or modified shirts are not acceptable. Open-toed shoes are not appropriate outside of an administrative environment. Apparel will protect areas where biological or chemical irritants could touch the skin.

8.5.9 Apparel Necessitated By Environmental Conditions. Extreme weather conditions, whether they be hot, cold, wet, windy, a caustic or toxic environment, or biologic hazards may necessitate additional protection of the employee than would be normally expected in the routine aspects of the job. A JHA will be conducted to analyze the hazards and to select the appropriate control method. For chemical hazards, the Material Safety Data Sheet will be used to assist in the selection of the appropriate employee protection. See Section 7, "Occupational Health," for additional guidance on hot and cold environments.

8.5.10 Electric Arc Flash Protection. Based on the incident energy analysis or a task-based assessment (if determined appropriate by a qualified engineer), as stated in FIST 5-14, "Electrical Safety Program," any person who enters the arc flash protection boundary (an approach limit at a distance from exposed live parts within which a person could receive a second-degree burn if an electrical arc flash were to occur) will wear appropriate PPE. The incident energy analysis will calculate the flash protection boundary for each item of electrical equipment in the facility that is 50 volts or greater. The task-based assessment may be used as an interim step at all facilities until a detailed incident energy analysis is completed. All parts of the body inside the arc flash protection boundary will be protected.

a. Head, Face, Neck, and Chin Protection. Employees will wear nonconductive, arc-rated, head protection (ANSI Z89.1, Class E or G) and nonconductive PPE for the face, neck, and chin whenever there is a danger of injury from electric shock, burns, arcs, flashes, or from flying objects resulting from electrical explosion. If employees use hair nets and/or beard nets, these items must be nonmelting and flame resistant.

b. Eye Protection. Employees will wear protective eyewear whenever there is a danger of injury from electric arc, flashes, or from flying objects resulting from electrical explosion. If the worker's head is within the arc flash boundary, the worker's eyes must be protected from the thermal hazard as well. Safety glasses that meet the requirements of ANSI Z87.1 provide protection from impact and filter damaging ultraviolet energy. Always wear eye protection (safety glasses or goggles) under face shields or hoods. The face shield will have an arc rating at least as great as the predicted incident energy.

c. Hearing Protection. Hearing protection will be worn for all hazard risk categories to protect against the high noise potential from an electric arc blast.

d. Body Protection. Employees will wear AR clothing whenever they may be exposed to an electric arc flash above the threshold incident energy level for a second-degree burn (1.2 calories per square centimeter [cal/cm2]). Flash suits and their closure design will permit easy and rapid removal. Garments such as rain gear worn as an outer layer over AR clothing will also be made of AR materials. The entire flash suit, including the window, will have energy-absorbing characteristics suitable for arc-flash exposure. Use clothing and equipment to maximize employee protection. Do not wear meltable synthetic fibers next to the skin.

e. Hand and Arm Protection. Employees will wear rubber insulating gloves whenever there is a danger of hand and arm injury from electric shock and burns due to contact with energized parts. Wear hand and arm protection when the possibility of arc flash burn exists. Gloves made from layers of AR material provide the highest level of hand arc flash protection. Heavy-duty leather gloves also provide good protection. Where voltage-rated gloves are used, wear leather protectors over the rubber gloves.

f. Foot and Leg Protection. Dielectric overshoes are required where electrically insulated footwear is used as a protection against step and touch potential. Heavy-duty leather work shoes normally provide a significant degree of protection to the feet from arc flash. Shoes made from lightweight material will not be selected. If the arc flash analysis indicates that the worker's legs could be exposed to an arc flash, AR clothing worn to protect the lower torso also must protect the worker's legs from exposure.

8.5.11 Determination of Appropriate Clothing. Where it has been determined that work will be performed within the arc flash protection boundary, one of the following methods will be used for the selection of protective clothing and other PPE to adequately protect the employee.

a. Incident Energy Analysis. An incident energy analysis will be performed to document the incident energy exposure of the employee (in cal/cm^2). The incident energy exposure level will be based on the working distance of the employee's face and chest area for a potential arc source for the specific task to be performed. Arc rated clothing and other PPE will be selected based on the incident energy exposure associated with the specific task. Additional PPE shall be used for any parts of the body that are closer than the distance at which the incident energy was determined. FIST 5-14, Appendix E, describes protective clothing characteristics, hazard risk categories, and required minimum arc flash ratings.

b. Hazard/Risk Categories. The requirements in the latest National Fire Protection Association (NFPA) 70E, paragraphs 130.7(C)(15) and 130.7(C)(16), shall be used for selecting and using personal and other protective equipment. When this method is selected, tables 130.7(C)(15)(a) and 130.7(C)(15)(b) shall be used to determine the hazard/risk category and requirements for using rubber insulating gloves and insulated and insulating hand tools for a task. The assumed maximum short-circuit current capacities and maximum fault clearing times for various tasks are listed in table 130.7(C)(15)(a). For tasks not listed, or for power systems with greater than the assumed maximum short-circuit current capacity or with longer than the assumed maximum fault clearing times, an incident energy analysis shall be required in accordance with Table 130.5. Once the hazard/risk category has been identified from tables 130.7(C)(15)(a) and 130.7(C)(15)(b) (including associated notes), as well as the requirements of Table 130.7(C)(15), table 130.7(C)(16) shall be used to determine the required PPE for the task. Table 130.7(C)(16) lists the requirements for protective clothing and other protective equipment based on Hazard/Risk Categories 0 through 4. This clothing and equipment shall be used when working within the arc flash boundary.

As an alternative to using tables 130.7(C)(15)(a and b) and 130.7(C)(16), NFPA70E, Annex H, Table H.2 (Simplified, Two Category, AR Clothing System) provides a quicker method of determining appropriate clothing for use within the flash protection boundary of energized electrical equipment. This simplified method will only be used as an interim measure until a detailed incident energy analysis and appropriate hazard level are calculated.

8.5.12 Synthetic Clothing Not Permitted. Do not wear synthetic clothing such as acetate, nylon, polyester, polypropylene, or spandex in fabric underlayers. These materials will melt into the skin when exposed to high temperatures and can aggravate a burn injury. An incidental amount of elastic used on nonmelting fabric underwear or socks is permitted.

8.5.13 Prohibited Articles. Do not wear conductive articles of jewelry and clothing (such as watchbands, bracelets, rings, key chains, necklaces, metalized aprons, cloth with conductive thread, metal headgear, or metal frame glasses) where they can present an electrical contact hazard with live parts, unless such articles are rendered nonconductive by covering, wrapping, or other insulating means.

8.6 Protection Against Drowning

Provide U.S. Coast Guard (USCG) approved type III or type V personal flotation devices (PFDs) to employees when working on or around water where a drowning hazard exists. Employees will properly wear (zipped, latched, tied, etc., in a closed fashion) the provided devices. Where USCG approved type V auto-inflating PFDs are selected, they must be carefully inspected before each use to ensure that the inflator mechanism is armed and in good condition. The bladder must not leak, and the user must be familiar with its use and operation. An auto-inflatable PFD must be worn as the outermost layer.

8.6.1 Design. The PFD will be of a highly visible color and will have at least 200 square centimeters of retroreflective material attached to both the front and the back. If the PFD is reversible, retroreflective material will be attached to each of its reversible sides.

8.6.2 Inspection And Replacement. Before each use, visually inspect each PFD for defects that would compromise its strength or buoyancy. Check the PFD for rips, tears, and holes and ensure that seams and fabric straps are satisfactory. There must be no signs of waterlogging, mildew odor, or shrinkage of the buoyant materials. Metal or plastic hardware used to secure the PFD on the wearer will not be broken, deformed, or weakened by corrosion. Webbing or straps used to secure the PFD on the wearer will not be ripped, torn, or separated from an attachment point on the PFD. If any of the aforementioned defects are found, or others are identified in the manufacturer's instructions, do not use the PFD; replace it immediately.

8.6.3 Ring Buoys. Install ring buoys, approved by the USCG, with at least 90 feet of line at 200-foot intervals on worksites where a water hazard exists. On an annual basis, visually inspect and document each ring buoy and rope for defects that would compromise their strength or buoyancy, and replace them as needed.

8.6.4 Lifesaving Skiffs. Provide one or more lifesaving boats or skiffs where employees work over or immediately adjacent to water, if determined necessary by a JHA. Persons trained in launching and operating the skiff will be immediately available during working hours. Use the skiff only for drills and in emergencies. Lifesaving skiffs will have the following equipment on board:

- Four oars (two if motor powered)
- Oarlocks attached to the gunwales or to the oars
- One ball-pointed boat hook
- At least one ring buoy with 90 feet of line attached
- One life preserver or work vest for each crew member, and additional devices necessary for rescued persons
- Emergency lighting

In locations where waters are rough or swift, or where manually operated boats are not practical, a power boat suitable for the waters will be provided and equipped for lifesaving.

8.7 Other Protective Equipment

Other sections of these Reclamation Safety and Health Standards cover other protective equipment, fall protection, fire and rescue devices, first aid and medical facilities, seatbelts, and special devices and equipment for protecting employees from specific hazards. Employees will use such specified protective equipment when exposed to the respective hazards.

Section 9

Signs, Signals, and Barricades

This section establishes design specifications for safety signs, tags, and barricades used on sites administered by Reclamation. This section also covers standard hoisting signals and provisions about the use of signal persons.

9.1 Requirements for Signs

9.1.1 Application. Signs described in this subsection must be visible at all times when work is in progress. Promptly remove or cover them when the hazard no longer exists.

9.1.2 Standards. In addition to the design specifications set forth in this subsection, the design and application of signs must conform to the latest edition of the following standards:

a. American National Standards Institute (ANSI) Z535.1, *Safety Color Code*

b. ANSI Z35.2, Environmental and Facility Safety Signs

c. ANSI Z35.5, Accident Prevention Tags (For Temporary Hazards)

d. ANSI C95.2, Radio Frequency Radiation Hazard Warning Symbols

e. 29 Code of Federal Regulations (CFR) 1910.145, Specifications for Accident Prevention Signs and Tags

f. U.S. Department of Transportation Federal Highway Administration, *Manual on Uniform Traffic Control Devices for Streets and Highways* (MUTCD)

g. American Society of Mechanical Engineers (ASME) A13.1, *Scheme for the Identification of Piping Systems*

9.1.3 Danger Signs. Danger signs must conform to the following requirements:

a. Application. Use danger signs only when the lives of employees or others are in danger.

b. Design. As illustrated in figure 9-1, danger signs must have “DANGER” in white letters placed at the top of a rectangular safety sign with a red background. The safety alert symbol must precede “DANGER.” The base of the symbol must be on the same horizontal line as the base of “DANGER.” The safety alert symbol must be as high as or higher than “DANGER.”

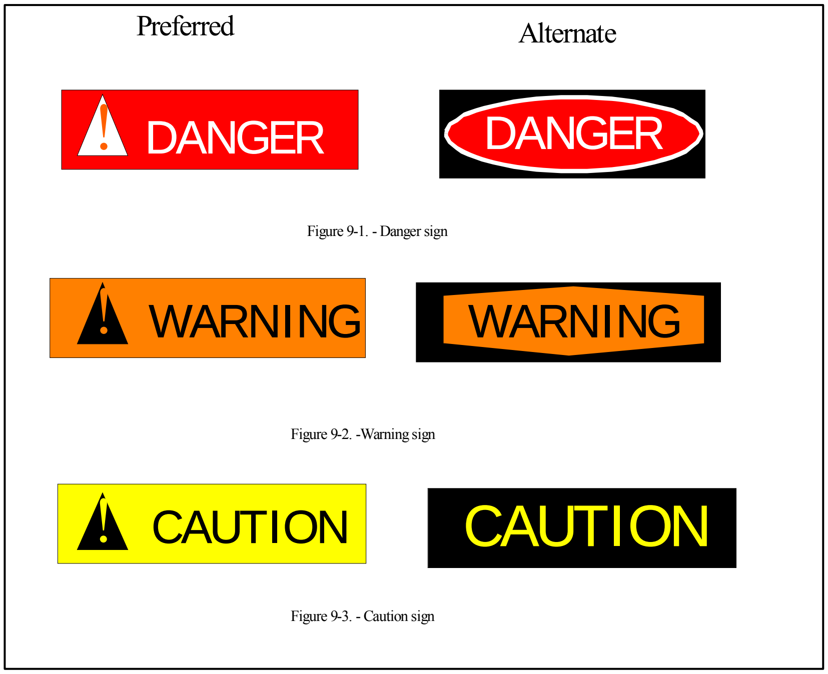


Figure 9-1.—Danger, warning, and caution signs.

c. Alternative. As an alternative, danger signs may have "DANGER" in white letters on a safety red oval background with a white border on a black rectangular field. This distinctive panel must appear in the uppermost portion of the sign. Do not use any other signal word or symbol within this distinctive shape and color arrangement. The message must be in black or red letters on a white background, or white letters on a black background. The symbol/pictorial panel, if used, must be square with a black, safety red, or black and safety red symbol on a white background.

9.1.4 Warning Signs. Warning signs must conform to the following requirements:

a. Application. Use warning signs to warn against a potential hazard that, if not avoided, may result in serious injury or death. Do not use warning signs for property damage hazards unless personal injury risk also exists.

b. Design. As illustrated in figure 9-1, warning signs must have "WARNING" placed at the top of the sign in black letters on a rectangular orange background. The safety alert symbol must precede "WARNING." The base of the symbol must be on the same horizontal line as the base of "WARNING." The safety alert symbol must be as high as or higher than "WARNING."

c. Alternative. As an alternative, warning signs may have "WARNING" in black letters within a safety orange truncated diamond of a black rectangular background. Locate this distinctive panel in the uppermost portion of the sign. See figure 9-1. Do not use any other word or symbol within this distinctive shape or color arrangement. The message panel must be in black letters on a white background or white letters on a black background. The message may, as an alternative, be black letters on a safety orange background.

9.1.5 Caution Signs. Caution signs must conform to the following requirements:

a. Application. Use caution signs to warn against a potential hazard that, if not avoided, may result in minor or moderate injury. Caution signs may also alert against unsafe practices that may cause property damage.

b. Design. As illustrated in figure 9-1, caution signs must have "CAUTION" placed at the top of the sign in black letters on a rectangular yellow background. The safety alert symbol must precede "CAUTION" if the hazard is a potential personal injury hazard. The base of the symbol must be on the same horizontal line as the base of "CAUTION." The safety alert symbol must be as high as or higher than "CAUTION."

c. Alternative. As an alternative, caution signs may have "CAUTION" in safety yellow letters within a black rectangular background located in the uppermost portion of the sign. See figure 9-1. Do not use any other signal word or symbol with this distinctive color or signal shape arrangement. Caution signs used to indicate accidents of property damage only do not include the safety alert symbol. These signs have "CAUTION" in black letters on a rectangular safety yellow background. The message panel must be in black letters on a white background or white letters on a black background. As an alternative, the message may be black letters on a safety yellow background.

9.1.6 Exit and Fire Protection Signs. Identify fire exits, fire protection equipment, and physical hazards in accordance with ANSI Z35.1, "Safety Color Code," or NFPA No. 101, "Life Safety Code."

9.1.7 Instructional Safety Signs. Signs intended for general safety instructions or information must have a green upper panel and white lower section. White letters on the green background must convey the principal message. Additional information must appear in safety green or black letters on the white background.

9.1.8 Directional Arrow Sign Panels. The directional arrow symbol must be white on a black or colored background on a rectangular field. The symbol must appear in the uppermost portion of the visual alerting device if it appears by itself or with general safety or fire safety signs. When using these directional arrows along with DANGER, WARNING, CAUTION, or NOTICE signs, the arrow must be in the lower sign panel. The color of the arrows must be the same arrangement as the message or symbol described above. The design of the directional arrows must be in accordance with ANSI Z35.2.

9.1.9 Pipe Labels. Label pipes that carry hazardous materials to identify their contents in accordance with ASME 13.1, "Scheme for the Identification of Piping Systems."

9.1.10 Traffic Signs and Barricades. Traffic signs and barricades must conform to the following requirements.

a. Design and Use. Traffic signs and barricades erected in areas under Reclamation jurisdiction must conform to the current U.S. Department Of Transportation Federal Highway Administration MUTCD. Signs and barricades erected on highways and roads must comply with MUTCD requirements or the highway or street department having jurisdiction, whichever are the more stringent. Do not use cable as a gate or road closure device. Single and double pole pipe gates are permitted if they comply with the standards set forth in MUTCD, section 3C-4, END OF ROADWAY provisions. Each gate must have at least two double-sided, 18-inch by18-inch, red reflective diamond panels mounted on and spaced equally across the gate, as described in MUTCD section 3C-3. Mount the diamond panels 36 to 48 inches above the ground. When closed, the reflective panels must be visible from both directions of travel.

Equip gate ends with reflective material to identify the open end of the gate. The gates must be designed to remain either fully opened or fully closed.

b. Installation and Removal. Erect appropriate traffic control signs and devices immediately before need and promptly remove them when no longer required.

c. Visibility. Keep signs and barricades clean and legible. Reflectorize or illuminate, as appropriate, any signs and barricades used at night. Signs and barricades must be visible at all times. Do not obscure them with parked equipment or other objects.

d. Traffic Controls. When signs and barricades do not provide adequate protection, flag persons or other appropriate traffic controls must be provided.

9.2 Accident Prevention Tags

Accident prevention tags are intended to warn employees and others of an existing hazard. They are intended for temporary use to warn of equipment under repair, defective tools, or deflective equipment. Accident prevention tags must conform to the current ANSI Z35.5, "Accident Prevention Tags (For Temporary Hazards)."

9.3 Requirements for Radiation Hazard Signs

9.3.1 Lasers. Laser warning signs and symbols must conform to the design specifications in the current issue of ANSI Z35.2, "Environmental and Facility Safety Signs," and ANSI Z136.1, "Safe Use of Lasers."

9.3.2 Ionizing Radiation. Ionizing radiation warning signs and symbols must conform to the design specifications in the current issue of ANSI Z35.2, "Environmental and Facility Safety Signs."

9.3.3 Radio Frequencies. Signs warning of harmful radio frequencies must display the standard warning symbol, as described in the current issue of ANSI C95.2, "Radio Frequency Radiation Hazard Warning Symbol."

9.4 Traffic Control Signals

9.4.1 Requirement. Flag persons directing traffic must use the signals and procedures contained in the current issue of the U.S. Department of Transportation Federal Highway Administration, MUTCD. It can be accessed on the Internet at the following website address:
http://mutcd.fhwa.dot.gov/kno-millennium.htm

9.4.2 Flag Persons. Use only employees who are trained, qualified, and/or State certified as flag persons. Flag persons controlling traffic must wear high visibility fluorescent apparel.

9.5 Barrier Tape

9.5.1 Requirement. When using barrier tape to identify a temporary hazardous location, the employee in charge of the area must mark the tape with an accident prevention tag showing his/her name and phone extension.

9.5.2 Red Plastic Tape. You may use red plastic tape to warn of dangerous locations. Red plastic tape will mean STOP, DANGER, or DO NOT ENTER. Instruct personnel working inside of the taped area on the requirements of the JHA for the taped area. The employee in charge of the area must provide a proper briefing and approval for other personnel requiring entry. Personnel must not cross over or under a red barrier tape without proper authorization.

9.5.3 Yellow Plastic Tape. You may use yellow plastic tape marked "CAUTION" to identify hazardous locations where caution is needed. Using yellow plastic tape does not prevent employees from entering an area, but does warn them of a hazardous condition.

Section 10

Fire Prevention and Protection

This section sets forth the requirements for fire prevention and protection. In addition to the fire prevention and protection requirements of this section, other sections of these standards address requirements relating to specific hazards and operations, welding and cutting, etc. Where these standards do not provide more specific instructions, they adopt, by reference, the current edition of the National Fire Codes, published by the National Fire Protection Association (NFPA).

10.1 Fire Prevention Requirements

10.1.1 Fire Prevention Plans. Write a fire prevention plan for each facility. Include a list of major workplace fire hazards; potential ignition sources; the type of fire suppression equipment of systems appropriate to control a fire; assignments of responsibilities for maintaining the equipment and systems; personnel responsible for controlling the fuel source hazards; and housekeeping procedures, including the removal of waste materials. Inform employees of the fire hazards of the materials and processes to which they are exposed. Brief new employees on the parts of the plan that are essential for their protection and emergency evacuations. Keep the written plan in the workplace and make it available for employee review.

Provide additional training for personnel assigned tasks that require them to remain in a facility during a fire emergency. The work area where these individuals remain during a fire emergency must be evaluated as an area of refuge in accordance with NFPA 101, Life Safety Code.

10.1.2 Housekeeping. Maintain good housekeeping. Promptly remove and dispose of accumulations of combustible scrap and debris in all areas of the job site. Use self-closing metal containers to collect waste saturated with flammable or combustible liquids. At all facilities, properly collect, store, and remove combustible and flammable waste products at the end of each workday or at the end of each work shift. Use only noncombustible or UL labeled, nonmetallic containers to dispose of waste and rubbish. Keep combustible items separate from each other and from noncombustible items. Label the contents of containers.

10.1.3 Grounds Maintenance. Don't allow rubbish and waste to accumulate. Prevent the growth of tall dry grass, brush, and weeds adjacent to facilities with a maximum 3-foot fire break. Place combustible waste materials outdoors to await subsequent disposal, at least 20 feet from a structure.

10.1.4 Smoking. Prohibit smoking and other sources of ignition in storage areas for flammable or explosive materials or near operations that constitute a fire hazard. Conspicuously post "NO SMOKING OR OPEN FLAMES" in all such areas.

10.1.5 Open Flame Devices. Do not leave fires and open flame devices, such as incinerators, torches, and controlled fires, unattended unless they have automatic temperature control and cutoff devices.

10.1.6 Cleaning and Degreasing. Do not use gasoline or liquids with a flashpoint below 100 degrees Fahrenheit for cleaning and degreasing. Use only approved cleaners specifically for the type of equipment or material.

10.1.7 Fireproofing. Maintain adequate clearance between heating facilities and combustible materials.

10.1.8 Explosive Gases and Vapors. Do not use open flames or heating elements where flammable gases or vapors may be present.

10.1.9 Buildings and Structures. Ensure non-fire-resistive buildings or structures are at least 25 feet apart. However, consider a group of non-fire resistive buildings with a total ground floor area of no more than 2,000 square feet as one building for this purpose, provided that each building in the group is at least 10 feet away, on each side, from other buildings.

10.1.10 Building Exits. Ensure that exits from all buildings, shops, and other facilities in which personnel work, or which are open to the public, are sufficiently well marked and lighted. Evaluate the adequacy of the means of exit, based on NFPA 101 Life Safety Code.

10.1.11 Inspections. When justified by the size or nature of the operation, security services personnel or other assigned personnel must frequently inspect buildings, storage areas, employee quarters, and work areas.

10.2 Requirements for Heating Devices

10.2.1 General. The following requirements must be met prior to the use of heating devices:

a. Approval. Use only heating devices accepted by the area/office manager. Include the following items in acceptance requests:

1. The proposed placement, including distance from combustibles.

2. The service, maintenance, and surveillance schedules.

3. The proposed fuel storage and refueling system.

4. The method for prompt detection of gaseous contamination or oxygen deficiency.

b. Data Plates. Permanently affix a data plate to each heater that provides the following information:

1. Required clearances.
2. Ventilation requirements.
3. Fuel type and input pressure.
4. Lighting and extinguishing instructions.
5. Electrical power supply characteristics.

c. Wood Floors. Mark heaters that are not suitable for use on wood floors and do not place them on combustible materials. When using such heaters, rest them on appropriate noncombustible material equivalent to at least 1 inch of concrete. The noncombustible material must extend at least 2 feet beyond the heater in all directions.

d. Combustible Covering. Do not use heaters near covers such as tarpaulins, canvas, or similar combustible materials. Locate heaters at least 10 feet away from these and similar materials. Securely fasten or tie down the coverings.

e. Stability. Place heaters on level surfaces to prevent tipping.

f. Installation. Install, vent, operate, and maintain heaters in accordance with the manufacturers' instructions.

g. Spark arresters. Install spark arresters on smokestacks that could otherwise permit sparks to escape.

h. Carbon monoxide monitors. Facilities where heating devices use combustible fuel require carbon monoxide (CO) monitors.

i. Grounding. Ground the non-current carrying metal parts of cord and plug connected heaters.

10.2.2 Portable Space Heaters. Use only electric-powered portable space heaters equipped with tipover safety devices and thermostatic controls in office spaces. Maintain 3 feet of clearance from combustible materials.

10.2.3 Liquid-Fueled Heaters. The following requirements govern the use of liquid-fueled heaters:

a. General. Heaters may be either direct or indirect fired. Kerosene, stove oil, fuel oil, and diesel oil are permissible fuels. The flashpoint of the fuel must be at least 100 degrees Fahrenheit.

b. Stability. Securely anchor liquid-fueled heaters or locate them to prevent tipping.

c. Design. Equip liquid-fueled heaters with an automatic flame loss device that will stop the flow of fuel when the flame is extinguished.

d. Fueling. Train employees tasked with fueling to be thoroughly familiar with the manufacturer's heater operation and fueling instructions. Before fueling, extinguish the heater and permit it to cool until cool to touch. Store fuel in, and dispense fuel from, approved flammable liquid containers.

e. Maintenance. Maintain heaters in good operating condition in accordance with the manufacturer's instructions.

10.2.4 Natural Gas Heaters. The following requirements apply to the use of natural gas heaters:

a. General. Install, operate, and maintain natural gas heaters in accordance with the manufacturer's instructions.

b. Stability. Securely anchor heaters or locate to prevent tipping.

c. Piping. Leak-test piping, tubing, or hose after installation, using a safe detection means, such as soap suds. When using flexible gas supply lines, they must not be more than 5 feet long. Supply lines and hose must have a minimum working gauge pressure of 350 pounds per square inch, a minimum burst gauge pressure of 1,750 pounds per square inch, and a pull test of 400 pounds without leakage.

d. Fuel Cutoff. Equip heaters with an automatic flame loss device that will shut off the gas supply if the flame or pilot light is extinguished.

10.2.5 Liquified Petroleum Gas (LPG) Heaters. The following requirements apply to the use of LPG heaters:

a. General. Install, operate, and maintain LPG heaters in accordance with the manufacturer's instructions. Do not use, locate, or store LPG containers and heating devices below grade or in confined spaces.

b. Protection. Protect heaters, when in use, from damage by location, anchoring, or barricading.

c. Testing. Leak-test piping, tubing, hoses, and flexible hose connections following installation, using a means such as soap suds. Use only flexible gas supply lines that are less than 5 feet long. Supply lines and hose must have a minimum working gauge pressure of 350 pounds per square inch, a minimum burst gauge pressure of 1,750 pounds per square inch, and a pull test of 400 pounds without leakage.

d. Hoses. Use only a hose labeled "LP-gas" or "LPG." Hoses must have a minimum working gauge pressure of 350 pounds per square inch and a minimum burst gauge pressure of 1,750 pounds per square inch. Keep the hose as short as practical, although long enough to comply with specified safe spacing requirements without kinking or straining the hose or causing it to be close enough to a burner to be damaged by heat.

e. Hose Connections. The design capability of hose assemblies, after the application of connections, must withstand a pressure of at least 700 pounds per square inch. Do not leak-test such assemblies at pressures higher than the working pressure (350 pounds per square inch minimum) of the hose.

f. Regulator. Equip heaters with an approved regulator between the cylinder and the supply line.

g. Check Valve. Provide fuel cylinder connectors with an excess flow check to minimize the flow of gas in case of fuel line ruptures.

h. Fuel Cutoff. Equip heaters with an automatic flame loss device that will shut off the gas supply if the flame or pilot light is extinguished.

i. Fuel Supply in Buildings. Allow gas cylinders or containers in buildings or structures only in accordance with the following provisions:

1. Keep the maximum water capacity of individual cylinders to 245 pounds (nominal 100 pounds LPG capacity) or less.

2. For temporary heating, such as curing concrete, drying materials, or similar uses, keep heaters (other than integral heater-container units) at least 6 feet away from any LPG container. However, you may use heaters specifically designed for attachment to the LPG container or to a supporting structure with connecting hose less than 6 feet long, provided the heater does not directly radiate heat onto the container. Do not direct blower-type or radiant heaters toward any LPG container that is within 20 feet of the heater.

3. Keep LPG supply containers at least 20 feet apart when two or more heaters are in an unpartitioned area on the same floor.

4. LPG containers manifolded together supplying one or more heaters in an unpartitioned area on the same floor must not exceed 300-pound nominal LPG capacity. Keep such manifolds at least 20 feet apart.

5. Containers may be manifolded together on floors where heaters are not connected for use, for connection to one or more heaters located on another floor, provided that: (a) the total nominal capacity of containers connected to any one manifold does not exceed 1,000 pounds LPG and (b) where more than one manifold having a nominal capacity exceeding 300 pounds LPG is located in the same unpartitioned area, the manifolds must be at least 50 feet apart.

j. Storage of Containers. Store LPG containers not in use outside, in accordance with the minimum distances identified in the section on material handling, storage, and disposal.

10.2.6 Restricted Use. The following restrictions apply to the use of heating devices:

a. Open Flame-Type Heaters. Do not use open flame-type heating devices with exposed fuel below the flame.

b. Lubrication or Service Areas. You may install an approved-type heater in lubrication or service areas where employees do not dispense or transfer flammable liquids, only if the bottom of the heater is at least 18 inches above the floor and protected from damage. If employees dispense flammable liquids in such areas, the heater must be of a type approved for garages and installed at least 8 feet above the floor.

10.3 Application of Fire Protection Requirements

10.3.1 Fire Fighting Response. Each facility must prepare an effective, detailed fire protection plan, including provisions for the fire protection and suppression equipment that are set forth in this section. The area/office manager will review and approve the plan.

When community fire department services are not available, or are insufficient, you may provide a trained firefighting brigade meeting NFPA criteria, at the discretion of the area/office manager. Fire brigades must be organized, trained, equipped, and protected as required by 29 CFR 1910.156. Provide and install mobile and fixed firefighting equipment in accordance with NFPA standards. The area/office manager may elect to evacuate all persons and not fight any fire.

Meet the following requirements in arranging for offsite assistance:

a. Written Agreement. Secure a written agreement for fire response covering the nature and type of assistance available, if possible. Otherwise, provide a letter to the area/office manager, stating the nature of the assistance, together with the details covering the equipment and personnel to be made available. The agreement must be signed and dated, and reviewed at least annually.

b. Standpipe and Hydrant Connections. When you receive offsite assistance, make sure that standpipe and hydrant connections are compatible with the equipment available from the fire department providing the assistance.

c. Reporting. Post emergency telephone numbers and reporting instructions at the job site.

10.3.2 Maintenance. Inspect and maintain fire protection systems, alarms, and fire extinguishers in accordance with NFPA standards. All equipment must be inspected periodically according to inspection table 10-1 and after each use.

10.3.3 Fire Extinguishers. Select fire extinguishers for a given situation according to the character of the fire(s) anticipated, the construction and occupancy of the facility, the vehicle or hazard to be protected, ambient-temperature conditions, and other factors identified in NFPA Standard 10. Select fire extinguishers for the class(es) of hazards to be protected in accordance with the following:

a. Class A hazards—ordinary combustibles. Use water and multipurpose dry chemical type fire extinguishers.

b. Class B hazards—flammable liquids. Use aqueous film forming foam (FFF), film forming fluoroprotein foam (FFFP), carbon dioxide, and dry chemical type extinguishers.

c. Class C hazards—energized electrical equipment. Use carbon dioxide and dry chemical type fire extinguishers. ***Note:*** carbon dioxide fire extinguishers equipped with metal horns are not safe for use on fires in energized electrical equipment and, therefore, are not classified for use on Class C hazards.

d. Class D hazards—combustible metals. Use fire extinguishers that are approved for use on the specific combustible metal hazard.

10.3.4. Water Supply. Install a temporary or permanent water supply with sufficient flow volume and duration to supply the standpipes, hose stations, and sprinkler systems, before or during the construction of the facility to be protected. In permanent structures under contract in which standpipes are installed, connect the standpipe to the water supply, install the standpipe concurrently with construction of the structure, and maintain the standpipe in operable condition for fire protection use. Provide the standpipes with fire department connections on the outside of the structure, conspicuously marked, and located in an accessible location at street or road level.

10.3.5 Burning Areas. Do not burn waste materials, except in an approved and permitted incinerator.

Table 10-1.—Inspection schedule for fire protection equipment

Item	Inspection interval	Procedure
1. All portable and wheeled extinguishers	Monthly	Ensure that all extinguishers are in the proper locations, have clear access, and are plainly visible. Visually inspect extinguishers for damage, leakage, and to determine if they are fully charged and operable. If necessary, recharge extinguisher and correct deficiencies.
	Annually	Reference NFC Standard 10, "Standard for Portable Fire Extinguishers." Ensure annual maintenance of extinguishers according to specific type.
2. Main generator CO_2 system	Weekly	Check nozzles for physical damage. Ensure that self-closing doors or automatically releasing doors are in place. For low-pressure CO_2 systems, check the liquid level in each low pressure gauge and refill if loss is greater than 10 percent.
	Monthly	Check electrical control circuits and indicating lights. Check for signs of leakage at cylinders. Check for signs of physical damage to system components.
	Semi-annually	Weigh all cylinders and refill if necessary. Operate control heads. Test and check system in accordance with the manufacturer's recommendations.
	Annually	Conduct an actuating test of the system. Test all system components without discharging CO_2.
3. Sprinkler systems	Weekly	Inspect sealed control valves. Check that water supply valves are open. Inspect condition of sprinkler heads. Maintain an 18-inch clear space. For dry pipe systems, inspect air and water pressure gauges, and record readings.
	Monthly	Inspect fire department connections. Inspect control valves. Ensure that water supply valves are open.
	Quarterly	Determine dry pipe priming water level. Flow- test main drains. Test water flow alarms in wet pipe systems. Test low-air pressure alarms and water flow alarms in dry pipe systems. Exercise post indicator and valves.
	Semi-annually	Close and drain cold weather valves in the fall, before freezing weather, and again in the spring, after freezing weather has passed.
	Annually	Test the freezing point of antifreeze solutions. Trip-test the dry pipe valve on dry pipe systems. Lubricate all valve stems. Clean strainers, if installed. Drain all low pint drains on dry pipe systems.

Table 10-1.—Inspection schedule for fire protection equipment (continued)

Item	Inspection interval	Procedure
3. Sprinkler systems (continued)	After 50 years	After the first 50 years that a sprinkler system has been in place, remove a representative sample of heads and send to a lab for testing.
4. Fire pumps	Monthly	Check the pressure of all gauges. Check for automatic indication of controller lights. Ensure that all valves are open. Conduct operational test, check packing gland tightness, suction, and discharge pressure gauges.
	Annually	Test pump performance. Test waterflow and alarm switches. Check valve position. Verify pump speed at each flow. Record suction and discharge pressure at each flow.
5. Fire doors and dampers	Monthly	Inspect and manually operate doors.
	Quarterly	Test operation of automatic fire doors.
	Annually	Lubricate rollers, clean-out channels, and moving parts. Check operation of dampers and moving parts.
6. Water supply systems	Weekly	Check air pressure in pressure tanks. Check water level in storage and pressure tanks. Check control valves (usually in open position).
	Annually	Check accessibility and condition of fire department connections. Check condition of storage tanks for scale or rust; check storage tank access; check condition of paint or fabric. Conduct a flow test.
7. Fire hose stations	Monthly	Inspect nozzles, hoses, and connections. Replace defective hose and discard old hose.
	Semi-annually	Check dry barrel hydrants for leaks and cracks; check the operating nut for wear and the nozzle threads for damage.
	Annually	Test flow and hydrant pressure. Wet barrel hydrants are checked for leaks and cracks, wear on the operating nut and nozzle threads. Thoroughly inspect and rerack hoses. Use graphite to lubricate swing-out hose racks or hose reels.
	Every 5 years	Hydrostatically test dry standpipes.

Table 10-1.—Inspection schedule for fire protection equipment (continued)

Item	Inspection interval	Procedure
8. Fire alarm systems	Monthly	Ensure that all equipment is operable. Illuminate lamps and LEDs on fire alarm annunciator panels. Conduct operational test of engine generator (if connected to system). Check water level of rechargeable batteries. Test initiating and signaling device circuits.
	Quarterly	Test two-way communications.
	Semi-annual	Check fuse ratings; check voltage of each rechargeable battery cell. Test all remote annunciators. Test smoke detectors.
	Annually	Test supervisory device circuits. Test primary and secondary power supply. Test lamps and LEDs.
9. Transformer fog system	Weekly	Check pilot lights indicating that system is operable and that all control valves are open. Check that nozzles have not been blocked or repositioned.
	Annually	Test the control valve and automatic detection equipment (a full operational test with water flowing is not necessary). Inspect all piping for corrosion and ensure proper drainage.
	Every 5 years	A full flow test of the system is required at least every 5 years. This should be conducted when the transformer bank is out of service.

Section 11

Standards for Material Handling, Storage, and Disposal

This section sets forth the requirements for handling, storage, and disposal of material. It specifically addresses the requirements for storing material in an open yard; stacking bagged material; storing material in bulk; storing lumber; storing bricks and masonry blocks; handling and storing cement and lime; handling and storing reinforcing sheet and structural steel; handling and storing pipe, conduit, and cylindrical material; storing sand, gravel, and crushed stone; handling and storing flammable and combustible liquids; handling asphalt and tar products; handling liquified petroleum gas; and housekeeping.

11.1 General Requirements for Storage of Materials

Store materials in a planned and orderly manner that does not endanger employee safety. Ensure stacks, tiers, and piles are stable and stacked to aid safe handling and loading. Store hazardous materials in accordance with the individual requirements.

Store all materials on pallets to discourage rodent infestation. Immediately clean up spills and leaks that create such rodent habitat.

Use slings to hoist bagged material, lumber, bricks, masonry blocks, and similar loosely stacked materials only if the slings are fully secured against falling by straps, sideboards, nets, or other suitable devices.

11.2 Storing Materials in an Open Yard

Storing materials in an open yard requires attention to combustible materials, access, powerlines, and fire protection.

11.2.1 Combustible Materials. Stack combustible materials securely. Stacks or piles must be no more than 16 feet high. Store combustible material at least 10 feet away from a building or structure.

11.2.2 Access. Driveways between and around combustible storage piles must be at least 15 feet wide. Keep them free from accumulations of material or rubbish. Use a map grid system of 50 by 150 feet when planning driveways in open-yard combustible material storage areas.

11.2.3 Powerlines. Do not store materials under power lines or where materials may block egress or emergency equipment.

11.2.4 Fire Protection. Provide portable fire extinguishing equipment rated 2-A:40-B:C at accessible marked locations in the yard so that the nearest extinguisher is no more than 50 feet away for a Class B hazard or 75 feet away for a Class A hazard.

11.3 Requirements for Storing Materials Indoors

Storing materials indoors requires attention to access, fire prevention and protection, floor loading, and overhead hazards. Buildings under construction require special precautions.

11.3.1 Access. Place or store materials so they do not interfere with access ways, doorways, electrical panels, fire extinguishers, or hoistways. Do not obstruct access ways or exits with accumulations of scrap or materials. Aisles must be wide enough to accommodate forklifts or firefighting equipment.

11.3.2 Fire Prevention. When storing, handling, and piling materials, consider the fire characteristics. Store noncompatible materials that may create a fire hazard at least 25 feet apart or separate them with a barrier having at least a 1-hour fire rating. Pile material to minimize internal fire spread and to provide convenient access for firefighting.

11.3.3 Fire Doors. Maintain a 24-inch clearance around the travel path of fire doors.

11.3.4 Sprinklers. Maintain at least an 18-inch clearance between stored materials and sprinkler heads.

11.3.5 Heating Appliances. Maintain at least a 3-foot clearance between stored materials and unit heaters, radiant space heaters, duct furnaces, and flues or the clearances shown on the approval agency label.

11.3.6 Fire Protection. Emergency fire equipment must be readily accessible and in good working order.

11.3.7 Floor Loading. Conspicuously post load limits in all storage areas, except for floors or slabs on grade.

11.3.8 Buildings Under Construction. Store materials inside buildings under construction at least 6 feet away from any hoistway or inside floor openings, and 10 feet away from an exterior wall that does not extend above the top of the material stored.

11.4 Requirements for Stacking Bagged Material

Stack bagged materials by stepping back the layers and cross-keying the bags at least every 10 bags high, except when restrained by walls or partitions of adequate strength.

11.5 Requirements for Storing Material in Bulk

Ensure entry to bulk storage locations, such as silos, hoppers, tanks, or bins (which are also classified as confined spaces) complies with OSHA requirements and local operating procedures.

11.6 Requirements for Lumber Storage

Stack lumber on level and solidly supported sills so that the stacks are stable. Do not pile lumber more than 16 feet high.

11.7 Requirements for Storing Bricks and Masonry Blocks

Stack bricks and masonry blocks on level and solid surfaces.

11.7.1 Bricks. Stack bricks no more than 7 feet high. Step back a loose brick stack at least 2 inches for every foot of height above 4 feet. Stack packaged brick no more than three units high.

11.7.2 Masonry Blocks. Step back masonry blocks one-half block per tier above the 6-foot level.

11.8 Requirements for Handling and Storing Cement and Lime

Handling or storing cement or lime requires a job hazard analysis (JHA). Lime requires careful storage and handling procedures.

11.8.1 Cement and Lime. Employees must wear appropriate personal protective equipment, as specified in the "Personal Protective Equipment" section and as identified in the JHA. Provide washing facilities, hand cream, chemical barrier cream, or similar preparations for protection from dermatitis.

11.8.2 Lime. Store unslaked lime in a dry area and, because it presents a fire hazard, separate it from other materials.

11.9 Requirements for Handling and Storing Reinforcing, Sheet, and Structural Steel

Stack steel to prevent sliding, rolling, spreading, or falling.

Use lagging (sleeve) when steel is handled by a crane or forklift to aid safe rigging.

11.10 Requirements for Handling and Storing Pipe, Conduit, and Cylindrical Material

Make sure cylindrical materials are stable when storing or handling.

11.10.1 Stacking. Place pipe, conduit bar stock, and other cylindrical materials in racks or stack and block them on a firm, level surface to prevent spreading, rolling, or falling. Use either a pyramided or battened stack. Step back battened stacks at least one unit per tier and securely chock them on both sides of the stack.

11.10.2 Removal. Remove round stock (e.g., wood poles, pipe, and conduit) from a stack from the ends of the stock.

11.10.3 Unloading. Unload carriers so that employees are not exposed to the unsecured load.

11.10.4 Taglines. Use taglines when working with round stock.

11.11 Requirements for Storing Sand, Gravel, and Crushed Stone

Locate stockpiles to provide safe access for withdrawing material. Material or vertical faces must not overhang.

Store material against walls or partitions only in an amount that will not endanger the stability of the wall or partition.

11.12 Requirements for Handling Flammable and Combustible Liquids

Unless defined otherwise, terms used in this subsection are the same as those in the flammable and combustible liquids code, NFPA 30, or 29 CFR 1910.106.

11.12.1 Classification of Flammable and Combustible Liquids. Flammable and combustible liquids are classified as follows:

a. Flammable Liquids (Class I Liquids):

1. Class I—Flashpoint below 100 °F (38 °C)
2. Class IA—Flashpoint below 73 °F (23 °C) and boiling point below 100 °F (38 °C)
3. Class IB—Flashpoint below 73 °F (23 °C) and boiling point at or above 100 °F (38 °C)
4. Class IC—Flashpoint at or above 73 °F (23 °C) but below 100 °F (38 °C)

b. Combustible Liquids (Class II and III Liquids):

1. Class II—Flashpoint at or above 100 °F (38 °C) and below 140 °F (60 °C)
2. Class III—Flashpoint at or above 140 °F (60 °C)

11.12.2 Class IA Flammable Liquids

a. Restricted Use. Because of the extreme explosion hazard of Class IA liquids, purchase them only after you have reviewed the MSDS and the storage, dispensing, and use procedures have been approved. Submittals for approval must provide the name and description of the liquid, its characteristics, a detailed description of its intended use, the MSDS, and the safety and health precautions. This requirement does not apply to small quantities of aerosol starter fluid used for engines.

b. Substitute Product. Wherever practical, use a less hazardous product.

c. Controlled Use. A competent person must supervise storage, dispensing, and use of Class IA liquids, including design of the storage and dispensing system.

11.12.3 Toxicity of Flammable and Combustible Liquids. Most flammable and combustible liquids are highly toxic. Use them only after determining their toxic characteristics. In handling toxic liquids, follow the appropriate safety and health requirements in the "Occupational Health" section.

11.12.4 Closed Tanks and Containers

a. Approved Types. Use only the following approved and labeled closed tanks and containers to store, handle, and dispense flammable and combustible liquids.

1. Original Container. Store and use flammable and combustible liquids in the original Department of Transportation (DOT) shipping containers, as shown in table 11-1. However, store only up to 1-day's use in the work area, up to a maximum of 25 gallons of a Class 1A liquid or a maximum of 120 gallons of any other class of liquid. When dispensing and using smaller quantities of flammable and combustible liquids, dispense them into properly labeled, approved safety containers. Exception: You may store and handle highly viscous (extremely hard to pour) liquids in any size original container. Liquids that are transferred from labeled containers to portable containers for immediate use are exempt from labeling.

2. Safety Can. An approved container holding no more than 5 gallons with a spring-closing lid, spout cover, and designed to safely relieve internal pressure when subjected to fire or heat exposure.

3. Drum/Barrel. An approved container holding more than 5 gallons but no more than 60 gallons.

4. Portable Tanks. An approved, closed storage vessel holding more than 60 but no more than 660 gallons and not intended to be a fixed installation.

5. Tanks. Any vessel holding more than 60 gallons, intended for fixed installation, is not used for processing.

Table 11-1.—Maximum allowable size of containers and portable tanks, combustible

	Flammable liquids			Liquids	
Container type	**Class IA**	**Class IB**	**Class IB**	**Class II**	**Class III**
Glass	1 pint	1 quart	1 gallon	1 gallon	5 gallons
Metal (other than approved DOT drums) or approved plastic	1 gallon	5 gallons	5 gallons	5 gallons	5 gallons
Safety cans	2 gallon	5 gallons	5 gallons	5 gallons	5 gallons
Metal drums (DOT specifications)	60 gallons	60 gallons	60 gallons	60 gallons	60 gallons
Approved portable tanks	660 gallons	660 gallons	660 gallons	660 gallons	660 gallons
Polyethylene DOT specification 34,or as authorized by DOT exemption	1 gallon	5 gallons	5 gallons	60 gallons	60 gallons

11.12.5 Approved Storage Cabinets

a. General Design and Construction. The design, construction, and approval of storage cabinets must comply with NFPA 30.

11.12.6 Requirements for Storing Flammable or Combustible Liquids

a. Indoor Storage. Do not store flammable and combustible liquids indoors, except as follows:

1. Store no more than 25 gallons in a room or single fire area.

2. Store no more than 60 gallons of Class I or II liquids, or more than 120 gallons of Class III liquids, in an approved cabinet. Locate no more than three such cabinets in a single fire area.

3. You may store larger quantities in separated indoor storage areas when such storage meets the requirements of NFPA 30, Section 4-4, “Design, Construction, and Operation of Inside Storage Areas.”

4. Place at least one 2-A:40-B:C fire extinguisher 10 feet to 30 feet away from the stored material or cabinet.

5. Place at least one 2-A:40-B:C fire extinguisher outside of, but not more than 10 feet from, the door opening into an inside liquid storage area.

b. Outdoor Storage. Do not store flammable and combustible liquids outdoors, except as follows:

1. Above ground in approved containers with no more than 60-gallon capacity, subject to the following restrictions:

(a) The total capacity of any one group of containers stored together must not exceed 1,100 gallons. Each group of containers must be at least 5 feet apart, and each group must be at least 20 feet away from any building or other combustibles.

(b) Each group of containers must be adjacent to an access way at least 12 feet wide to facilitate the use of firefighting equipment.

2. Above ground in approved portable tanks with no more than 660-gallon capacity, providing that you:

(a) Keep a 5-foot clear area around groups of two or more tanks with a combined capacity of more than 2,200 gallons.

(b) Keep portable tanks at least 20 feet away from any building or other combustibles.

(c) Equip portable storage tanks with emergency venting and other devices, as required in NFPA 30.

(d) Locate each tank adjacent to an access way at least 12 feet wide to facilitate use of firefighting equipment.

3. Above ground in approved tanks installed in accordance with NFPA 30, Section 2-3, “Installation of Outside Above Ground Tanks.”

4. Dike storage areas at least 12 inches high or grade and slope them, and seal them with a 50-mil plastic compatible sheeting or equivalent liner to contain leaks and spills equal to the capacity of all tanks or containers in each area. Keep the area free from vegetation or combustible material within 10 feet of the storage area perimeter.

5. Place at least one portable fire extinguisher unit rated not less than 2-A:40-B:C 25 feet to 75 feet away from each portable tank or group of tanks or containers.

11.12.7 Handling and Dispensing Flammable or Combustible Liquids

a. Dispensing Area. Separate areas where you transfer more than 5 gallons of flammable or combustible liquids at a time from other operations by at least 25 feet or by a partition with a minimum 1-hour fire rating. Use drainage or an equally effective method to contain spills.

b. Ventilation. Provide adequate natural or mechanical ventilation to maintain the concentrations of flammable vapor below 10 percent of the lower explosive limit (LEL).

c. Grounding. Transferring Class I flammable liquids from one container to another requires bonding of the containers and the transfer system. Electrically ground and bond all dispensing systems.

d. Dispensing. Withdraw or transfer flammable and combustible liquids into vessels, containers, or tanks only (1) through a closed piping system, (2) from safety cans, (3) by means of a device drawing through the top, or (4) from containers or tanks by gravity or pump through a listed self-closing valve. Do not transfer by injecting pressurized air into a tank or container. Use approved dispensing devises and nozzles. The dispensing units must be protected against collision damage.

e. Lighting and Electrical Equipment. Use only electrical lighting to illuminate areas where Class I flammable liquids are handled or dispensed or where flammable vapor may be present. Wiring and all electrical equipment must meet the requirements of NFPA designation: Class I, Division 2, of the National Electrical Code.

f. Covered Containers. Keep Class I and II liquids in covered containers when not in use.

g. Flame and Ignition. Do not permit open flame, smoking, or other sources of ignition within at least 50 feet of areas where Class I flammable liquids are dispensed or used. Post approved “No Smoking” signs in such areas.

h. Leakage or Spillage. Clean up leaking or spilled flammable or combustible liquids promptly and dispose of them safely.

i. Refuse Containers. Provide self-closing metal refuse containers in all areas where employees use or dispense flammable or combustible liquids.

11.12.8 Requirements for Refueling

a. Equipment. Ensure that the design and installation of tanks and equipment used to refuel vehicles or equipment (fueled with flammable or combustible liquids) comply with the applicable provisions of the NFPA standards or nationally recognized testing laboratories or have the approval of the Government agency having jurisdiction.

b. Tank Truck. Ensure that tank trucks comply with the requirements published in NFPA 385, “Standard for Flammable and Combustible Liquid Tank Vehicles.”

c. Dispensing Stations. Mount dispensing devices, except those attached to containers, on a concrete platform elevated at least 5 inches above grade. Use guardrails or posts to protect them from collision with a motor vehicle.

d. Dispensing Hose. To dispense flammable and combustible liquids, use an approved-type hose with an automatic self-closing valve or nozzle without a latch-open device. Ensure that a hanger or hose retracting system is in place to protect the hose from traffic abuse.

e. Electrical Equipment. Ensure that electrical wiring, pumps, and equipment meet the appropriate requirements of NFPA designation, Class I of the National Electrical Code. Provide clearly marked and accessible switches at a location remote from dispensing devices to shut off all power to devices in an emergency.

f. Refueling Equipment. During refueling, shut down vehicles or equipment that use gasoline, liquified petroleum gas (LPG), or other flammable or combustible liquid fuels. An exception is diesel equipment when fueled in accordance with the manufacturer's recommendations. Use guardrails or posts to protect refueling tanks or dispensing islands from vehicular damage.

g. Smoking. Post a "No Smoking Within 50 Feet" sign on all mobile refueling equipment and in established refueling areas.

h. Emergency Shut-Off Switch. Ensure that an emergency shut-off switch is within 50 shall be located within 50 feet of the fuel dispensing equipment. Post a conspicuous sign to identify the switch location.

i. Fire Protection. Provide each refueling area with one or more listed fire extinguishers with a minimum classification of 40B:C. Locate a fire extinguisher within 100 feet of each pump, dispenser, underground fill pipe opening, and lubrication or service room.

11.13 Requirements for Handling Asphalt and Tar Products

Employees who handle or work with these materials must complete a JHA, including exposure determinations. Make available and ensure employees follow the MSDS for storing, handling, and applying these materials.

11.13.1 Protective Clothing and Equipment. Give full consideration to protective clothing, respiratory protection, and skin protection, as specified in the "Personal Protective Equipment" section, to protect employees handling or applying these materials.

11.13.2 Confined Spaces. In enclosed or confined areas where hot tar, asphalt, enamel, or similar materials are heated or applied, the operation must conform fully with the "Confined Spaces" section.

11.13.3 Heating Kettles. Do not leave asphalt or tar kettles unattended, when in use. Place them on a firm, level base and protect them from overturning. Kettles must have an effective lid or hood. They must have an operable temperature indicator and limiting device ensuring the asphalt or tar remains at no less than 50 EF below the flashpoint. Do not use kettles in confined or unventilated spaces, underground, in conduits, or in or on enclosed buildings or structures.

11.13.4 Fire Protection. Provide a fire extinguisher, rated not less than 2-A:40-B:C, where heating devices or heating kettles are in use.

11.13.5 Handling. Provide adequate unobstructed runways or access ways for employees handling hot materials. Employees must not carry hot materials up or down ladders. Instead, provide adequate hoisting devices.

11.13.6 Thinners. Do not use gasoline or similar volatile liquids as thinners.

11.13.7 Hand Spraying. The nozzle person applying hot tar asphalt must not work under the hoses supplying the material to the spray nozzle. Use flexible metallic hoses fitted with insulated handles in hand spraying operations.

11.13.8 Housekeeping. Keep distributors, retorts, hoses, and related equipment reasonably free of asphalt and tar accumulations.

11.14 Requirements for Handling Liquified Petroleum Gas (LPG)

Store, handle, install, and use LPG and systems in accordance with NFPA 58, 29 CFR 1910.110(f), and 29 CFR 1926.153. Cylinders must meet DOT specifications published in 49 CFR, Part 178, "Shipping Container Specifications."

11.14.1 Hazardous Locations. Do not use LPG containers and equipment in unventilated spaces, below grade in pits or trenches, below deck, or in confined areas.

11.14.2 Tubing. Use only tubing or piping approved for use in LPG systems. Do not use aluminum or polyvinyl piping or tubing.

11.14.3 Hose. Use only hoses labeled "LP-gas or LPG." Hose must have a minimum working pressure of 250 pounds per square inch.

11.14.4 Valves and Accessories. Valves, fittings, and accessories connected directly to the container, including primary shutoff valves, must have a minimum working gauge pressure of 250 pounds per square inch and be designed for LPG service.

11.14.5 Shutoff Valves. Connections to containers, except safety relief connections, liquid level gauging devices, and plugged openings, must have a shutoff valve located as close to the container as possible. Shutoff valves must not be located between the safety relief device and the container, except when the location of the shutoff valve allows the fully required capacity flow through the safety relief device.

11.14.6 Safety Relief Valves. Equip each container with one or more approved safety relief valves. These valves must allow free venting to the outer air. The discharge must be 5 feet away from any building opening. Place container safety relief devices and regulator relief vents at least 5 feet from air openings into sealed combustion system appliances or mechanical ventilation air intakes.

11.14.7 Dispensing

a. Portable Containers. Fill portable containers from storage containers outside and at least 50 feet away from the nearest building.

b. Motor Vehicles. Fill fuel containers on motor vehicles from bulk storage containers at least 10 feet away from a masonry-walled building and at least 25 feet away from any other building or structure.

c. Refueling. Shut down equipment using LPG during refueling.

11.14.8 Storage of Cylinders and Containers. Store LPG containers and cylinders not in use outside of buildings or structures, at not less than the following distances away from the nearest building or combustible material storage.

Quantity of LP-gas stored (pounds)	Minimum distance		
	(a) and (b) (feet)	(c) and (d) (feet)	(e) (feet)
720 or less	0	0	5
721 to 2,500	0	10	10
2,501 to 6,000	10	10	10
6,001 to 10,000	20	20	20
Over 10,000	25	25	25

(a) nearest building or storage area; (b) line of adjoining property; (c) thoroughfares or sidewalks; (d) line of adjoining property used for public gathering; (e) dispensing station.

11.14.9 Fire Protection. Provide storage locations with at least one accessible portable fire extinguisher rated not less than 2-A:40-B:C, between 25 feet and 75 feet away from the container.

11.15 Requirements for Storing and Handling Paints, Varnishes, and Thinners

Storing and handling paints, varnishes, or thinners requires special attention to flammability characteristics.

11.15.1 Storage. Store and dispense paints, varnishes, lacquers, thinners, and other volatile paints or coatings according to their flammability characteristics. Tightly close containers when not in use; store no more than a 1-day supply in buildings under construction.

11.15.2 Ventilation. Provide sufficient ventilation to prevent hazardous concentrations of flammable vapors from accumulating where employees dispense or apply paints or coatings.

11.15.3 Spray Painting. Do not allow smoking, open flame, exposed heating elements, or other sources of ignition where employees spray flammable or combustible paints or coating. Spray painting booths and equipment must be in accordance with NFPA 33, “Standard for Spray Application Using Flammable and Combustible Materials.”

11.15.4 Personal Protective Equipment. Make exposure determinations for employees who have been exposed to paints or coatings potentially hazardous to their health to document exposure and, when appropriate, provide appropriate protective equipment and hazard training.

11.15.5 Electrostatic Paint Spraying

a. Electrical. Locate transformers, power packs, control apparatus, and other electrical portions of the equipment, with exception of the gun and its connection to the power supply, outside the spraying area.

b. Grounding. Ground the handle of the spray gun with a conductive device to ensure the gun and the operator are at the same ground potential.

11.16 Housekeeping

Keep work and storage areas clean and orderly and in a sanitary condition. Keep stairways, access ways, and exits free from scrap, supplies, materials, or equipment.

11.16.1 Waste Disposal. Collect, store, and remove combustible waste products at the end of each workday or at the end of each work shift. Use only noncombustible containers to dispose of waste and rubbish and equip them with fitted or self-closing covers. Promptly remove and dispose of spills of flammable or combustible liquids. Place scrap lumber in containers and do not allow it to accumulate in work areas. Remove or bend over protruding nails unless the scrap lumber is placed directly in containers for removal.

11.16.2 Segregation of Materials and Waste. Consider storage segregation precautions for all materials. Use MSDS to determine appropriate storage segregation. Identify and label segregated material containers. Following are some examples of materials that must be segregated:

a. Ordinary combustibles such as paper, wood, and natural fiber fabrics.

b. Oily or flammable materials, such as saturated oily or solvent rags.

c. Corrosive and caustic materials, such as batteries.

d. Infectious materials that may cause infection, disease, or death.

e. Reactive materials that may self-decompose or self-ignite because of heat, chemical reaction, friction, or impact.

f. Radioactive materials.

g. Toxic materials that may be fatal if inhaled, swallowed, or absorbed through the skin.

11.16.3 Outdoor Housekeeping. Keep the areas adjacent to facilities free from rubbish, waste, and tall, dry vegetation. Place combustible waste materials stored outdoors to await subsequent disposal at least 20 feet away from facilities.

11.16.4 Tools and Equipment. To prevent tripping or injury, keep floors clear of tools and portable equipment. Adequately secure tools, materials, and equipment where a tripping hazard exists.

11.16.5 Wind. Store loose or light materials on roofs or unenclosed height only if they are safely tied down or secured.

11.16.6 Sacks and Bags. Remove empty bags that contained cement, lime, or other dust-producing material from the work area at least daily.

11.16.7 Working Aloft. Provide containers to store or carry rivets, bolts, drift pins, and similar items. Secure containers against accidental displacement.

11.16.8 Excavated Materials. Keep roads and walkways clear of excavated materials wherever possible. Where this is not possible, adequately post or barricade these areas and provide other access.

11.16.9 Dropping Material. Drop or throw waste material and debris more than 6 feet only if you:

a. Completely enclose the area into which the material is dropped with barricades at least 6 feet back from the projected edge of the opening or level above. Post signs warning of the hazard at each level.

b. Install safely designed chutes providing protection for persons below. Fully enclose chutes for debris and scrap for their entire run except for openings for inserting materials. Equip such openings with covers or enclosures.

Section 12

Electrical Safety Requirements

This section sets forth requirements for electrical safety. It specifically addresses working in restricted areas; working near exposed energized overhead lines or parts; operating equipment near radio and microwave transmission towers; working on electrical equipment and systems; personal protective grounding; temporary wiring; disconnect and overcurrent protection; ground-fault protection; hazardous locations; wet locations; and battery charging.

12.1 General Electrical Safety Requirements

All electrical work practices must comply with applicable sections of the Occupational Safety and Health Administration (OSHA), National Fire Protection Association (NFPA), National Electrical Code, National Electrical Safety Code, and State adopted electrical codes.

12.1.1 Approval Required. Use only electrical wire, conduit, apparatus, and equipment for the specific application that is approved or listed by Underwriters Laboratories (UL), or Factory Mutual Corporation (FMC). Install and use listed, labeled, or certified equipment according to the instructions included in the listing, labeling, or certification.

12.1.2 Qualified Persons. Only qualified personnel familiar with code requirements, safety standards, and experienced in the type work may work on electrical circuits and equipment. NFPA 70E and OSHA 29 CFR 1910.269 contain references for training requirements. See attachment at the end of this section.

12.1.3 Safety Requirements Before Performing Electrical Work. The employer will determine, by inquiry, direct observation, or instruments, the location of any part of an energized electric power circuit, exposed or concealed. If the work may cause any person, tool, or machine to penetrate the boundaries set forth in table 12-1, de-energize the circuit(s) and ground them, as appropriate. Additionally, all of the following must be required:

a. Underground Lines. Protect all underground lines with surface signs and a longitudinal warning tape buried 12 inches to 18 inches above the lines. Do not perform drilling, auguring, or material excavating operation within 6 feet of underground lines unless the lines have been deenergized.

b. Job Briefing. The supervisor or designee must conduct a job briefing with affected workers. The supervisor or designee must hold additional job briefings if significant changes occur during the course of work. The briefing must cover the following:

(1) Job Hazard Analysis (JHA). Identify all hazards associated with the job in a written JHA and discuss them.

(2) Nonelectrical Hazards. Identify, in a written JHA, hazards not associated with the electrical work but expected to be encountered, and discuss them.

(3) Personal Protective Equipment (PPE). Provide and use the appropriate PPE needed to accomplish the job safely. Use flash-protection clothing in accordance with NFPA 70E if the job requires operating, racking, circuit breakers with the doors open, or, working within reaching distances of exposed energized parts. Employees working on energized lines and equipment rated at 440 volts or greater must use rubber gloves, hard hats, safety boots, and other approved protective equipment or hot-line tools that meet ASTM standards.

12.1.4 Other Procedures. Perform procedures related to electrical work in accordance with the following:

- FIST 1-1, Hazardous Energy Control Program
- FIST 5-1, Personal Protective Grounding, and
- Written Standard Operating Procedures (SOPs) of each area office

12.2 Restricted Areas

12.2.1 General. Provide effective barriers or other means to ensure that people do not use areas with electrical circuits or equipment as passageways when energized lines or equipment are exposed. Effectively guard live parts of wiring or equipment to protect persons or objects from harmful contact. Use special tools insulated for the voltage when installing or removing fuses with one or both terminals energized.

12.2.2 High-Voltage Equipment (over 600 volts nominal). Isolate exposed high-voltage equipment, such as transformer banks, open switches, and similar equipment with exposed energized parts to prevent unauthorized access. Isolation must consist of locked rooms, fences or screened enclosures, walls, partitions, or elevated locations. Keep entrances to isolated areas locked when not under constant observation. Post **DANGER—HIGH VOLTAGE** warning signs at entrances to these areas. Properly ground conductive components, fences, guardrails, screens, partitions, walls, and equipment frames and enclosures.

12.2.3. Temporary Fences. When extending a fence or removing it for work on high voltage equipment, erect a temporary fence of comparable construction and protection. Electrically bond the temporary fence to the existing fence. If the fence is more than 40 feet long, bond posts to the ground mat at no more than 40-foot intervals. Bond posts at each side of gates or openings to the ground mat/grid and install a bonding jumper across all gate hinges. Bond all corner posts to the ground mat.

12.2.4 Perimeter Markings. Use approved perimeter markings to isolate restricted areas from designated work areas and entryways. Erect them before work begins and maintain them for the duration of work. Approved perimeter marking must be:

a. Barrier Tape. Install red barrier tape printed with the words **"DANGER—HIGH VOLTAGE"** around the perimeter of the work area and accessway approximately 42 inches above the floor or work surface.

b. Synthetic Rope Barrier. Install a barrier of yellow or orange synthetic rope 36 to 45 inches from the floor with standard danger signs of non-conductive material attached at 10-foot intervals containing the words **"DANGER–HIGH VOLTAGE."**

12.3 Working Near Exposed Energized Overhead Lines or Parts

12.3.1 General. For troubleshooting and testing purposes only, qualified persons using proper test equipment and personal protective equipment must adhere to the boundaries shown in figure 12-1 and specified in table 12-1. For adjusting, tightening, calibrating or any other work, the circuits must be de-energized, or employees must use voltage-rated gloves and voltage-rated insulated tools.

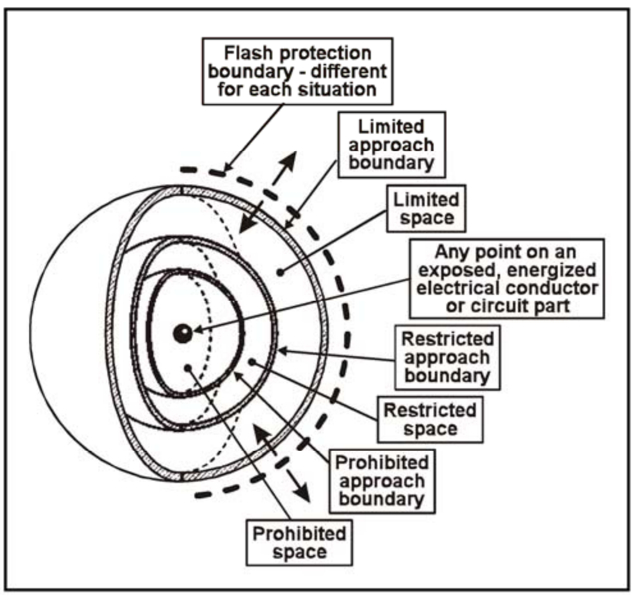


Figure 12.1—Boundaries.

12.3.2 Low Voltage Testing. For low voltage troubleshooting and testing purposes only, i.e., under 480 volts, a qualified person may penetrate the prohibited approach boundary shown in table 12-1, column 5, with test instrument probes, leads, ct's, etc. The qualified person must wear Class 00 (500 volt-rated) gloves.

12.3.3 Unqualified Person Restrictions. When a person without electrical training works on the ground or in an elevated position near overhead lines or any other exposed energized parts, supervisors and employees must ensure that the unqualified person and the longest conductive object they might contact or handle, can never come closer to any energized line or part than those distances listed in table 12-1, column 2, for energized lines or column 3 for other exposed live parts.

Table 12-1.—Approach boundaries to exposed energized conductors/parts for qualified employees (All dimensions are distances from energized conductor/part to employee)

(1)	(2)	(3)	(4)	(5)
	Limited approach boundaries			
Nominal voltage phase to phase, or single phase	Exposed moveable conductor	Exposed fixed circuit part	Restricted approach boundary includes inadvertent movement	Prohibited approach boundary
0 to 50	not specified	not specified	not specified	not specified
51 to 300	10-ft 0-in	3-ft 6-in	avoid contact	avoid contact
301 to 750	10-ft 0-in	3-ft 6-in	1-ft 0-in	0-ft 1-in
751 to 15 kV	10-ft 0-in	5-ft 0-in	2-ft 2-in	0-ft 7-in
15.1 kV to 36 kV	10-ft 0-in	6-ft 0-in	2-ft 7-in	0-ft 10-in
36.1 kV to 46 kV	10-ft 0-in	8-ft 0-in	2-ft 9-in	1-ft 5-in
46.1 kV to 72.5 kV	10-ft 0-in	8-ft 0-in	3-ft 3-in	2-ft 1-in
72.6 kV to 121 kV	10-ft 8-in	8-ft 0-in	3-ft 2-in	2-ft 8-in
138 kV to 145 kV	11-ft 0-in	10-ft 0-in	3-ft 7-in	3-ft 1-in
161 kV to 169 kV	11-ft 8-in	11-ft 8-in	4-ft 0-in	3-ft 6-in
230 kV to 242 kV	13-ft 0-in	13-ft 0-in	5-ft 3-in	4-ft 9-in
345 kV to 362 kV	15-ft 4-in	15-ft 4-in	8-ft 6-in	8-ft 0-in
500 kV to 550 kV	19-ft 0-in	19-ft 0-in	11-ft 3-in	10-ft 9-in
765 kV to 800 kV	23-ft 9-in	23-ft 9-in	14-ft 11-in	14-ft 5-in

Notes: This table is taken from NFPA 70E table 2-1.3.4 and OSHA 29 CFR,1910.269 table R6.

Limited Approach Boundaries. A shock protection boundary to be crossed only by qualified persons (at a distance from a live part). Unqualified persons must not cross this boundary unless accompanied by a qualified person.

Restricted approach Boundary. A shock protection boundary to be crossed only by qualified persons (at a distance from a live part). The boundary's proximity to a shock hazard requires the use of shock protection techniques and equipment when crossed.

Prohibited Approach Boundary. A shock protection boundary to be crossed only by qualified persons (at a distance from a live part). When crossed by a body part or object, this boundary requires the same protection as if direct contact is made with a live part (i.e., requires voltage rated tools and voltage rated gloves and, in some cases, other voltage rated clothing).

12.3.4 Equipment Transit Clearances. A signal or flag person must guide cranes, cherry pickers, high lifts, and other equipment in transit near exposed energized lines or parts at all times. Do not move any equipment or machinery under energized overhead high-voltage lines or near exposed energized parts, unless clearances listed in table 12-2 are maintained. Unload and lower any boom or mast to transport position. Ground the equipment while it is being transported. Two grounds must be leap-frogged as the vehicle is moved or the vehicles must be treated as energized.

Table 12-2.—Equipment in transit clearances

Up to 50 kV	4 feet
50 kv up to and including 345 kV	10 feet
Over 345 kV up to 750 kV	16 feet

12.3.5 Sign Posting. Post all crossings where equipment will be moved under energized high-voltage line(s) with appropriate signs. Place the signs 50 feet from and on both sides of the line(s). They must be large enough to be easily read from moving equipment. The sign must include the following information:

- Warning of the high-voltage line.
- Line voltage.
- Maximum height of equipment that may pass under the line. Determine the maximum height of the equipment by subtracting the clearance distance shown in table 12-2 from the actual line to ground distance during maximum sag conditions.

12.3.6 Equipment Operation Near Energized Lines. Prohibit equipment from coming any closer to overhead high-voltage lines or exposed energized parts than distances shown in table 12-3, unless both subparagraphs a. and b. below are satisfied, or subparagraph c. below is satisfied.

a. Before beginning work, place a clearance, ground and de-energize the line or exposed energized parts, and implement hazardous energy control procedures to prevent re-energization.

b. Equipment does not have the capability of coming within distances shown in table 12-3.

c. In addition to the clearances in table 12-3, effectively ground all equipment with booms or extensions above cab level while it is operating in a substation, switchyard, or on a transformer deck, or any other location near high voltage energized lines/parts.

Table 12-3.—Equipment clearances for operations near energized overhead lines

Table of minimum clearances (ft) for nominal system voltages (kV)	
kV	**Ft**
50 (or less)	10
69	11
115	12
230	16
500	25

Note: Table 12-3 shows only common Reclamation voltages and rounds them up to the nearest foot. For other voltages, use the 10-foot minimum and add 4 inches for every 10 kilovolts over 50 kilovolts. For example, 60 kilovolts would be 10 feet plus 4 inches; rounding up to the nearest foot would require an 11-foot clearance. Always round up because the clearance is usually only an estimate. It is difficult, if not impossible, to accurately measure the actual distance unless you de-energize the line and/or equipment.

12.3.7 Placard Posting in Equipment Cabs. Post a placard of minimum clearances (table 12-3) in the cabs of all cranes, cherry pickers, shovels, backhoes, and any other equipment with booms or extensions that could possibly contact high-voltage lines. Tables posted in machines must be of substantial material and suitable for the environment.

12.4 Operating Equipment Near Radio and Microwave Transmission Towers

12.4.1 General. Because of high frequency, low power output, and point-to-point transmissions, microwave transmissions do not present an induced charge hazard. However, many microwave towers are mounted on VHF radio transmission antennas. Therefore, the following safety precautions apply to all transmission towers. Vehicles will rarely need to be grounded at transmission towers. Tires contain carbon compounds and are conductive or semiconductive, and static charges will bleed off through tires and/or out-riggers. However, voltage could build up if all tires were insulated from the earth by dry rip-rap or other insulation.

12.4.2 Requirement. Shut down the transmitter or ground and test the equipment to determine if a hazard exists before working near any transmission tower where an electrical charge may be induced in the equipment or materials being handled. To conduct a test, connect an insulated wire to the vehicle and touch it to the tower base. If you see or hear the spark, you must ground the vehicle.

12.4.3 Grounding Mobile Equipment Near Transmission Towers. If needed, ground the equipment to dissipate static electrical charge. On equipment with a rotating boom, attach a ground wire to the structure supporting the boom. Place and remove ground wires using hot-sticks or voltage-rated gloves. Attach the ground connection first (if possible, to the tower ground), then attach the other end to the equipment. These ground wires do not have to be sized to carry fault current. They need only to carry low level current to bleed off static voltage charges induced on the vehicle or lifted materials. Any convenient wire size that will mechanically withstand the service will be sufficient. A smaller conductor would carry the current, but an insulated #2 copper conductor is recommended for mechanical strength.

12.4.4 Material Ground Wire. Also, attach a ground wire to conductive materials handled by hoisting equipment. Attach the ground connection first, then attach the other end on the materials. Alternatively, provide a ground jumper from the load to the required grounding conductor installed on the structure.

12.5 Working on Electrical Equipment and Systems

12.5.1 General. Electrical installations must comply with the applicable provisions of the current editions of the National Electrical Safety Code, National Electrical Code, OSHA Regulations, and the Reclamation Safety and Health Standards. The Underwriters Laboratories, Factory Mutual Laboratories, or other nationally recognized testing laboratory must approve or list electrical wire, conduit, apparatus, power tools and equipment, for the specific application. This approval/listing must appear on each piece of equipment or tool as part of the "marking or labeling" required below.

12.5.2 Marking or Labeling. Do not use electrical equipment unless the manufacturer's name, trademark, and other descriptive marking by which the manufacturer may be identified, is located on the equipment. Markings must also provide voltage, current, wattage, approvals/listings, and ratings as required by the edition of the National Electric Code in effect at the time of purchase. Markings must be sufficiently durability to withstand the environment.

12.5.3 Working Space

a. Figure 12-2 and table 12-4 provide access and working space distances around electrical equipment and enclosures, e.g., panelboards, motor controls, disconnects, etc., to permit ready and safe operation and maintenance. Keep working space clear at all times.

b. Provide a working space of at least 30 inches horizontally where rear or side access is required to work on de-energized parts of enclosed equipment (see figure 12-3).

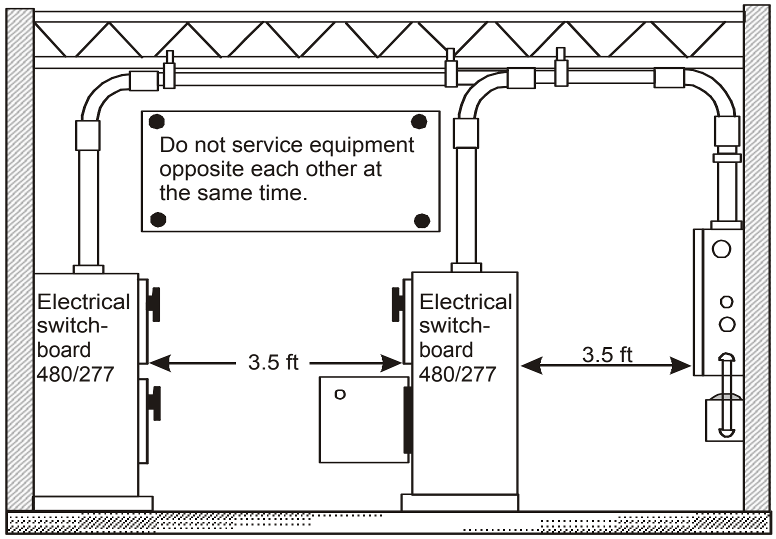


Figure 12-2.—Access and working space requirements around enclosures and equipment.

Table 12-4.—Working spaces around enclosures and equipment

Working spaces			
Nominal voltage to ground	Minimum clear distance (ft)		
	Condition 1	Condition 2	Condition 3
0-150	3	3	3
151-600	3	3.5	4
601-2,500	3	4	5
2,501-9,000	4	5	6
9,001-25,000	5	6	6

Condition 1 - Exposed live parts on one side and no live parts 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 materials. Insulated wire or insulated busbars operating at not over 300 volts to ground shall not be considered live parts.

Condition 2 - Exposed live parts on one side and grounded parts on the other side. Consider concrete, brick, or tile walls grounded.

Condition 3 - Exposed live parts on both sides of the work space (not guarded or enclosed, as provided in Condition 1) with the worker between.

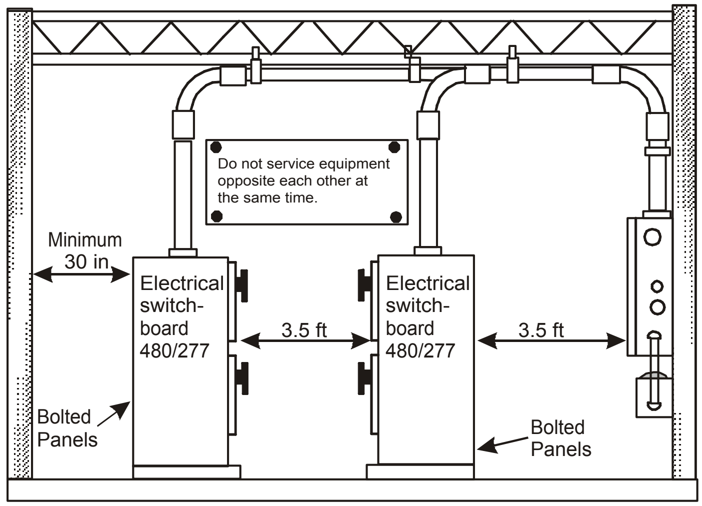


Figure 12-3.—Working space requirements for rear or side access.

c. Doors and hinged panels. Doors and hinged panels must have at least at least a 90-degree opening. Keep working space clear at all times. Do not store parts, tools, and equipment in the clear space (see figure 12-4).

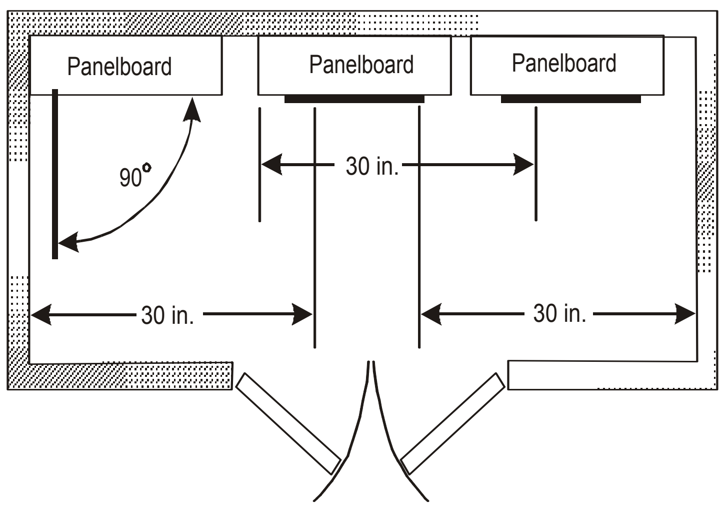


Figure 12-4.—Working space requirements for doors and hinged panels.

12.5.4 Passageway Barriers. Provide effective barriers or other means (barrier tape) to ensure that areas containing electrical circuits or equipment are not used as passageways when energized lines or equipment are exposed for testing or maintenance. This includes open doors on motor control centers, and switchgear.

12.6 Personal Protective Grounding

12.6.1 General. Qualified persons must comply with applicable provisions of FIST Volume 5-1 "Personal Protective Grounding." Include written grounding procedures in all clearances, special work permits, etc. The JHA must include the procedures, and employees must discuss them before beginning work.

12.6.2 Over 600 Volts. Place grounds as close as possible to the work and within sight of the workers for all electrical circuits and equipment operated in excess of 600 volts. The clearance holder is personally responsible for proper placement and removal of protective grounds.

12.6.3 Personal Protective Ground Cables. Personal protective grounds and clamps must be capable of conducting the calculated maximum fault current available for the time necessary to clear the fault. They must be sized in accordance with FIST 5-1.

12.6.4 Prior to Applying Grounds. After implementing hazardous energy control, use a hot-stick "noise tester" or similar approved device of sufficient insulating capacity to verify that the circuit or equipment is de-energized before placing personal protective grounds. Test the voltage tester immediately before use on a known energized source of similar voltage before testing the equipment to be worked on. The circuit/equipment to be worked on must be considered energized while conducting the test.

12.6.5 Placement and Removal of Personal Protective Grounds. After de-energization, install personal protective grounds so that all phases of lines and equipment are visibly and effectively bonded together in a multi-phase short and connected to ground at one point. Do not use single-phase personal protective grounds or grounding chains. Install personal protective grounds using a hot-stick or voltage-rated gloves on both sides of the work area, if possible. This precaution prevents a possible backfeed, especially when working on transformers and related equipment. When attaching grounds, attach the ground end first, and then attach the other end to the de-energized circuit. When removing personal protective grounds, first remove the grounding clamp from the de-energized circuit using a hot stick or voltage-rated gloves, and then remove the other end from the ground connection.

12.7 Temporary Wiring

12.7.1 Installation. Temporary wiring must meet all the requirements of the National Electrical Code (NEC). Permit temporary wiring only during the period of construction, remodeling, maintenance, repair, or demolition. Remove temporary wiring immediately upon completion of construction or purposes for which the wiring was installed. Permit temporary wiring used for feeders and branch circuits in multi-conductor cord or cable assemblies or open conductors, and guard, bury, or isolate it by elevation to prevent accidental contact by personnel or equipment. Allow at least 10 feet of vertical clearance above walkways for circuits rated 600 volts or less. Support all exposed temporary wiring on insulators. Provide ground fault protection for personnel for all temporary wiring installations to comply with the National Electrical Code.

12.7.2 Weatherproof. Conductors used in tunnels, shafts, trenches, and wet or damp locations must be of a type approved for the purpose as listed in Article 310 of the NEC.

12.7.3 Bushings. Wiring installed in conduit must be equipped with bushings at ends of conduit.

12.7.4 Receptacles. All receptacles must be of the grounding type and must be electrically connected to the equipment grounding conductor. Do not install receptacles on construction sites on branch circuits that supply temporary lighting. Do not connect receptacles to the same ungrounded conductor of multiwire circuits that supply temporary wiring.

12.7.5 Lighting Strings. Temporary lighting strings must consist of nonconductive lamp sockets and connections permanently molded to the conductor insulation. Use lamp guards to protect bulbs attached to festoon lighting strings and extension cords. Promptly replace broken or defective bulbs. Protect all lights used for illumination from accidental contact or breakage.

12.7.6 Extension Cords. Extension cords must be 3-wire grounded type, must be designated for hard service or extra hard service, and must be listed by the Underwriters Laboratories. Do not exceed the rated load. Use cords only in continuous lengths without splice. Do not use worn or frayed extension cords. To protect cable assemblies, flexible cords, and cables from damage, support them in place with approved staples, cable ties, straps, or similar type fittings installed to prevent damage.

12.8 Disconnect and Overcurrent Protection

12.8.1 Marking. Plainly mark, label, or arrange switches, fuses, and automatic circuit breakers to identify the circuits or equipment controlled by them.

12.8.2 Switches. Switches must be of the enclosed safety type, with the enclosures grounded, and installed so as to minimize the possibility of accidental operation.

12.8.3 Lockout Provision. Provide disconnects and breakers with a means of locking in the OFF position. Also, fuse cabinets and circuit breaker cabinets must be equipped with lockable doors.

12.8.4 Wet and Outside Locations. Enclose switches, circuit breakers, fuse panels, and motor controllers in wet or outside locations in approved weatherproof cabinets or enclosures. Prevent moisture or water from entering or accumulating within the cabinets or enclosure.

12.8.5 Shielding. Isolate or shield the disconnecting means to protect employees.

12.8.6 Service Entrance Disconnect. Install the service entrance disconnecting means in a readily accessible location, as close as possible to the point where the service entrance conductors enter the premise. The service disconnecting means must disconnect all the ungrounded service entrance conductors supplying power to the service equipment. This disconnecting means must plainly indicate that it is either in the open or closed position.

12.8.7 Overcurrent Protection. Fuses or circuit breakers must provide overcurrent protection for all ungrounded conductors. All overcurrent protection devices and conductors must be designed and installed according to the latest provisions of the NEC to ensure protection and proper installation. Do not place any overcurrent device in any permanently grounded conductor, except where the overcurrent device simultaneously opens all conductors of the circuit.

12.9 Ground-Fault Protection

12.9.1 Requirement. Protect all 125-volt, single-phase, 15 and 20 ampere receptacles outlets used in locations such as laboratories, shops, garages, wet locations, outdoor receptacles, bathrooms, kitchens, and for construction operations with a ground-fault circuit interrupter (GFCI). For temporary wiring, all 125 volt, single-phase, 15-, 20-, and 30-ampere receptacle outlets that are not a part of the permanent wiring of the building or structure and that employees use must have ground-fault circuit interrupter protection for personnel. For temporary wiring, receptacles other than 125 volt, single-phase, 15-, 20-, and 30-ampere receptacles must have ground-fault circuit protection or protection in accordance with the assured equipment grounding conductor program. The ground-fault interrupter must open the circuit on a ground current of 5 milliamperes plus or minus 1 and must be equipped with an integral push-button test circuit. Install the GFCI in accordance with the manufacturer's instructions and test it before initial use and periodically thereafter.

12.9.2 Assured Equipment Grounding Conductor Program. Where GFCI protection is not provided for personnel, the Assured Equipment Grounding Conductor Program must be implemented. This program must be used on all receptacle outlets, except 125-volt, single-phase, 15-, 20-, and 30-amp receptacle outlets, used during construction, remodeling, maintenance, repair or demolition of buildings, structures, equipment, or similar activities. Receptacle outlets must not be connected to any branch circuits that supply power to lighting outlets, per NEC 527.4(D).

a. All cord sets and receptacles that are not part of the permanent wiring of the building or structure, as well as cord and plug connected equipment required to be grounded, must meet the following requirements:

- Have a written description of the program
- Have a qualified person to implement the program

b. All equipment grounding conductors must be tested for continuity and be electrically continuous.

c. Each receptacle and attachment plug must be tested for correct attachment of the equipment grounding conductor.

d. Tests are required under the following conditions for an Assured Equipment Grounding Program:

- Before first use onsite
- When there is evidence of damage
- Before equipment is returned to service following any repairs
- At intervals not exceeding 3 months

e. The required test for all equipment grounding conductors and each receptacle and attachment plug above must be recorded and available for inspection.

12.10 Hazardous Locations

12.10.1 General. A hazardous location is any location where a potential hazard, either a fire or an explosion, can exist because of the presence of flammable, combustible, or ignitable materials. These materials can consist of gases, vapors, liquids, dust, fibers, etc. Hazardous locations are classified according to the properties and quantities of the hazardous material that may be present. Hazardous locations are divided into three classes, two divisions, and seven classified groups as follows: Class I, II, and III; Division 1 and 2; and Groups A, B, C, D, E, F, and G. Wiring methods used in hazardous locations must comply with more stringent requirements than wiring methods used in other locations.

12.10.2 Requirement. Electrical wiring and equipment installed in hazardous locations, as defined in the National Electrical Code, must conform to the respective standards. All components and equipment used in hazardous locations must be from among the equipment listed by a nationally recognized testing laboratory, such as Underwriters Laboratories, Inc., or Factory Mutual Engineering Corporation.

12.10.3 Marking. Approved equipment must be marked to show the class, group, and operating temperature or temperature range referenced to a 40 degree C ambient. Install approved equipment in accordance with the requirements of the NEC.

12.10.4 Intrinsically Safe Systems. Permit intrinsically safe apparatus and wiring in any hazardous (classified) location for which it is approved.

12.10.5 Maintenance. Maintain wiring components and equipment as explosion-proof. There must be no loose or missing screws, gaskets, threaded connections, seals, or other impairments to tight conditions.

12.11 Wet Locations

12.11.1 Requirement. Only the following type electrical systems are permissible for use in wet areas where there is danger of electrical shock:

a. Ground-Fault Circuit Interrupter. Electrical circuits for lighting and hand tools must not exceed 120 volts and must be protected by UL-listed ground-fault circuit interrupters installed in conformance with the manufacturer's specifications, and tested before beginning work.

b. Stationary Portable Equipment. Connect stationary portable electrically powered equipment, such as pumps, heaters, blowers, welders, transformers, etc., to a circuit protected by a ground-fault circuit interrupter or effectively ground the equipment with both an internal grounding system and a visible flexible copper ground wire.

c. Substitute Equipment. Whenever practical, substitute air, battery, or hydraulically powered tools for electrically powered tools.

12.11.2 Receptacles. Receptacles and cord connectors used in damp or wet locations must be designed for use in wet or damp locations and, unless approved for submersion, must not be allowed to lie in water.

12.12 Battery Charging

12.12.1 Requirement. Restrict battery charging operations to well-ventilated areas designated for that purpose. Post signs with the following wording (or equivalent) at all entrances when explosive gases are produced: "BATTERY ROOM - NO SMOKING OR OPEN FLAME WITHIN 25 FEET."

12.12.2 Ventilation. Ventilation must be adequate to ensure diffusion of the battery gases and prevent accumulation of an explosive mixture.

12.12.3 Vented Batteries. Locate nonseal-type batteries in enclosures with outside vents or in well-ventilated rooms, arranged to prevent the escape of fumes, gases, or electrolyte spray or liquid into other areas. Keep safety vent caps in place during charging.

12.12.4 Racks and Trays. Racks and trays must be of sufficient strength and treated with an electrolyte resistive coating.

12.12.5 Housekeeping. Keep battery storage and charging areas free of combustible materials and scrap. Promptly clean up and dispose of acid or corrosive spills.

12.12.6 Protective Equipment. Provide face shields, goggles, aprons, and rubber gloves for employees who handle acids or recharging batteries.

12.12.7 First Aid. Provide facilities for quick emergency drenching of the eyes and body within 25 feet of a battery charging area.

Attachment 12-1

Training Requirements for Electrically Qualified Persons

1. General. NFPA 70E, 2000 Edition, and OSHA 29 CFR 1910.269 contains references for training requirements. A person must have all the training listed below to be a qualified person.

a. Required training must be of classroom and on-the-job training.

b. Qualified persons must be trained in and familiar with "Safety-Related Work Practices," safety procedures, and other safety requirements pertaining to their work. Qualified persons must be trained in first aid and CPR and be familiar with applicable emergency procedures. They must be trained in any other safety practices, including those not specifically addressed in this section such as confined space entry, manhole and pole-top rescue, fall protection, personal protective equipment, etc.

c. Qualified persons must be trained and knowledgeable in Job Hazard Analysis (JHA). This training and knowledge includes recognizing work hazards, doing the work safely, writing a JHA, and communicating hazards and safety work practices to fellow employees.

d. Qualified persons must be trained and knowledgeable in the construction, operation, and maintenance of equipment and specific work methods. They must be trained to recognize and avoid hazards with respect to equipment or work methods and must be familiar with applicable codes and standards. They shall be familiar with the proper use of special precautionary techniques, personal protective equipment, insulating and shielding materials, and insulated tools and test equipment.

2. Additional Training Required. Qualified persons permitted to work within limited approach boundaries (table 12-1) of exposed conductors and parts must, at a minimum, be additionally trained in all of the following:

a. Skills and techniques necessary to distinguish exposed energized parts from other parts.

b. Skills and techniques necessary to determine the nominal voltage of exposed energized parts. These skills and techniques include those necessary to safely use high and low-voltage meters, test instruments, and personal protective equipment while performing measurements and testing.

c. The approach distances specified in table 12-1 and corresponding voltages to which the qualified person will be exposed. (Post table 12-1 in the Electric

Shop and hand it out to each team member before beginning work on a project that involves work near exposed energized lines or other equipment.)

d. The decision-making process to determine the degree and extent of the hazard and the personal protective equipment necessary to perform the task safely. For example, clothing that would increase injury by fire is not permitted. Clothing made of acetate, nylon, polyester, and rayon is prohibited. Refer to OSHA 29 CFR 1910.269 on apparel.

e. Lockout/Tagout and clearance procedures of FIST 1-1.

3. In-Training. A person who is undergoing on-the-job training and who, in the course of this training, has demonstrated the ability to perform specific duties safely at his or her level of training, and is under the direct supervision of a qualified person, is considered a qualified person for the performance of those specific duties only. For qualified persons, the employer must determine by regular supervision and inspections of the employee's work and his/her on-the-job work practices, at least annually, that each qualified person is complying with the safety-related-work practices required.

4. Training Documentation. The employer must generate and maintain written documentation that each employee has received the required training. The employer must verify that the training has been accomplished and is current. The documentation must contain the employee's name, the training he/she has received, and dates of training. Employee demonstrate their competence by their proficiency in safety-on-the-job and work practices. Maintain training records in the employee's training file for the duration of employment. Employment records that indicate an employee has received the required training are an acceptable means of meeting this requirement.

5. An employee must receive additional training (or re-training) under any of the following conditions:

- If supervision and/or annual inspections of the employees work and on-the-job, safety-related work practices indicate the employee is not knowledgeable or complying with the requirements of this section.
- If new technology, new type equipment, or changes in procedures dictate the use of safety-related work practices that are different from those which the employee would normally use.
- If the worker must use safety-related practices not normally used during normal job duties.
- If the worker has not performed this specific task within 1 year or feels a need for additional training to perform the job safely.
- If the worker's other qualifications have expired, such as First Aid and CPR.

Note: Employee who perform a task less than once a year must receive hazard retraining before the employee may perform the task again. Retraining may be done during the JHA, but must also include a jobsite visit to discuss hazards. Performing a task less than once a year is not considered a part of normal job duties.

Section 13

Walking and Working Surfaces

This section sets forth safety standards and work practices for walking and working surfaces. It specifically addresses making work locations safe for access, using scaffolds, requirements of work platforms, and designing and constructing guardrails.

13.1 Safe Access to Work

Use ladders, stairways, or ramps that comply with the requirements of this section to provide safe access to all work locations (temporary or permanent).

- Provide a stairway, ladder, ramp, or manhoist at all personnel access points where elevation changes 19 inches or more.
- Keep at least one point of access between levels of buildings or structures, so employees can pass freely at all times.

13.1.1 Ladders. Use ladders where stairs or ramps cannot be installed. Ladder construction must comply with the applicable ladder safety code.

a. General Ladder Requirements

1. Electrical Hazard. Do not use portable metal ladders or wood ladders with metal reinforcements for any electrical work or in substations, switchyards, powerplants, pumping plants, or in any area where employees may contact energized circuits.

2. Maintenance. Routinely inspect and maintain all ladders. Promptly repair or remove broken or damaged ladders. Properly store ladders to prevent damage.

3. Securing Ladders. Portable ladders, except stepladders must be secured. Fixed ladders must be fixed, and don't require securing for use, portable ladders do not require intermediate support.

4. Location. Protect ladders placed in access ways or other locations where they may be displaced with barricades or guards. Keep the area immediately adjacent to the top and bottom of a ladder free from debris, materials, equipment, or other obstructions.

5. Restrictions. Use ladders as work platforms only for short duration tasks, and use only light tools or material (changing a light bulb, for example).

6. Use. Face ladders and keep hands free when going up or down ladders.

b. Portable Ladders

1. Design, construct, use, and maintain portable ladders according to the more stringent standards published in this subsection and ANSI A14.1, "Portable Wood Ladders," ANSI A14.2, "Portable Metal Ladders," and ANSI A14.5, "Portable Reinforced Plastic Ladders." Use only type 1A, extra heavy-duty industrial ladders.

2. Place portable ladders at a slope of 4:1 (vertical:horizontal).

3. Portable stepladders must be no more than 20 feet tall.

4. Employees working from ladders must remain within 20 feet of the floor.

5. Secure portable ladders against accidental displacement at the top and bottom. Portable ladders must extend at least 42 inches above the upper landing. Do not use stepladders for access.

6. Rest portable ladders on a firm foundation that can support the load without displacement.

7. Do not use extension sections of ladders as independent ladders.

8. Use job-made ladders only for their designed and constructed purpose and not as portable ladders.

9. Allow only one person at a time on a portable ladder.

10. Equip ladders with safety shoes, spurs, spikes, tread feet, or other slip-resistant devices at the base section of each rail. Use the appropriate device for the type of surface they are used on.

c. Fixed Ladders

1. Design, construct, use, and maintain fixed ladders according to the more stringent of standards in this subsection; ANSI A14.3, "Safety Requirements for Fixed Ladders," and ANSI A14.4, "Safety Requirements for Job-Made Ladders."

2. The climb length of fixed ladders must be 24 feet or less; otherwise, equip the ladder with a cage, well, or ladder climbing device or offset landings at 20-foot intervals. Ladders equipped with cages or ladder climbing devices must have a climb length of 30 feet or less between ground, floors, or offset landings. Bottom of cages must start between 7 and 8 feet from the base of each section of ladder. Install climbing devices so an employee can connect or disconnect while standing on ground, floors, or platform. Increase ladder widths to accommodate climbing devices. Do not use the reinforcing bar of fixed ladders as a rung or grab rail.

3. Provide a landing at the top of all fixed ladders and extend the side rails, stanchions, or other supports at least 42 inches above the landing.

4. Provide at least 7 inches of toe space from the centerline of the rung or step to the wall or other obstructions.

5. Provide two separate ladders or double-cleat ladders for access to and from work areas for 25 or more employees, or where simultaneous, two-way traffic is necessary.

6. Use nonslip material on rungs in slippery areas.

13.1.2 Stairways

a. Requirement. Use stairways for access to areas 20 feet or more above the adjacent surface, except for scaffolds which are commonly accessed by ladder. If scaffold is to be used for extended time periods, or if employees routinely carry tools or materials, stairs must be provided.

b. Design

1. Temporary Stairways. Design and construct temporary stairways with a live load safety factor of five, but never less than a moving concentrated load of 1,000 pounds. Install temporary stairways at 30- to 50-degree angles from horizontal. Use any uniform combination of rise/tread dimensions between 6-1/2- to 9-1/2-inch rise and 11- to 8-inch tread run, to obtain a stairway within this permissible range. Any flight of stairs with an unbroken rise of more than 12 feet must have a standard landing that extends at least 30 inches in the direction of travel. Where doors or gates open directly onto the stairway, provide a platform. The swing of the door or gate must not reduce the width of the platform to less than 20 inches. Provide a vertical clearance of at least 7 feet above any stair tread, measured from the leading edge.

2. Existing Permanent Stairways. On permanent stairways, riser must be no more than 7-1/2 inches high and treads no less than 10 inches deep. Adjacent steps must not vary by more than 3/16 inch. No flight of stairs may vary more than 3/8 inch.

3. New Permanent Stairways. New stairways must have risers no more than 7 inches high and treads no less than 11 inches deep.

c. Construction. Construct temporary stairways and handrails of materials without hazardous projections or surface imperfections, rigidly support them, and securely fasten stair treads in place.

d. Stair Railings and Handrails. Stairs with 4 or more risers, or rising more than 30 inches, must have standard railings and a standard handrail, as specified below:

- Less than 44 inches wide and both sides enclosed: at least one handrail on right side descending.
- Less than 44 inches wide and one side open: one stair railing on the open side.
- Less than 44 inches wide and both sides open: a stair railing on each side.
- More than 44 inches, but less than 88 inches, wide: one handrail on each enclosed side and a stair railing on each open side.
- More than 88 inches wide: one handrail on each enclosed side, plus a standard stair railing located midway (width).

e. Standard Stair Railing. Construct standard stair railings to the specifications set forth in "Standard Guardrails," except that no toeboard is required, and it must be at least 36 inches high (measured from top of the forward edge of the tread to the upper surface of the top rail). When the top edge of the stair rail system also serves as a handrail, the top edge must be 37 inches maximum height.

f. Standard Handrail. Securely mount a standard handrail on the wall or partition, enclosing the stairs. It must be between 30 and 37 inches high. Material and strength requirements must equal the stair railing. Mount the handrail with a minimum 1-1/2-inch clearance from any obstruction. Handrails must provide an adequate handhold for employees grasping them to avoid falling.

g. Projection Hazard. The ends of stair rail systems and handrails must not be a projection hazard.

h. Metal Pan Stairs. Where permanent metal pan stairs are set for temporary use, install treads of wood filler pieces flush with the pan rims.

i. Stairwells and Platforms. Protect platforms on all open sides with standard guardrails and toeboards.

j. Maintenance. Routinely maintain stairways. Keep stairs free from debris and materials. Eliminate slippery conditions as they occur.

13.1.3 Ramps.

a. Requirement. Substitute temporary access ramps, for stairways, when the slope or incline does not exceed 15 degrees. With prior approval, you may use cleated ramps for access on slopes up to 20 degrees.

b. Design.

1. Temporary Ramps. Design temporary ramps with a safety factor of five, with a minimum 100-pound-per-square-foot live load. The ramp must be at least 18 inches wide, yet not cause congestion of persons, materials, or equipment. Equip ramps with standard guardrails on open sides and with at least one handrail. Cleated ramps (chicken walks) must have 1- by 2-inch cleats. Space the cleats no more than 12 inches apart. The cleats must be as long as the width of the ramp. Secure them with nails, driven through the decking and clinched on the underside. Provide vehicle trestles, ramps, and bridges that permit foot traffic with a suitable walkway and guardrail outside of the roadway. Protect roadway ramps with timbers or curbs at least 8 inches high, secured to each side of the roadway.

2. Permanent Ramps. Permanent ramps must be at least 44 inches wide, and the slope must not exceed 1:12. The continuous slope must not have more than a 30-inch rise, unless there is a horizontal landing as long as the width of the ramp. When possible, ramps will be designed for handicap access. When the ramp is used for public access, wheelchair accessibility is required.

3. Overhead Protection. Provide overhead protection whenever falling objects could pose a hazard to the public, employees, or property. The overhead protection must be strong enough to withstand all potential impacts. Install overhead protection between 7 and 9 feet above the ramp.

13.2 Safe Use of Scaffolds

Provide scaffolds, platforms, or temporary floors whenever employees perform work that they cannot perform safely from the ground or from solid construction.

13.2.1 General Requirements.

a. Competent Person. A competent person must supervise erecting, dismantling, or altering of scaffolding. Such action must also comply with the requirements of this section and ANSI A10.8, "Construction and Demolition Operations - Scaffolding - Safety Requirements." (The more stringent standards must prevail.) Do not use ladders or makeshift devices to increase scaffolding height. Keep scaffolding working surfaces level.

b. Safety Factors. Wire or fiber rope used for scaffold suspension must be able to support at least six times the maximum intended load. All other scaffolds and their components must be able to support at least four times the maximum intended load.

c. Access. Access scaffolding by separate or integral ladders or by stairways. Do not use structural members to access scaffolding.

d. Nets, Lifelines, Lanyard, and Belts. When employees work on suspended or movable scaffolding (or scaffolding without standard guardrails), use a fall protection system.

e. Guardrails. Work platforms and scaffolds more than 6 feet above the ground or floor level must have standard guardrails, midrails, and toeboards on the open side and ends. (Exceptions are floats, needle beam, and ladder-supported scaffolds.) In addition, install standard guardrails on open sides and ends on scaffolds 4 to 6 feet high, erected above machinery or other hazards, or with a minimum horizontal dimension less than 45 inches in either direction.

f. Footing. The footing or anchorage for scaffolds must be sound, rigid, and able to carry the maximum intended load without settling or displacement. Do not use unstable objects (such as barrels, boxes, loose brick, or concrete blocks) to support scaffolds or planks.

g. Poles, Legs, Uprights. Make sure poles, legs, and uprights are plumb. Brace them securely and rigidly to prevent swaying or displacement.

h. Scaffold Lumber. All load-carrying wood members of scaffold framing, except planks, must be No. 1 Douglas fir, or equivalent. All dimensions are nominal sizes provided in the American Lumber Standards. However, rough sizes are an exception. When rough sizes are noted, only rough or undressed lumber of the specified size will satisfy minimum requirements.

i. Loadings. Load scaffolds only up to their designed working load. Store only those supplies needed for immediate operations on scaffolds.

j. Restrictions. While employees use or occupy scaffolds, do not alter or move them horizontally, unless specifically designed for such use.

k. Design. A professional engineer (PE) must design scaffolding with structural members or working surfaces that differ from those specified here. The COR or office head must accept the design before erecting the scaffolding onsite. The design of wood scaffolding members and connections must adhere to the "National Design Specifications for Wood Construction," published by the National Forest Products Association. To account for the additional safety factors for scaffolding, multiply basic allowable stresses therein by a factor of 0.065, and use a duration load adjustment of 1.25. These section multiplication factors are cumulative.

l. Overhead Protection. Provide overhead protection for employees who work on scaffolds and are exposed to falling objects.

m. Scaffold Enclosures. When employees must work under scaffolding, or the scaffold is above an accessway, enclose the scaffold on the open side and ends. Also, enclose the space between the decking and the form or wall. The protective enclosure must be No. 18 U.S. Standard gauge wire, or equivalent, with mesh of 0.5 inch or less.

n. Welding, Cutting, Burning, and Riveting. Do not weld, cut, burn, rivet, or perform open flame work on staging suspended by natural fiber or synthetic rope. When using natural fiber or synthetic rope staging supports near corrosive materials, protect or treat them to prevent deterioration.

o. Hoisting Equipment. Only mount material hoists on scaffolds or elevated work platforms if the scaffold or work platform is designed or strengthened to withstand the additional loading. A PE must certify such design or strengthening.

p. Lean-to Scaffolds. Do not use lean-to scaffolds.

q. Unsafe Conditions. Keep scaffolds, platforms, and access ways free of ice, snow, grease, mud, and any other material or equipment that creates a slipping or falling hazard. Do not permit tools, materials, equipment, or debris to accumulate on scaffolds, work platforms, or in access ways. To improve footing, apply an abrasive material to scaffolds, work platforms, or accessways that are usually wet or slippery. The competent person must perform a daily inspection.

13.2.2 Scaffolding Platforms

a. Requirement. Select materials for scaffold decking that can safely support the intended load. The load rating for scaffold decking is the person loading requirements or the uniformly distributed load requirement, whichever is greater**.**

1. Person Loading Requirements. If scaffold design is based on person loading, use a 250-pound point loading at center span to represent one person, two 250-pound point loads 18 inches from the center on each side to represent two persons, and the sum of the above to represent three persons.

2. Uniformly Distributed Load Requirement. When applicable, you may design each scaffold decking unit to carry a uniformly distributed load, as an alternate to the person loading requirement.

Light duty:	25 pounds per square foot
Medium duty:	50 pounds per square foot
Heavy duty:	75 pounds per square foot
Special duty:	More than 75 pounds per square foot

b. Scaffold Planks.

1. Sawn Wood Scaffold Planks. Design wood scaffold planks so the deflection, at the center of the span at the design load, does not exceed the span divided by 60. All solid sawn scaffold planks must be of a scaffold grade and certified by, or bear the grade stamp of, a grading agency approved by the American Lumber Standards Committee. Table 13-1 shows permissible spans that comply with the above requirements.

Table 13-1.—Permissible spans for wood scaffold planks

Rough sawn Douglas fir, 2 inches by 10 inches	
One person, or medium duty	10 feet
Two persons, or heavy duty	8 feet
Three persons	5 feet

Note: Other combinations of planks and spans are permissible, as long as all planks are grade stamped or certified as scaffold plank grade and the stresses and deflections do not exceed those specified in ANSI A10.8.

2. Manufactured Wood Scaffold Planks. Wood scaffold planks that are not solid sawn (laminated wood planks) must bear the seal of an independent, nationally recognized inspection agency to certify that they comply with the design criteria in ANSI A10.8.

3. Fabricated Metal Scaffold Planks and Decks. Use fabricated metal scaffold planks and decks only if they are marked by the manufacturer to show the rated working load.

c. Width. Scaffolds, ramps, runways, and platforms must be wide enough to prevent congestion of persons, materials, or equipment. They must be at least 18 inches wide.

d. Lapped Planking. Planking, when lapped, must overlap at least 12 inches. Scaffold from 6 to 12 inches, or be cleated at 6 to 12 inches, or else be cleated at both ends to prevent sliding off supports.

e. Flush Planking. When installed flush, the butt joint must be at the centerline of a pole, and the plank ends supported by, and secured to, separate bearers.

f. Corner Planking. When a scaffold changes direction, place and secure planks to prevent tipping. Use diagonally installed bearers to support the intended load and to prevent tipping.

g. Changing Levels. When moving platforms or planking to another adjacent level, leave the old planking in place until you install the new bearers.

h. Working Surfaces. Fully plank or deck all working surfaces on scaffolds. Place planking units as close together as possible. The decking and guardrails must be no more than 9-1/2 inches apart.

13.2.3 Suspension Scaffolds.

a. General. Apply the following requirements when constructing and using all types of suspension scaffolds**.**

1. Design. Design and construct all parts and components of suspension scaffold systems with a minimum safety factor of four, except the suspension ropes.

2. Suspension. Support suspension scaffolds by wire, synthetic, or fiber ropes with a minimum safety factor of six. Secure suspension scaffolds to outrigger beams. Equip the fixed ends of the suspension ropes with a proper size thimble, secured by splicing or other equivalent means, and attached to the supports by shackles. Securely attach running ends of the suspension ropes to the hoisting drums. Keep at least four turns of the rope on the drum at all times. Attach the suspension ropes at the vertical centerline of the outrigger. The attachment must be directly over the hoisting drum.

3. Outrigger Beams. Outrigger beams must be structural steel, equivalent in strength to at least a standard 7-inch, 15.3-pound-per-foot, steel I-beam. Outrigger beams must be at least 15 feet long. Unless a PE designs outrigger beams for a specific use, they must not extend more than 6.5 feet beyond the fulcrum or bearing point. Set outrigger beams with their webs in the vertical position and anchor them to the structure with U-bolts and anchor plates, washers, and nuts (or equivalent). Rest the beams on wood-bearing blocks and install a stop bolt on each end of every beam. When counterweights stabilize the inboard ends of the outrigger beams, securely fasten the weight to the outrigger beam and provide a safety factor of 4 to 1 against overturning. Construct counterweights of solid material. Do not use sandbags or other containers of material for counterweights.

4. Hoisting Devices. Equip all suspension scaffolds (except stationary or crane supported) with either manual or powered hoisting machines. The machines must be either worm geared or powered both up and down. Design suspension scaffolds to stop independently of manual braking; they must not move when power is not applied.

5. Hoist Safety Controls. Powered scaffolds must have constant pressure, nonlocking controls. Install a device to shut off the power ahead of the operating control. Design the speed control device to prevent manual release.

6. Scaffold Brackets. Scaffold brackets must be wrought iron or mild steel. Do not use reinforcing steel as part of the support system.

7. Stability Control. Control suspension scaffolds with wire rope guides or equivalent means, such as taglines, to prevent sway. Install 3/4-inch, manilla rope tiebacks, or equivalent, on suspension scaffolds as a secondary means of anchorage.

8. Plank-Type Platforms. Construct plank-type platforms of not less than 2- by 10-inch scaffold planks, cleated together on the underside. Install cleats within 6 inches of each end and at intervals no greater than 4 feet along planks. The platform hangers must not be more than 8 feet apart, and the planking must not extend more than 12 inches past the end hangers. Securely fasten the platform to the hangers.

9. Beam-Type Platforms. Side stringers for beam-type platforms must be at least 2 by 6 inches and made of knot-free lumber, set on edge. Support the flooring on 2- by 6-inch cross beams, laid flat and set snugly into the top edge of stringers at intervals no greater than 4 feet. Flooring must be 1- by 6-inch lumber, nailed to the supports, and spaced no more than 0.5 inch apart. Hangers must not be more than 12 feet apart.

10. Metal Platforms. Use metal platforms only if they are tested and listed by a nationally recognized testing laboratory.

11. Safety Harnesses. When using suspension scaffolds, employees must wear approved fall protection harnesses. Attach the harnesses to a lifeline rigged independently of the scaffold system. An employee does not need to use the lifeline if the system has independent wire safety ropes installed at each end of the scaffold, with approved grabbing and locking devices. However, each employee must wear a safety harness with lanyard attached to the scaffold.

12. Overhead Protection. When an overhead hazard exists, erect overhead protection of 3/4-inch exterior plywood (or equivalent strength material). Overhead protection must be no more than 9 feet above the decking.

13. Guardrails. Equip suspension scaffolds with standard guardrails and toeboards on all sides and ends.

14. Operation. Only qualified persons trained in operating, using, and inspecting the particular suspended scaffold may operate suspended scaffolds.

15. Testing and Maintenance. Test suspension scaffolds at twice the intended working load before use. Before each shift begins, inspect the scaffold, including anchorage, rigging, and hoisting machines. Maintain scaffolds and hoisting machines in safe, operable condition.

b. Two-Point Suspension Scaffolds.

1. Platforms. Platforms of two-point suspension scaffolds must be plank, beam, or metal type. Construct platforms according to the requirements in this section. The platforms must be between 20 and 36 inches wide. Securely fasten platforms to the hangers with U-bolts or other equivalent means.

2. Securing to building. At each elevated work station, secure the scaffold to the building or structure to prevent sway or movement away from the wall. Do not use window cleaner's anchors for this purpose.

13.2.4 Boatswain's Chairs

a. Restrictions. Do not suspend boatswain's chairs from cranes, derricks, or any type of motorized hoist without prior approval.

b. Seat Design. The chair seat must be at least 12 by 24 inches and 1 inch thick. Reinforce the underside with cleats to prevent the seat from splitting.

c. Seat Slings. The seat slings must be either fiber rope at least 5/8 inch in diameter, or wire rope at least 3/8 inch in diameter. Thread the two slings through the four seat holes so they cross each other on the bottom of the seat. Construct boatswain's chairs used for cutting, welding, or other heat-producing operations with wire rope slings.

d. Safety Belts. Protect employees using boatswain's chairs with safety harness and lifelines.

13.2.5 Metal Scaffolds and Towers

a. General Requirements

1. Listing. A nationally recognized testing laboratory must list all metal scaffolds and towers. Erect such scaffolds and towers according to the manufacturer's specifications. Do not exceed the design load limits.

2. Access. Provide metal scaffolds and towers with access ladders or stairways.

3. Erection. Set sections of metal scaffolds plumb and securely connect them together. Install all braces before using the scaffold. Secure the entire scaffold together and brace it to the building or structure at intervals no more than 30 feet apart horizontally and 26 feet vertically.

b. Tube and Coupler Scaffolds

1. Design. Design and construct tube and coupler scaffolds to the specifications set forth in this paragraph. PEs must review all design scaffolds.

2. Minimum Dimensions. Construct tube and coupler scaffolds of steel tubing not less than the minimum diameters and maximum spacing according to 29 CFR 1910.28.

Table 13-2.—Tube and coupler scaffold dimensions

Component	Light duty	Medium duty	Heavy duty
Posts, runners, and bracing diameter (minimum)	2 inches	2 inches	2 inches
Bearer diameter (minimum)	2 inches	2.5 inches	2.5 inches
Post spacing (maximum length)	10 feet	8 feet	6.5 feet
Post spacing (maximum width)	6 feet	6 feet	6 feet

Note: Design other spacing dimensions or other structural components, when used, to support an equivalent load. Donot use dissimilar metal on the same scaffold frame. When tubing of metals other than steel are used, they must be designed to support an equivalent load.

3. Bearers. Bearers must be at least 4 inches, but not more than 12 inches longer than the post or runner spacing. Install bearers transversely between posts; secure the bearer coupler to the posts bearing on the runner coupler.

4. Runners. Space runners no more than 6-1/2 feet apart on centers. Make the bottom runners as close to the base as possible.

5. Transverse Bracing. Install transverse bracing, in an "X," across the width of the scaffold at the top and bottom of the end posts, and at every fourth runner vertically. Repeat this "X" bracing at every third set of posts measured horizontally from one end of the scaffold.

6. Longitudinal Diagonal Bracing. Install longitudinal diagonal bracing along the inside and outside rows of posts, beginning near the bottom of the posts at one end and extending to the top of the posts at the other end. Install the diagonal bracing at a 45-degree angle. Couple longitudinal diagonal bracing to each runner it crosses.

c. Tubular Welded Frame Scaffolds

1. Design. Use tubular welded frame scaffold only if it is designed to safely support four times the maximum rated load. Place the frames directly over one another, using couplings or stacking pins to vertically align the posts.

2. Height Limitation. A licensed PE must prepare drawings and specifications for metal frame scaffolds that are more than 125 feet high.

3. Uplift. Lock frame members together vertically with pins or other equivalent means, whenever there is possibility that an uplift may occur.

4. Cross Bracing. Properly brace metal tubular frame scaffold with cross bracing or diagonal braces, or both, to secure vertical members. The length of the cross braces must automatically square and align vertical members. Make all brace connections secure.

d. Mobile Scaffolds

1. Maximum Height. Free-standing mobile scaffolds must be no higher than four times the minimum base dimension.

2. Casters. Equip wheels and casters with a positive locking device to prevent the scaffold from accidentally moving.

3. Moving. When moving mobile scaffolds, apply the force to move them as close to the base of the scaffold as possible. Stabilize the scaffold during movement. Use scaffolds only on firm, level, and broom-clean surfaces.

- 4. Riding. Employees may ride manually propelled mobile scaffolds only under the following conditions:
- The floor or surface is within 1.5 degrees of level and is free of pits, holes, or obstructions.
- The minimum dimension of the scaffold base, when ready to move, is at least one-half the height.
- If used, outriggers must be installed on both sides of staging.
- Equip wheels or coasters with rubber or similarly resilient tires.
- Remove tools and materials from the platform or secure them prior to moving the scaffold.

13.2.6 Form Scaffolds

a. Figure-Four Form Scaffolds

1. General. Use figure-four form scaffolds for light duty. Do not use them to support loads more than 25 pounds per square foot, unless specifically designed for greater loading.

2. Design and Construction. Design and construct figure-four form scaffolds, incorporating the dimensions shown in table 13-3:

Table 13-3.—Figure-four scaffold dimensions

Component	Dimensions
Upright and guardrail	2 x 4 inches minimum
Upright or guardrail and ledger spacing	8 feet 0 inch maximum
Guardrail height	Approximately 42 inches
Bearers (two)	1 x 6 inches minimum[1]
Braces (two)	1 x 6 inches minimum
Intermediate guardrail	1 x 6 inches minimum
Maximum ledger length	3 feet 6 inches beyond form support member
Planking	2 x 10 inches minimum
Toeboards	4 inches minimum height

[1] Lumber sizes for components other than planking are nominal sizes.

3. Attachment to a Form. The form scaffold must be an integral part of the form and nailed or bolted to the form studding.

b. Metal Bracket Form Scaffolds

1. Design. Metal bracket form scaffolds must be designed and constructed with a minimum safety factor of four, computed on the basis of maximum rated load. The metal brackets may be of any metal that will support the maximum rated load. Equip them with standard guardrails and toeboards.

2. Attachment to Form. Space metal brackets no more than 8 feet apart on centers. The brackets may be an integral part of the form. If so, bolt or weld them to the form, or attach them using "clip-on" or "hook-over" brackets, provided that you bolt the form walers to the form or secure them with snap ties or shea-bolts extending through the form and anchor securely.

3. Folding Brackets. Bolt or secure folding brackets in the extended position with locking pins.

13.2.7 Ladder-Jack Scaffolds

a. Requirement. Use only type 1A ladders with ladder-jack scaffolds. The combined weight of workers, the planks, equipment, and materials must not exceed the rated load of the ladders.

b. Height. The working platform of ladder-supported scaffolds must be no more than 20 feet high.

c. Securing. To prevent ladders from moving, secure them at the top and bottom with brackets.

d. Scaffold Planking. Only one person may occupy a ladder-jack scaffold erected with wood scaffold planks. When using fabricated planks, allow no more than two people on the plank.

e. Ladder Jacks. Design ladder jacks so that they bear on the side rails, in addition to the ladder rungs, or they must bear on a minimum length of 10 inches on each rung.

f. Fall Protection. Protect employees using ladder-supported scaffolds that are 6 feet or more above the ground or floor level with safety harnesses and lifelines.

13.2.8 Special Work Platforms. A PE must design special work platforms, such as draft tube scaffolds, and penstock jumbos. Recertify them every 5 years. A competent person must inspect them before each use.

13.2.9 Crane Supported Personnel Platforms (Manskips)

a. General Requirements. Use crane-supported personnel platforms to reach the worksite only when conventional means of erection, use, and dismantling (for example, personnel hoists, ladders, stairways, aerial lifts, elevating work platforms, or scaffolding) are impossible or hazardous. Use of crane-supported personnel platforms requires specific authorization, must comply with the requirements of this subsection, and requires supporting justification. The written request must be specific to the operation and must: (1) detail the proposed operation with supporting data that show why employees cannot safely reach the worksite using other standard procedures and (2) confirm, with sufficient manufacturing and design engineering data, that the proposed system and equipment fully comply with the requirements contained herein. Approvals will be for the specific operation described. Do not use the platform system for any other operation, unless an additional request has been submitted and approved. Place approved systems in operation only after you have developed a JHA. The JHA must contain provisions for initially and periodically instructing the crane operator and all affected employees. Personnel must not work from crane-supported scaffolding except when under constant supervision of a general foreman or superintendent, or designated lift supervisor, and the crane and operation meet the requirements of this subsection and the section on cranes.

b. Specific Requirements

1. Hoist-Line Suspended Personnel Platforms

(a) Suspend platform only from the main boom nose.

(b) Do not handle personnel above ground when wind velocity exceeds 10 miles per hour, when any dangerous weather condition exists, or when other danger is impending.

(c) Keep cranes level during operation with outriggers fully extended and jack pads set on firm, level terrain or on substantial shoring.

(d) Select sites so that, when locating cranes for platform operation, no part may come within the minimum distance from energized lines. Do not use barriers, manufacturer's locks, or control level restraints to meet these requirements.

(e) Do not handle materials lifts when personnel are on the platform. Detach the platform before rigging the crane for material handling.

(f) Do not belt off or otherwise attach a platform to an adjacent pole, structure, or equipment.

(g) Lifting and lowering speeds must not exceed 100 feet per minute.

(h) Engage load and boom hoist drum brakes, swing brakes, and locking devices (such as pawls or dogs) when the occupied personnel platform is in the stationary position.

(i) When employees occupy platforms, they must wear body harnesses with lanyards appropriately attached to the load block, headache ball, or to a structural member of the platform. Harnesses, lanyards, and structural support members used as anchorages must meet requirements contained in the section that discusses personal protective equipment and fall protection.

(j) Do not move a mobile-crane when employees are aloft.

(k) Employees must keep all body parts inside the platform during raising, lowering, and positioning.

2. Cranes

(a) Install and test the crane periodically, using the section on hoisting equipment.

(b) Use only cranes equipped with planetary or worm gears, torque converters, automatic braking systems, or other equivalent systems that prevent placing the boom hoist and loadlines in a freewheeling or neutral position controlled by manual brake and/or dogs only. Use only the main hoist for personnel handling.

(c) The crane must be able to sustain a static load (as shown on the crane's capacity chart) of two times the rated platform capacity for all radii and configurations through which the platform will be hoisted.

(d) The minimum load hoist line wire rope safety factor must be 7 or 10 when using rotation-resistant rope.

(e) Install an anti-two-blocking device or two-block damage prevention feature and ensure that it is operating. The anti-two blocking device must have automatic capabilities for controlling functions that may cause two-blocking conditions.

(f) Mark telescoping booms or equip them with a device that clearly shows the boom's extended length to the operator at all times.

(g) All critical components of hydraulic or pneumatic systems must have a minimum bursting strength of at least four times the system's designed operating pressure. (Critical components are those in which a failure could result in free rotation or lowering of the boom or platform.)

(h) Equip all critical hydraulic cylinders with pilot-operated check valve, or other appropriate devices, to prevent freefall or uncontrolled movement of boom or platform in the event of a hydraulic line failure. Electrical systems used for positioning platforms must provide equal protection in the event of power failure.

(i) Make sure the crane is level within 1 percent and located on firm footing. Extend and engage the outriggers.

3. Platforms

(a) The crane manufacturer or a PE must design the personnel platform.

(b) Suspension systems must be designed to minimize tipping of the platform due to movement of employees on the platform.

(c) The entire platform must be designed with a minimum safety factor of five.

(d) Provide 6-foot minimum headroom for employees on the platform.

(e) Provide each personnel platform with perimeter protection from the floor to 42 incheṣ 3 inches above the floor. Perimeter protection must be either solid construction or expanded metal with openings no greater than one-half of an inch.

(f) Provide a grab rail inside the personnel platform.

(g) If you provide an access gate, make sure it swings inward and equip it with a latch (restraining device) to prevent accidental opening.

(h) Provide overhead protection on the personnel platform when employees are exposed to falling objects.

(i) Grind smooth all exposed rough edges that employees on the platform could contact.

(j) A certified welder, qualified for the weld grades, types, and material specified in the design, must perform all welding.

(k) Conspicuously post a plate or other permanent marking on the personnel platform showing the weight and the rated load capacity of the personnel platform.

(l) Personnel platforms must be easily identifiable by color or marking. Use personnel platforms only to hoist personnel and approved tools and equipment.

(m) Use a wire rope bridle sling to connect the personnel platform to the loadline.

(n) You must close and lock hooks, headache ball assemblies, lower load blocks, or other attachment assemblies, thus eliminating the hook throat opening. Alternatively, use a shackle with a screw pin, nut, and retaining pin.

(o) Wire rope, shackles, rings, and other rigging hardware must have a minimum safety factor of seven.

4. Additional Inspections and Tests

(a) At the beginning of each shift, the competent person must inspect cranes used to hoist personnel platforms. In addition, inspect the crane again after using it for any material handling operations, before using it to hoist employees.

(b) Before hoisting employees for the first time at each new setup location, make a full-cycle operational test lift at 150 percent of the intended load of the personnel platform.

(c) Note: Setup location means the location where the crane or derrick is brought and set up, including assembly and leveling.

(d) Immediately after lift testing, visually inspect the crane, personnel platform, and base support to determine if the testing has adversely affected any component or structure.

(e) Before further use, correct any defects found during such inspections that may create a safety hazard.

(f) At the beginning of each shift, and after using the crane to hoist materials, make a trial lift with the personnel platform unoccupied to make sure all systems, controls, and safety devices are functioning properly.

5. Work Practices

(a) The crane operator must remain at the controls at all times when the personnel platform is raised.

(b) Employees being hoisted must remain in direct communication with the crane operator at all times.

(c) Hold a prelift meeting before each personnel hoisting operation. The crane operator, employees involved, and the responsible general foreman, superintendent, or designated lift supervisor must attend the prelift meeting.

13.2.10 System Scaffolds. System scaffold means a scaffold consisting of posts with fixed connection points that accept runners, bearers, and diagonals that can be connected at predetermined levels.

a. Scaffold Components. Do not intermix or modify the load-carrying members of system scaffolding manufactured by different manufacturers unless a competent person verifies that the resulting scaffold is structurally sound.

b. Erection. Erect the system scaffolding according to manufacturer's guidelines. The manufacturer's guidelines for erecting and using system scaffold must be on the jobsite while the scaffold is erected, used, and dismantled. A PE must design scaffolds erected or used in a manner not covered in the manufacturer's guidelines.

c. Erection. Erect posts plumb, with runners and bearers level. Install vertical, horizontal, and diagonal bracing as recommended by the scaffold manufacturer. Secure all connections on a scaffold level before assembling the next level.

13.3 Elevating and Rotating Work Platforms

Design and use elevating and rotating work platforms according to the standards set forth in applicable ANSI standards and these standards.

The design, construction, and operation of platforms and cranes must comply with the current edition of ANSI A92.2, "Vehicle Mounted Elevating and Rotating Aerial Devices," or the manufacturer or PE for personnel platform work must design and certify them. Mount personnel platforms on a crane boom only when they conform with the more stringent of these or manufacturer's requirements. Control all crane operations from the platform with an overriding crane control feature, except operations associated with travel. The crane and platform must meet design safety factors, and employees must operate them according to appropriate restrictions and requirements defined in this subsection.

13.4 Design and Construction of Guardrails

13.4.1 Standard Guardrails – Construction

a. Design. A standard guardrail must consist of a top rail, intermediate rail, toeboard, and posts. The guardrail must be 42 inches high.

b. Dimension. Wooden posts and toprails must be at least 2- by 4-inch construction grade lumber, or equivalent, with posts not more than 8 feet apart on centers. Intermediate rails must be at least 1 inch by 6 inches. Toeboards must be at least 4 inches high and installed within 1/2 inch of the floor.

c. Pipe Guardrails. Posts, toprails, and intermediate rails must be at least 1.5-inch inside diameter steel pipe with posts not more than 8 feet apart on centers.

d. Metal Guardrails. Posts, toprails, and intermediate rails must be 2- by 2- by 3/8-inch angle iron, or equivalent, with posts not more than 8 feet apart on centers.

e. Guardrail Strength. Regardless of material used, the guardrail must be able to withstand a loading of 200 pounds, applied in any direction at any point on the toprail, with minimum deflection. The design of railings that must withstand greater stress, because of the nature of use, must have a minimum safety factor of four.

f. Rope Guardrails. Do not use wire, synthetic, or natural fiber ropes as guardrails on scaffolds. Wire rope may be used for protective railings on permanent structures during construction. When used, wire rope must have sufficient tension so the maximum midspan deflection is less than 3 inches when applying a 200-pound force. Toprails and midrails must be at least 1/4-inch in diameter. When using wire rope for the top rail, flag it with high visibility material at intervals of 6 feet or less.

13.4.2 Standard Guardrails – Permanent

a. Design. Standard guardrails must have a top rail at least 42 inches from the adjacent surface. Fill the opening between the toprail and the adjacent surface with solid material, grills, or ornamental work, designed so that a 4-inch ball cannot pass through any opening. However, if an exception is made to use a midrail in industrial areas, the openings between the midrail and the toprail, or the midrail and the adjacent surface, must not exceed 21 inches.

b. Materials. Construct the toprail, grill material, and/or midrail of wood or metal, strong enough to withstand a 200-pound force applied in any direction with minimum deflection.

13.5 Safeguarding Floor and Roof Openings

13.5.1 Requirement. Cover the floor and roof openings, including skylights into which persons can fall, with material and bracing that is strong enough to support any imposed load, or protect it with a securely anchored enclosure meeting the requirements of this subsection.

13.5.2 Protective Enclosure. Enclose all uncovered floor or roof openings on open sides with a standard guardrail and toeboard, or provide a cover for them that can sustain the expected load. At a minimum, the cover must be able to sustain a load of 250 pounds.

13.5.3 Stairways and Ladderway Openings. Provide all stairway and ladderway floor openings with a standard guardrail and toeboard on exposed sides (except the entrance). Offset entrances to stairways or ladderways, or provide a gate to prevent persons from walking directly into the opening.

13.5.4 Hatchways and Chute Openings. Guard hatchways and chute floor openings with one of the following:

a. Hinged covers that are strong enough to carry anticipated loads and a standard guardrail with one exposed or open side. When the hatchway or chute opening is not in use, keep the cover closed or guard the exposed side with a removable standard guardrail.

b. A removable standard guardrail or self-closing gate installed on just one side, and fixed standard guardrails and toeboards on all other exposed sides. When not using the opening, keep the removable guardrails in place. Guard chute openings into which debris is manually dumped. Provide a guardrail on the side of the opening where employees stand when they dump debris.

c. Removable standard guardrails, secured to the floor on all open or exposed sides, installed to permit removal of only a section or side(s) sufficiently large to perform the work. When the hatchway is not in use, immediately replace the guardrail and secure it.

13.5.5 Doors and Gates. Provide a platform where doors or gates open directly on a stairway. Make sure the swing of the door or gate does not reduce the effective length of the platform to less than 20 inches.

13.6 Safeguarding Wall Openings

13.6.1 Requirement. If there is a drop of more than 4 feet from a wall opening, and the bottom of the opening is less than 3 feet above the working surface, provide a standard guardrail or guardrail components to afford protection to a height of 42 inches above the working surface. Provide a standard toeboard where the bottom of the wall opening is less than 4 inches above the working surface.

13.6.2 Extension Platforms. Provide a standard guardrail and toeboard for exposed sides of extension platforms, outside of wall openings, that provide access for materials, equipment, or personnel.

13.7 Safeguarding Open Floors and Platforms

13.7.1 Requirement. Guard the perimeter of all floors, platforms, etc., 6 feet or more above adjacent floor or ground level by installing guardrails or equivalent guarding, unless or until permanently enclosed to a height of 3 feet or more above the floor or working surface. Provide standard toeboards where falling objects pose a hazard to persons or property.

13.7.2 Hazardous Locations. In locations where a hazardous condition exists (such as projecting reinforcing steel, moving equipment, or hazardous materials), provide standard guardrails, regardless of height.

13.7.3 Protection From Falling Objects. When employees must work under an open-sided wall opening or platform where a falling objects hazard exists, install effective protection, such as enclosed guardrails or nets, as described in this section and the section on fall protection.

13.8 Requirements for Roofing Protection

13.8.1 Requirement. Whenever employees work on roofs during construction, demolition, or repair and maintenance, and they are subject to falls exceeding 6 feet from the adjoining surface, provide adequate fall protection devices. Employees are subject to falls when working within 10 feet of the roof edge or when working in any place on a roof with a pitch steeper than 1:3.

13.8.2 Fall Protection. Adequate fall protection includes the following:

a. Restraining lines, harnesses, lanyards, and safety nets meeting the requirements in the section on fall protection.

b. Standard guardrails meeting the requirements of this section.

c. Catch platform.

d. Warning line system supplemented by a safety monitoring system is only adequate on roofs with pitch flatter than 1:3.

13.8.3 Warning Line System. Erect warning lines around all open sides of the work area. When mechanical equipment is not in use, erect the warning lines at least 6 feet from the roof edge or opening. When mechanical equipment is in use, erect the warning line at least 6 feet from the roof edge or opening that is parallel to the direction of mechanical equipment operation, and at least 10 feet from the roof edge or opening that is perpendicular to the direction of mechanical equipment operation. Do not work outside warning lines without fall protection.

a. The warning lines must be rope, wire, or chain, with a minimum breaking strength of 500 pounds. Attach warning lines to supporting stanchions. Mark the warning line with high-visibility material at intervals no more than 6 feet. Rig the warning line so that it is at least 34 inches from the roof surface at its lowest point and no more than 39 inches at its highest point.

b. After erection, the warning lines and stanchions must be able to support a minimum force of 16 pounds applied horizontally 30 inches above the floor.

c. Safety monitor. When using a warning line system, supplement it with a safety monitoring system. Assign a competent person to be the safety monitor. The safety monitor must ensure the safety of all employees working on the roof and warn any employee who appears unaware of a hazard or is acting unsafely. The safety monitor must be on the same roof as the employees, within visual sight of the employees, and close enough to verbally communicate with them. The safety monitor must not perform any other work.

13.8.4 Overhead Protection. Require overhead protection for all employees working under the roof edge. You may use temporary decking, suspended platforms, nets, or other equivalent devices to provide such overhead protection.

13.8.5 Roof Edge Materials Handling Areas and Materials Storage. When using guardrails at hoisting areas, bitumen pipe outlet areas, or roof edge storage areas, erect at least 4 feet of guardrail on each side of the area.

a. Place a chain or gate across the opening between the guardrail sections when not handling materials.

b. Protect employees working in the vicinity of the open guardrail with a safety belt or harness and lanyard system. Rig the safety belt system so that employees cannot move beyond the edge of the roof.

c. If roofs are more than 16 feet high, install a hoisting device, stairway, or progressive platform to supply material and equipment. Provide level landing platforms with guardrails and toeboards at the roof edge.

13.8.6 Crawling Boards (Chicken Ladders). Use crawling boards to help employees climb up and down steep roofs. Crawling boards must be at least 10 inches wide and 1 inch thick, with 1- by 1.5-inch cleats spaced not more than 24 inches apart. The lengthened cleats must equal the width of the crawl board. Secure the cleats with nails driven through the crawl board and clinched on the underside. The crawling board must extend from the ridge pole to the eaves. String a securely fastened grabline beside each crawl board. Grablines must be of 3/4-inch manila rope, or equivalent.

13.8.7 Roofing Brackets. Secure roofing brackets in place by nailing, in addition to using metal projections. If it is not practical to nail the brackets, use rope supports that are 3/4-inch manila rope, or equivalent.

13.8.8 Training. Implement a training program for all employees working on a roof. The training program must enable employees to recognize and deal with the falling hazards associated with working near a roof perimeter or roof opening. The training must cover the following areas:

a. The nature of the fall hazards.

b. The function, use, and operation of the fall protection systems, warning line system, and safety monitoring systems in use.

c. Each employee's role in the safety monitoring system when this system is in use.

d. The correct procedures for handling and storing equipment and materials.

Section 14

Confined Spaces

14.1 Purpose and Scope

This section establishes requirements for confined and permit required spaces. It specifically discusses the general and program requirements for permit required confined spaces; training requirements; and the duties of entrants, attendants, and the entry supervisor.

Underground construction activities must also comply with the requirements of tunnel and shaft construction. Tunnels are classified as confined spaces and usually permit-required confined spaces. Entry into tunnels must be conducted in accordance with the requirements of the confined space program, and address the specific hazards associated with distance, communication, physical demands, and emergency rescue, in addition to all other requirements.

The determination of whether a space is a permit-required confined space is contingent upon two factors. The first factor is solely based on physical characteristics of the space itself. A "confined space" must be large enough and so configured that an employee can bodily enter and perform assigned work, have limited or restricted means for entry or exit, and not be designed for continuous employee occupancy. If the space is so configured, then the second factor is whether the space contains or the activities introduce any hazard capable of causing death or serious physical harm. A space would be classified as a "permit-required" confined space if it either contained, or has a potential to contain, a hazardous atmosphere, a material which has the potential to engulf an entrant, an internal configuration such that an entrant could be trapped or asphyxiated, or contains any other recognized serious safety or health hazard.

14.2 Applicable Definitions

The following definitions apply to this discussion of confined spaces.

Confined Space	A space large enough for an employee to enter, but with limited means of entry and egress, and which is not designed for continuous human occupancy.
Permit Required Confined	A confined space in which one or more of the following:
Space	potential hazards or existing conditions: (a) the space contains, or may contain, an atmospheric hazard; (b) the space contains a potential

	engulfment hazard (i.e., water or other flowable material which may engulf an entrant); (c) the space has a configuration which may trap or asphyxiate an entrant; (d) the space has any other serious safety or health hazard. A serious safety or health hazard for purposes of this standard means a hazard which may render an entrant incapable of self-rescue.
Entrant	A person trained and authorized to enter confined spaces under conditions documented in the local confined space permit.
Attendant	A person trained and authorized to perform attending duties as prescribed in the confined space program.
Confined Space Supervisor	A person trained and authorized to conduct, approve, and oversee entries into confined spaces.
Confined Space Program	A site-specific program that establishes the procedures for permit-required confined spaces, identifies the persons authorized to perform the various duties, and includes the emergency procedures, equipment, and communication.
Prohibited Conditions	A condition within a confined space that indicates that a control measure specified in the permit has become ineffective or that a hazard exists within the space that was not anticipated and for which no control measure is in place.

Other definitions applicable to confined spaces can be found in OSHA 1910.146 (b) or on the Internet at the following website address: http://www.osha.gov/

14.3 Requirements for Confined Spaces

14.3.1 Maintain an inventory of permit-required confined spaces and the active and closed permits at each facility. The inventory must identify the space and its associated hazards that must be controlled before entry.

14.3.2 Do not enter permit required confined spaces until a program for managing such entries is in place and all of the requirements of that program have been met.

14.3.3 Place a danger sign at each entrance to each permit required confined space. The danger sign must identify the space as a permit required confined space and have additional instructions such as "authorized entrants only", or "entry prohibited."

14.3.4 Every employee whose assigned duties require entry into a permit required confined space must be trained in the requirements of this standard, the hazards of confined spaces, the measures used to control or eliminate those hazards, and the specific duties assigned.

Each document developed for confined space entries, including the program, the inventory, the closed entry permits, analysis for reclassification, written hazard analysis and determination for alternative entry procedures, rescue procedures, and training verification for participating

14.3.5 Personnel must be maintained in the facility files and be made available for review.

14.4 Program Requirements for Confined Spaces

14.4.1 The confined space program must establish the procedures for issuing and canceling permits, testing and preparing the space prior to entry, the communications required between entrants and attendants, the acceptable entry conditions, the rescue procedures, and the program documentation and review required. As a minimum, it shall provide for the following:

a. Program Coordinator. Identifying a program coordinator who is knowledgeable and responsible for implementing the confined space entry program at the site. This coordinator will be delegated sufficient authority to implement the program.

b. Confined Spaces. Before removing any cover to a confined space, determine that it is safe to do so. Immediately upon removing the cover, erect a barrier to prevent unauthorized entry into the space. If the opening into the space is a floor opening, the barrier must meet the requirements for a standard guardrail.

c. Permit. Before entry, complete a permit that contains the following information:

- The identification of the space to be entered.
- The purpose of the entry.
- The time of entry and the expected duration.
- The names of the entrants, attendants, and the entry supervisor.
- Results of any atmospheric testing for oxygen content, lower explosive limit, and toxic air contaminants, including the name of the qualified person conducting the testing.
- The control measures in place to control the hazards that caused the space to be classified as a permit-required confined space.
- A description of the hazards that may be introduced by the work to be performed in the space, and the measures in place to control those hazards.
- A description of the communications equipment and methods to be used to maintain communications between the entrants and the attendant(s).
- A list of the equipment to be used to conduct a safe entry and work in the space, including personal protective equipment that must be worn.
- A list of the prohibited conditions that would require an immediate evacuation of the space.
- A written rescue plan that identifies the rescue service and the means for contacting the rescue services. Coordination with local contracted agencies or in-house personnel must be established and verified prior to entry.
- The signature of the confined space entry supervisor, certifying that the space is safe to enter, and authorizing entry.

d. Additional Documents. Documents required by other standards such as switching procedures, clearances, hazardous energy control document, or hot work permits related to the work in the confined space must be attached to the confined space permit and be retained in the confined space files.

e. Air Testing Requirements. If atmospheric hazards or potential atmospheric hazards are identified for a particular confined space, the air inside the space shall be tested for oxygen content, flammable atmosphere, or toxic contaminants by a qualified person using a properly calibrated direct reading instrument prior to entry, and periodically, preferably continuously, during an entry, and while performing work in the permit required confined space. If testing is done using separate instruments, the order of testing shall be oxygen first, then flammability, then toxic contaminants. Employees or representatives of employees must be afforded an opportunity to observe any testing and results. Continuous air monitoring is highly advised, where practicable.

f. Control or Elimination of Hazards. Each hazard that caused the confined space to be classified as a permit-required confined space or will be introduced into the space as a result of the work to be performed must be controlled to the extent possible, or eliminated before entering the space.

g. Re-evaluation of Confined Space. The program must provide for a re-evaluation of all confined spaces whenever condition in those spaces change.

h. Communication Between Entrant(s) and Attendant(s). Communication between entrants and attendants are required for the duration of the permit required confined space work. Loss of communication is a prohibited condition requiring evacuation of the space and termination of the entry until communication can be restored. Communication may be by voice, land-line, radio, signaling system, or other reliable method.

i. Permit. In the permit, list all equipment necessary for safe entry into confined spaces, including monitoring equipment, ventilation equipment, rescue equipment, lighting equipment, personal protective equipment, and other equipment such as ladders and railings.

j. Provisions for Rescue. For every permitted entry into a confined space, the permit must include a plan for rescuing the entrants. The adequacy of the rescue plan must be verified before entry into the space. The selected rescue service's response time and rescue capability should be evaluated. Any one of the following three rescue procedures, generally in order of preference, are adequate:

> **1. Rescue Without Entry.** Make provision for rescuing entrants without entry by rescue team members, whenever possible. To facilitate such rescue without entry, entrants must wear a full body harness attached to a lifeline. The other end of the lifeline must be attached to a hoisting device to permit the attendant to begin rescue immediately if a prohibited condition arises in the space. If the full body harness presents a greater hazard, other rescue provisions must be used in lieu of the full body harness.

2. Employee Rescue. A designated group of employees trained and equipped to enter the confined space to rescue an incapacitated entrant. The designated rescue team must have practiced rescue from the space entered (or a similar space) within the last year. Before entry, the confined space entry supervisor must verify that an adequate number of rescue team members are available to make a timely response to an emergency, and must verify that the rescue team members have current training. The procedure for summoning the response must be established, and the attendant must have the means to issue the summons.

3. Outside Rescue Service. A commercial ambulance service or local fire department may be able to perform a rescue from a confined space, provided that there is an agreement and members have appropriate training and equipment. Reliance on a general emergency phone number available to the general public is not adequate without the written agreement. It is the responsibility of the entry supervisor to verify that the selected rescue service is qualified to perform a rescue, has current training, and is available at the time of the entry. The adequacy of the response time must be considered in selecting an outside rescue service. If the rescue service cannot make a timely response to a summons, they may be required to standby in the area of the access to the confined space. The attendant must have the means and be trained in the procedure for summoning the outside rescue squad. The outside rescue service must notify the attendant if some other emergency compromises their response capability. The attendant must then terminate the entry.

k. Alternative Entry Procedure. The program may provide for entry into permit-required confined spaces under carefully controlled conditions. If such alternative procedures are provided for in the program, the following conditions must be met:

1. No hazards, such as potential engulfment or serious safety hazards, other than actual or potential atmospheric hazards exist in the space.

2. The atmospheric hazards can be (are) controlled by continuous mechanical ventilation. Employees are not allowed to enter the space until forced air ventilation has eliminated the hazardous atmosphere.

3. Air testing is conducted before and after application of the ventilation and periodically, preferably continuously, for the duration of the entry. Employees or representatives of employees are provided an opportunity to observe the air testing and results.

4. The entrants are trained and qualified confined space entrants.

5. An alternative entry certificate is created and signed by a qualified confined space supervisor certifying that the above conditions have been met, and identifying the space, the purpose of the entry, the time of entry, and the entrants. Post the certificate at the point of entry into the space for the duration of the entry and file it in the confined space program files after termination of the entry.

l. Temporary Declassification of a Space. When no actual or potential atmospheric hazards are present, and the other hazards that caused the space to be considered a permit required confined space can be eliminated without entry into the space, a confined space can be temporarily identified as a non-permit confined space. Any such declassification must be approved by the qualified confined space supervisor on a certificate of declassification which identifies the space, the actions taken to eliminate the hazards, and the time for which the declassification is valid. The certificate will be posted at the point of entry for the period of validity, which will not exceed one shift, and filed in the confined space program files at expiration.

m. Contractors and Outside Entities. If confined spaces are to be entered by contractors or other outside entities who do not normally work in that facility, either alone, or in conjunction with the facility staff, the program must describe the coordination and controls which will be applied to such outside entity to assure a safe entry into a confined space.

n. Program Review. The program must be reviewed by the confined space program coordinator at least annually, and more frequently if necessary. Any prohibited condition or near-miss incident arising in a confined space will be investigated immediately.

14.5 Training Requirements

Each person who will be assigned duties in a confined space program shall be trained to perform those duties safely and competently. The training instructor must sign the certificate and include on it the date of training, the individuals trained, and the qualifications of persons trained.

14.5.1 Retraining. Retraining prior to assignment of additional confined space duties is required under any of the follow conditions:

a. The individual fails to perform the duties assigned in accordance with the program.

b. The individual has not performed any confined space work for a period of 1 year.

c. Changes are made in the program.

d. Individual or supervisory request.

e. The individual has been involved in an accident or near-miss accident.

14.6 Duties of Entrants

14.6.1 Entrants must know the hazards that may be encountered during the entry and be able to recognize when those hazards are present.

14.6.2 Entrants must properly use the equipment provided for entry into the confined space.

14.6.3 Entrants must maintain communication with the attendant.

14.6.4 Entrants must tell the attendant whenever: (a) the entrant recognizes any warning sign, or symptom of exposure to a dangerous situation, or (b) a prohibited condition is detected.

14.6.5 Entrants must immediately exit the permit space whenever (a) an order to evacuate is given, (b) a warning sign or symptom of exposure is recognized, (c) a prohibited condition is detected, or (d) an evacuation alarm is sounded.

14.7 Duties of Attendants

14.7.1 Attendants must know the hazards that may be encountered in the confined space they are attending.

14.7.2 Attendants must be able to recognize the behavioral effects that exposure to a hazardous condition may have on entrants.

14.7.3 Attendants must know at all times the number and identity of the entrants inside the attended space.

14.7.4 The attendant must remain outside the attended space unless relieved by another authorized attendant. Attendants may not enter the space unless relieved by another attendant who is trained, equipped, and authorized to perform attendant duties at that location.

14.7.5 Attendants must maintain communications with entrants to monitor their condition and to order an evacuation when necessary.

14.7.6 Attendants must order an evacuation of the permit space if: (a) the attendant detects a prohibited condition or is notified of a prohibited condition by an entrant (b) the attendant detects entrant behaviors indicating potential exposure to a hazardous situation, (c) the attendant detects a condition outside the space which may endanger the entrants, or (d) the attendant is unable to safely perform all of the duties.

14.7.7 The attendant must summon the rescue service as soon as it appears that the authorized entrants may need assistance to escape from hazards within the space.

14.7.8 The attendant must prevent unauthorized persons from entering the confined space and notify the entry supervisor and the entrants if an unauthorized person enters the space.

14.7.9 The attendant may perform nonentry rescue if specified on the Entry Permit.

14.7.10 The attendant may not be assigned any other duties that will interfere with his/her primary duty to monitor and protect the entrants.

14.8 Duties of the Entry Supervisor

14.8.1 The entry supervisor must know the hazards that may be encountered during the entry and be able to recognize the behavioral effects that exposure to a hazardous condition may have on entrants.

14.8.2 The entry supervisor must verify that appropriate steps have been taken to make the space safe for entry and record this before allowing entry.

14.8.3 The entry supervisor must hold a meeting with entrants and attendants before entry. At the meeting, the entry supervisor must review the hazards associated with the space to be entered, the control measures in place to mitigate the hazards, the results of air monitoring within the space, and prohibited conditions that would require an evacuation of the space. He/she must also verify that the entrants and attendants are trained and understand their duties associated with the entry and work in the confined space.

14.8.4 The entry supervisor must terminate the entry and cancel the permit when (1) the work is completed, (2) a prohibited condition arises in the space, or (3) an evacuation of the space is ordered. If the permit is terminated, the space must be re-evaluated before issuing a new permit to complete the work.

14.8.5 The entry supervisor must remove unauthorized individuals who attempt to enter the permitted space.

14.8.6 The entry supervisor must verify the capability and availability of rescue services and the means for summoning them prior to authorizing entry into a confined space.

14.8.7 When responsibility for a permit space entry is transferred to a new entry supervisor, the entry supervisor accepting the responsibility for the space must verify that the operations within the space are consistent with the permit.

Section 15

Control of Hazardous Energy(Lockout/Tagout)

15.1 Scope and Purpose of Lockout/Tagout Program

The unexpected energization, release of stored energy, or startup of machines or equipment can injure employees. This section covers servicing and maintenance of these machines or equipment. It establishes minimum performance requirements to control such hazardous energy at all Reclamation-operated facilities. Contractor work at Reclamation-owned and/or -operated facilities must comply with any existing hazardous energy control procedures of the facility. The section on Electrical Safety contains additional requirements for electrical clearance procedures to control hazardous energy sources.

15.1.1 Application. This standard applies to the control of energy when installing, removing, servicing, or maintaining machines and equipment. This standard applies to any source of electrical, mechanical, hydraulic, pneumatic, chemical, thermal, or other energy, but does not apply to the following:

a. Work on cord and plug connected electric equipment in which unplugging the equipment from the energy source controls the exposure to the hazards of unexpected energization or startup of the equipment and the plug is under the exclusive control of the employee servicing or maintaining the equipment.

b. Hot tap operations involving transmission and distribution of substances such as gas, steam, water, or petroleum products when they are performed on pressurized pipelines, provided that the employer demonstrates that (1) continuity of service is essential; (2) shutdown of the system is impractical; and (3) documented procedures are followed and special equipment is used that will effectively protect employees.

15.1.2 Purpose. This section requires the establishment of a hazardous energy control program and the use of procedures to affix appropriate lockout devices or tagout devices to energy isolating devices, and to otherwise disable machines or equipment to prevent unexpected energization, startup, or release of stored energy to prevent injury. When required by other sections, use lockout or tagout devices and supplement them with the procedural and training requirements of this section.

15.1.3 Definitions

Affected person	An employee whose job requires them to operate or use a system on which servicing or maintenance is being performed under lockout or tagout, or whose job requires them to work in an area where such servicing or maintenance is being performed.
Authorized employee	A qualified person who locks out or tags out machines or equipment in order to perform servicing or maintenance on that machine or equipment. An affected employee becomes an authorized employee when that employee's duties include performing servicing or maintenance covered under this section.
Capable of being locked out	An energy isolating device has a built-in lock, a hasp, or other means for affixing a lock. Other energy isolating devices are capable of being locked out if lockout can be achieved without dismantling, rebuilding, or replacing the energy isolating device or permanently altering its energy control capability (i.e., vendor devices that will make energy isolating device lockable).
Energized	Connection to an energy source or containing residual or stored energy.
Energy isolating device	A mechanical device that physically prevents the transmission or release of energy, including, but not limited to the following: manually operated circuit breakers, disconnect switches, slide gates, line valves, blocks, or similar devices capable of blocking or isolating energy. The term does not include push buttons, selector switches, and other control circuit type devices.

Energy source	Any source of electrical, mechanical, hydraulic, pneumatic, chemical, thermal, nuclear, stored, or other energy.
Hot tap	Work involving welding on a piece of equipment (pipelines, vessels, or tanks) under pressure, to install connections or appurtenances. It is commonly used to replace or add sections of pipeline without interrupting service for air, gas, water, steam, and petrochemical distribution systems.
Job supervisor	Any person authorized to request, receive, and release clearances or Hot Line Orders and who is responsible for meeting the requirements of the Hazardous Energy Control Program.
Lockout	Placing a lockout device on an energy isolating device, in accordance with an established procedure, ensuring that the energy isolating device and the equipment being controlled cannot be operated until the lockout device is removed.
Lockout device	A device that uses a positive means such as a physical lock, to hold an energy isolating device in the safe position and to prevent the energizing of a machine or equipment. Lockout devices include blank flanges and bolted slip blinds.
Responsible official	The manager responsible for administering the Hazardous Energy Control Program.
Servicing or maintenance	Workplace activities such as constructing, installing, setting up, adjusting, inspecting, modifying, and maintaining or servicing machines or equipment. These activities include lubricating, cleaning, or unjamming machines or equipment and making adjustments or tool changes where the employee may be exposed to the unexpected energization or startup of equipment, or release of hazardous energy.

Setting up	Work to prepare a machine or equipment for normal production operation.
Tagout	Attaching a tag on an energy isolating device, in accordance with an established procedure, to indicate that employees must not operate the energy isolating device or the equipment until the tagout device is removed.
Tagout device	A prominent visible warning device, such as a tag with a means of attachment, which can be securely fastened to an energy isolating device in accordance with established procedures, to indicate that employees must not operate the energy isolating device until the tagout device is removed.

15.2 Requirements of the Hazardous Energy Program

15.2.1 Program. Each Reclamation facility and each contractor must have a written Hazardous Energy Control Program that includes written procedures, personnel training, and periodic inspections to ensure that before any employee performs any servicing or maintenance on a machine or equipment in which the unexpected energizing, startup, or release of stored energy could occur and cause injury or death, the machine or equipment is isolated from all hazardous energy sources.

15.2.2 Energy Control Procedure

a. The procedures must clearly and specifically outline the scope, purpose, authorization, rules, and techniques to control hazardous energy and the means to ensure compliance including, but not limited to, the following:

1. A specific statement of the intended use of the procedure.

2. Specific procedural steps for shutting down, isolating, blocking and securing machines or equipment to control hazardous energy.

3. Specific procedural steps for placing, removing, and transferring lockout devices or tagout devices and the responsibility for them.

4. Specific requirements for testing a machine or equipment to determine and verify the effectiveness of lockout devices, tagout devices, and other energy control measures.

b. You do not need to document the procedures for a particular machine or equipment when all of the following elements exist:

1. The machine or equipment has no potential for stored or residual energy or reaccumulation of stored energy after shutdown that could endanger employees.

2. The machine or equipment has a readily identified and isolated, single energy source that will completely deenergize and deactivate the machine or equipment.

3. The machine or equipment is isolated from that energy source and locked out during installation, removal, servicing or maintenance.

4. A single lockout device will achieve a locked-out condition.

5. The lockout device is under the exclusive control of the authorized employee performing the servicing or maintenance.

6. The servicing or maintenance does not create hazards for other employees.

7. No accidents involving the unexpected activation or reenergization of the machine or equipment during servicing or maintenance have occurred.

15.2.3 Lockout/Tagout

a. If an energy isolating device is capable of being locked out, the Hazardous Energy Control Program must use lockout procedures, unless the employer can justify an operational need to use a tagout system instead of locking out. The employer must demonstrate that using a tagout system will fully protect employees.

b. If an energy isolating device is not capable of being locked out, the Hazardous Energy Control Program must use a tagout system.

c. Whenever replacing, making major repairs to, renovating, or modifying a machine or equipment, and whenever installing new machines or equipment, the design of energy isolating devices for the machine or equipment must be designed to accept a lockout device.

15.2.4 Full Personnel Protection

a. When using a tagout device on an energy isolating device that is capable of being locked out, attach the tagout device at the same place you would have attached the lockout device. The employer must demonstrate that the tagout program will provide the same level of safety as a lockout program. Tagout alone is not considered as protective as lockout; therefore, additional measures must be taken.

b. In demonstrating that the tagout program provides an equivalent level of safety as a lockout program, the employer must demonstrate full compliance with all tagout-related provisions of this section, together with such additional elements needed to provide the same level of safety as a lockout device. Full personnel protection must include implementing additional safety measures, such as removing an isolating circuit element, blocking a controlling switch, opening an extra disconnecting device, or removing a valve handle to reduce the likelihood of inadvertent energization.

15.2.5 Protective Materials and Hardware

a. Use locks, tags, chains, wedges, key blocks, adapter pins, self-locking fasteners, or other hardware will be provided to isolate, secure, or block machines or equipment from energy sources.

b. Lockout devices and tagout devices must be singularly identified, must be the only device(s) used to control energy, must not be used for other purposes, and must meet the following requirements:

1. Durable.

(a) Lockout and tagout devices must be capable of withstanding their environment for the maximum expected exposure.

(b) The construction and printing of tagout devices must prevent the tag from deteriorating or the message on the tag from becoming illegible when exposed to weather conditions or wet and damp locations.

(c) Tags must not deteriorate when used in corrosive environments such as areas where acid and alkali chemicals are handled and stored.

2. Standardized.

(a) Lockout devices within the facility must be of the same color, shape, and size.

3. Substantial.

(a) Lockout Devices. Lockout devices must be substantial enough to prevent removal without using excessive force or unusual techniques, such as bolt cutters or other metal cutting tools.

(b) Tagout Devices. Tagout devices, including their means of attachment, must be substantial enough to prevent inadvertent or accidental removal. The means to attach tagout devices must be nonreusable type, attachable by hand, self-locking, and nonreleasable with a minimum unlocking strength of at least 50 pounds and at least equivalent in general design and basic characteristics, to a one-piece**,** all environment-tolerant, nylon cable tie.

4. **Identifiable**.

(a) Lockout devices and tagout devices must indicate who applied the device(s).

c. Tagout devices must warn against hazardous conditions if the machine or equipment is energized and must include a legend such as: DO NOT START, DO NOT OPEN, DO NOT CLOSE, DO NOT ENERGIZE, DO NOT OPERATE.

15.2.6 Energy Isolation. Only authorized personnel may perform lockout or tagout.

15.2.7 Notification of Personnel. The job supervisor or authorized person must notify affected employees after lockout or tagout devices have been placed or removed and before machines or equipment are started.

15.2.8 Periodic Inspection. At least annually, conduct inspections to ensure adherence to all requirements of the hazardous energy control program. As a part of the inspection, inspect each energy control procedure used at the facility. The responsible official must certify that the inspections have been performed. The certification must specify the system on which the energy control procedures were used when inspected, the date of the inspections, and the names of employees and included in the inspections.

a. A qualified individual who does not use the specific hazardous energy control procedure must inspect it annually.

b. Annual inspections of hazardous energy control programs and procedures must include a review between the inspector and employees involved in use of the procedures to assess individual, personal knowledge of, and responsibilities under the program.

c. Document any deficiencies and take appropriate measures to correct the deficiencies and to ensure future compliance.

d. Conduct additional inspections when an incident occurs.

15.2.9 Training and Communication

a. Provide annual training to ensure that employees understand the purpose and procedures of the energy control program and that they acquire the knowledge and skills to safely apply, use, and remove the energy controls. All employees involved with hazardous energy control procedures must have initial training and must demonstrate adequate working knowledge of hazardous energy control policies and local programs and procedures before they are placed on the list of authorized personnel. The training must include the following:

1. Each authorized employee must receive training in recognizing applicable hazardous energy sources, the type and magnitude of the energy available in the workplace, and the methods and means necessary for energy isolation and control.

2. Each affected employee must be instructed in the purpose and use of energy control procedures.

3. All other persons whose work is, or may be, in an area where energy control procedures may be used, must be instructed about the procedure, and about the prohibition relating to attempts to restart or reenergize machines or equipment that are locked out or tagged out.

b. When tagout systems are used, also train employees in the following limitations of tags:

1. Tags are essentially warning devices affixed to energy isolating devices and do not provide the physical restraint on those devices that is provided by a lock.

2. A tag attached to an energy isolating device must not be removed without authorization of the employee responsible for it, and it must never be bypassed, ignored, or otherwise defeated.

3. Tags must be legible and understandable by all authorized employees, affected employees, and all other employees whose work operations are in, or may be in, the area.

4. Tags and their means of attachment must be made of materials that will withstand the environmental conditions encountered in the workplace.

5. Tags may evoke a false sense of security; understanding hazards, verification, and absolute vigilance must be understood as part of the overall energy control program.

6. Tags must be securely attached to energy isolating devices so that they cannot be inadvertently or accidentally detached during use.

c. Provide retraining:

1. For all authorized and affected employees whenever job assignments change, systems or processes that present a new energy control hazard change, or when energy control procedures change.

2. Whenever any inspection reveals, or there is reason to suspect, deviations from or inadequacies in the employee's knowledge or use of the energy control procedures.

3. At least annually.

d. The responsible official must certify and document all training and retraining. Certification must contain such information as the name of the employee, the time, date, and location of training, and the name of the trainer.

15.3 Application of Energy Control

The established procedures or applying energy control (the lockout or tagout procedures) must cover the following elements and actions and must be done in the following sequence:

15.3.1 Preparation for Shutdown. Before an authorized person or affected employee turns off a system (machine or equipment), the authorized person must have knowledge of the type and magnitude of the energy, the hazards of the energy to be controlled, and the method or means to control the energy.

15.3.2 System (Machine or Equipment) Shutdown. Turn off or shut down the machine or equipment, using the procedures established for the machine or equipment. Use an orderly shutdown to avoid any additional or increased hazard(s) to employees resulting from equipment stoppage.

15.3.3 System (Machine or Equipment) Isolation. Physically locate and operate each energy isolating device needed to control the energy to the machine or equipment to isolate it from the energy source(s**).**

15.3.4 Lockout or Tagout Device Application

a. Allow only authorized persons to affix lockout or tagout devices to each energy isolating device.

b. Affix lockout devices, where used, to hold the energy isolating devices in a "safe" or "off" position.

c. Affix tagout devices, where used, to clearly indicate that operating or moving energy isolating devices from the "safe" or "off" position is prohibited.

1. Systems with energy isolating devices that are capable of being locked out must use locking devices. If you cannot affix locking devices, affix tagout devices at the same point of attachment as a locking device.

2. If you cannot affix a tag directly to the energy isolating device, locate the tag as close as safely possible to the device, in a position that will be immediately obvious to anyone attempting to operate the device.

15.3.5 Stored Energy. Energy storage devices or equipment capable of storing energy may include, but are not limited to, capacitors; power electronic equipment; pneumatic, such as plant service compressed air and governor pressurized oil systems; and mechanical, such as raised gates and charged springs.

a. After affixing lockout or tagout devices to energy isolating devices, relieve, disconnect, restrain, or otherwise make safe all potentially hazardous stored or residual energy.

b. If stored energy can reaccumulate to a hazardous level, continue to verify isolation until the employee completes servicing or maintenance, or until the possibility of such accumulation no longer exists.

15.3.6 Verification of Isolation. Before starting work on locked out or tagged out machines or equipment, the authorized person must verify completion of machine or equipment isolation and deenergization.

15.4 Release From Lockout or Tagout

Before removing lockout or tagout devices and restoring energy to the machine or equipment. Authorized employees must follow procedures and take actions to ensure the following:

15.4.1 The Machine or Equipment. Inspect the work area to ensure that nonessential items have been removed and to ensure that machine or equipment components are operationally intact.

15.4.2 Personnel

a. Check the work area to ensure that all employees have been safely positioned or removed.

b. Before removing lockout or tagout devices and before energizing machines or equipment, notify affected employees.

c. After removing lockout or tagout devices and before energizing machines or equipment, notify affected employees.

15.4.3 Lockout or Tagout Device Removal. The employee who affixed each lockout or tagout device must remove it from each energy isolating device. The responsible official may grant an exception when that employee is not available to remove it. Then, the responsible official may remove the device, provided that specific procedures and training for such removal have been developed, documented, and incorporated into the employer's energy control program. The responsible official must demonstrate that the specific procedure includes at least the following elements:

a. Verification by the responsible official that the authorized employee who applied the device is not at the facility.

b. Making all reasonable efforts to inform the authorized employee that his/her lockout or tagout device has been removed.

c. Ensuring that the authorized employee has this knowledge before he/she resumes work at the facility.

15.5 Requirements of Operating Equipment Under Clearance

15.5.1 Testing or Positioning of Machines, Equipment or Components. If you must temporarily remove lockout or tagout devices from the energy isolating device and energize the machine or equipment to test or position the machine, equipment, or component, follow the following sequence of actions:

a. Clear the machine or equipment of tools and materials, referring to the subsection on release from lockout or tagout.

b. Remove personnel from the machine or equipment area, using the subsection on personnel. Be thoroughly familiar with the requirements of this section "Control of Hazardous Energy."

c. Remove the lockout or tagout devices referring to the subsection on lockout or tagout device removal.

d. Energize and proceed with testing or positioning.

e. Deenergize all systems and reapply energy control measures using procedures in this section to continue the servicing or maintenance.

15.5.2 Group Lockout or Tagout

a. When a crew, craft, department, or other group of employees performs servicing or maintenance, they must use a procedure that provides the same level of protection as a personal lockout or tagout device.

b. Use group lockout or tagout devices in accordance with the procedures required by this section and FIST Volume 1-1 including, but not necessarily limited to, the following specific requirements:

1. The primary authorized employee has the primary responsibility for the employees working under the protection of a group lockout or tagout device, and for the device itself. The primary authorized employee must determine the exposure status of individual group members with regard to the lockout or tagout of the system.

2. When using group lockout, each authorized employee must affix a personal lockout device to a group lockbox, or comparable mechanism before beginning work and must remove these devices when finished with their portion of the work.

3. When more than one crew, craft, or department, is involved, the written procedure must prescribe the assignment of overall job-associated lockout or tagout control responsibility.

15.5.3 Shift or Crew Changes. Use specific procedures during shift or crew changes to ensure the continuity of group lockout or tagout protection. The program must describe a procedure to allow for information exchange to ensure the continuity of protection between off going and oncoming personnel. The primary authorized employee accepting the transfer must physically verify the lockout points.

15.6 Requirements for Outside Personnel (Contractors, etc.)

a. Whenever a contractor or non-agency organization is involved in construction, maintenance, or testing on or near equipment in a Reclamation facility or transmission line, a special work permit is required to authorize the contractor to proceed with the work.

b. Properly qualified and authorized Reclamation representatives must request the clearances or hot line orders, perform the required switching, receive the clearances or hot line orders, and issue the special work permit.

c. Contractor personnel performing work at Reclamation-operated or maintained facilities must comply with all existing Hazardous Energy Control procedures of the facility and Reclamation's Hazardous Energy Control Program.

Section 16

Fall Protection and Rope-Access Work

16.1 Fall Protection

A personal fall fall protection system must be in place to protect employees who work on slopes steeper than 1½:1 (horizontal:vertical), who work on unstable footing, or who could fall from heights greater than 4 feet (ft) for general industry and 6 ft for construction activities (if not protected by fixed scaffolding, guardrails, or safety nets). The fall protection system must meet the requirements of this section. However, these requirements do not apply to rope supported work (high angle work) such as high scaling, geologic mapping, structural inspections, or other operations that require specialized rope equipment or techniques. Refer to Subsection 16.2, "Rope-Access Safety Requirements."

16.1.1 Hierarchy of Controls. Appropriate control measures will be implemented through the hierarchy of controls (i.e., eliminate, substitute, engineering controls, warnings, administrative controls, and personal protective equipment [PPE]) to reduce the hazard of falls to an acceptable level of risk. The use of fall protection PPE in this section will be considered only if the other controls described above are unavailable or infeasible.

16.1.2 Hardware. Connectors must be drop forged, pressed, or formed steel or equivalent materials. Connectors must have a corrosion-resistant finish, and edges must be smooth to prevent damage to interfacing parts of the system. D-rings, O-rings, snap-hooks, and carabiners must be able to sustain a minimum tensile load of 5,000 pounds (lb) (22.2 kilonewton [kN]). Snaphooks and carabiners must be self-closing, self-locking, and capable of being opened only by two or more consecutive, deliberate actions. Only snaphooks and carabiners meeting a gate strength of 3,600 lb (16 kN) in all directions, per American National Standards Institute/American Society of Safety Engineers (ANSI/ASSE) Z359, “Fall Protection Code,” will be used.

16.1.3 Full Body Harness. Only full body harnesses that have a label specifying that they meet the requirements of ANSI/ASSE Z359 are acceptable. Full body harnesses labeled to meet the requirements of the ANSI A10.14 will not be used. Load bearing straps will have a minimum width of 1-5/8 inches (41 millimeters [mm]) and develop a breaking strength of not less than 5,000 lb (22.2 kN).

a. Personal Fall Arrest Systems. Personal fall arrest systems require the use of a full body harness. The use of body belts is not acceptable.

b. Attachment Point. The fall arrest attachment point on the full body harness will be integrally attached and located at the wearer's upper back, between the shoulder blades (dorsal D-ring). A frontal D-ring attachment point integrally attached to the wearer's front full body harness and located at the sternum can be used for fall arrest (i.e., used with a ladder climbing device) as long as the free fall distance does not exceed 2 ft (0.61 meter [m]), and the maximum arresting force does not exceed 900 lb (4 kN).

c. Suspension Trauma Prevention. All full body harnesses will be equipped with suspension trauma preventers such as stirrups, relief steps, or similar components to provide short-term relief from the effects of orthostatic intolerance.

Note: Existing full body harnesses that are capable of being retrofitted with suspension trauma prevention components must be so modified by January 2014 or be replaced with equipment meeting paragraph c. above.

16.1.4 Lanyards and Lifelines. Lanyards and vertical lifelines that tie off one employee must have a minimum breaking strength of 5,000 lb (22.2 kN). Self-retracting lifelines and lanyards that automatically limit free fall distance to 2 ft (0.61 m) or less must have components that can sustain a minimum static load of 3,000 lb (13.3 kN) applied to the device, with the lifeline or lanyard fully extended. Self-retracting lifelines and lanyards that do not limit free fall distance to 2 ft (0.61 m) or less, ripstitch lanyards, and tearing and deforming lanyards must be able to sustain a minimum tensile load of 5,000 lb (22.2 kN), applied to the device with the lifeline or lanyard fully extended. A qualified person must design, install, and supervise the use of horizontal lifelines as part of a complete personal fall arrest system that maintains a safety factor of at least two. Restraint lines must be able to sustain a tensile load of at least 3,000 lb (13.3 kN). Lifelines and carriers must not be made of natural fiber rope.

16.1.5 Anchorages. Anchorages must be able to support at least 5,000 lb (22.2 kN) per employee attached, or must be designed, installed, and used under the supervision of a qualified person as part of a complete fall protection system that maintains a safety factor of at least two.

a. Rebar. Anchorages will not be made from drill steel or reinforcing bar.

b. Mobile Anchorages. Anchorages must not be made to mobile equipment or other items that can move while the anchorage is in use.

c. De-Energized Conductors and Insulators. De-energized conductors, insulators, and nonstructural components in switchyards, on transformers, circuit breakers, or other components will not be used as anchorage points.

16.1.6 Procedures. Use personal fall protection systems and their components only for employee fall protection. Inspect lifelines, lanyards, belts, hardware, and anchorages at the beginning of each day and discard questionable devices. Use and care for fiber lifelines and lanyards will be according to manufacturer's instructions, recommendations contained in the Rigging Manual (referenced in Subsection 18.1, "General Requirements"), and the procedures stated within this Section, whichever is more protective.

a. Lifelines. Provide each employee with a separate lifeline when using vertical lifelines.

b. Rescue. Make provisions to promptly rescue employees who fall or provide the means for self-rescue.

c. Protection. Protect lifelines from being cut, abraded, or damaged in any way.

d. Maintenance, Inspection, Testing. All personal fall protection systems must follow the manufacturers' recommendations for maintenance, inspection, and testing.

e. Training. Before using fall protection equipment, each worker who might be exposed to fall hazards from heights must be trained by a competent person who is qualified to deliver fall protection training to the workers. Such training will include the recognition of fall hazards; the application limits of the equipment; proper hookup, anchoring, and tie-off techniques; methods of use; proper methods of equipment inspection and storage; and use of rescue equipment and rescue procedures.

16.1.7 Personal Fall Arrest System. A fall arrest system for an employee who may fall from a working level will consist of an anchorage, connectors, and a body harness. The system may also include a lanyard, deceleration device, lifeline, or a suitable combination of these.

a. Performance Criteria. Personal fall arrest systems must have a label specifying that they meet the appropriate ANSI/ASSE Z359 standard.

b. Use. Rig personal fall arrest systems to prevent an employee from falling more than 6 ft (1.83 m) or contacting any lower level. Employees must wear a personal fall arrest system with the attachment point of the body harness in the center of the back, near the shoulder blades. When connected to a horizontal lifeline that could become vertical, connectors must be able to lock in either direction on the lifeline.

c. Maintenance. Maintenance is a critical element in personal fall arrest systems. Follow manufacturer's recommendations. At least one competent employee must be available to inspect and maintain personal fall arrest systems.

d. Annual Inspection. At least once a year, a competent person will inspect and document all fall arrest systems and components for wear, damage, or deterioration in accordance with the manufacturer's instructions.

e. Impact Loading. When a personal fall arrest system has been subjected to shock loading, immediately remove it from service until a competent person inspects it and determines that it is suitable for reuse.

16.1.8 Positioning Device System. Positioning device systems include equipment or hardware that, when used with its body belt or body harness, supports an employee on an elevated vertical surface (such as a wall or a rebar mat) and allows both hands freedom of movement. Positioning device systems also include devices attached between the employee and an anchorage to prevent an accidental fall from an elevated surface.

a. Performance Criteria. Positioning device systems must withstand, without failure, a 4-ft (1.22-m) drop of a 250-lb (113 kilogram [kg]) weight.

b. Performance Test. Positioning device systems comply with these requirements if they meet the test contained in 29 Code of Federal Regulations [CFR] 1926, subpart M, appendix D. Restraint line systems must be designed to meet the same test requirements as other positioning device systems.

16.1.9 Personal Fall Protection System for Ladder Climbing. Employees will wear, or must be attached to, personal fall protection systems to prevent injuries and falls when climbing a fixed ladder without a cage over 24 ft (7.32 m).

a. Design Criteria for System Components. The system must permit an employee to ascend or descend with both hands free for climbing, without having to hold, push, or pull any part of the system. The connection between the carrier or lifeline and the point of attachment to the body belt or harness must be no more than 9 inches (23 centimeters long. The system must activate within 2 ft (0.61 m) after a fall.

b. Performance Criteria. Ladder safety devices and their support systems must withstand, without failure, an 18-inch (0.46-m) drop of a 500-lb (226-kg) weight. All other personal fall protection systems for climbing activities must withstand, without failure, a 4-ft (1.22-m) drop of a 250-lb (113-kg) weight.

c. Installation. Attach mountings for rigid carriers at each end of the carrier. Attach intermediate mounting, as necessary, spaced along the entire length of the carrier to provide the strength necessary to stop employee falls. Attach mounting for flexible carriers at each end of the carrier. When the system is exposed to wind, install cable guides used with a flexible carrier that has a minimum spacing of 25 ft (7.6 m) and a maximum spacing of 40 ft (12.2 m) along the entire length of the carrier to prevent wind damage to the system. The design and installation of mountings and cable guides must not reduce the design strength of the ladder.

16.1.10 Requirements for Linemen's Harnesses and Lifelines

a. Lineman's Equipment (Arc Rated Harnesses). The full body harness used around high voltage equipment or structures will be an industry designed "linemen's arc rated harness" that will resist arc flashing and will have either straps or plastic coated D-rings and positioning side D-rings in lieu of exposed metal D-rings and exposed metal positioning side D-rings. All other exposed metal parts of the linemen's harness will also be plastic coated (i.e., buckles and adjusters).

b. Nonconductive Rope Lifelines. Nonconductive rope lifelines must have a minimum breaking strength of 5,000 lb (22.2 kN) and be able to withstand an alternating current dielectric test of at least 25,000 volts per foot "dry" for 3 minutes without visible deterioration.

16.2 Rope-Access Safety Requirements

The requirements in this subsection apply when an employee performs rope-access work on high-angle slopes or vertical environments where the rope is the primary means of support, and where the employee must manipulate the rope and its attachments while using industrial rope-access techniques to obtain access to the work area. These situations include such work as high scaling, geologic mapping, rock bolting, structural inspections, construction, operations, and maintenance activities. Permit rope-access work only when other means of access are not feasible or when methods other than rope-access work expose employees to greater danger.

16.2.1 Support System. Use two ropes for the support system: (1) a primary working (load) line, and (2) a separate and independently anchored safety (backup) line. The safety must be either self-controlled or controlled by another rope-access employee (attended belay). The standard working line and safety line (backup) must be ropes that meet the minimum strength requirements of this subsection. A safety line may be used alone, if feasible, for jobs where the work surface provides the primary support. When not using an attended belay, use a deceleration device to limit fall forces to less than 1,800 lb (8 kN). The maximum free fall distance must not exceed 6 ft (1.83 m).

16.2.2 Equipment. Use equipment designed for industrial rope-access use. Equipment components must be compatible to ensure proper loading and operation of the support system. Equipment strengths must be certified, listed as meeting, or proven by testing to meet the requirements of ANSI/ASSE Z359 series, the European Union (designated by the "CE" marking), Union Internationale des Associations d'Alpinisme (UIAA), or another recognized certification organization. Knots, friction devices, ascenders, and other hardware will decrease the overall strength of the rope support system. Before use, evaluate the complete support system, with all of its parts, for adequacy.

16.2.3 Anchorage. Use at least two independent anchor points to create two independent anchorage systems: one for the working (primary) line, and one for the safety (backup) line. Each anchorage system must be able to support at least a 5,000-lb (22.2-kN) static load. Failure of one anchor point will not allow for catastrophic failure of either anchorage system. If possible, locate anchors in line with the direction of rope pull; otherwise, take steps to limit the rope extension if one anchor fails. Except in a rescue situation, each set of anchorage systems will only be used by one employee. The anchorage systems will not be used by any auxiliary equipment that may impair the integrity of the anchor. Directional anchors are anchors used to laterally position rope-access personnel who are supported by two anchors that meet the requirements of this paragraph. Directional anchors do not take the place of the main support anchors.

16.2.4 Rope. Working and safety ropes must be synthetic fiber ropes that are specifically designed for rope-access or rescue applications. In addition, they must be capable of supporting a 5,000-lb (22.2-kN) static load without failure. Ropes must be of kernmantle construction with a minimum diameter of 3/8 inch (10 mm). All equipment used with these ropes must be designed by the manufacturer for the diameter of rope used.

16.2.5 Hardware. All connecting hardware used in the support system must be capable of supporting a 5,000-lb (22.2-kN) static load without failure. Use only locking carabiners in the support system, or substitute locking shackles or rated screw links for locking carabiners in anchor and personnel connections.

16.2.6 Body Harnesses. Use only full body harnesses that distribute fall arrest forces over at least the upper thighs, pelvis, waist, chest, and shoulders. Harness connections must be designed for work positioning and fall arrests and be capable of supporting a 5,000-lb (22.2-kN) static load without failure. Separate waist and chest harnesses are permitted if they are designed to be buckled together.

16.2.7 Rope and Equipment Inspection. Thoroughly inspect and document all rope and equipment periodically based on the frequency of use. Visually inspect all ropes and equipment before and after every use. The employee who performs the inspection must use the manufacturer's recommended procedures for inspection and know the critical inspection points of each piece of equipment. Maintain a rope log for each rope.

16.2.8 Equipment Retirement. If any equipment used for rope-access work is subjected to severe impact or shock loading, immediately remove it from service. Do not use it for employee protection until it has been inspected and determined suitable for reuse. The employee who inspects the equipment must be knowledgeable about equipment specifications. Remove from service any equipment that exceeds manufacturer's recommended wear or shows other defects. Unless expressly stated otherwise by the manufacturer, automatically retire ropes, webbing, accessory cord, and harnesses from service after 5 years, regardless of condition or use history.

16.2.9 Training. Train employees about the equipment and techniques used for rope-access work before assigning them to a job where rope access is required. The training must cover rope-access safety and hazards; the use, limitations, inspection, and maintenance of equipment; and rope-access and self- and team-rescue techniques. A rope-access worker must complete a minimum of 32 hours of rope-access training (e.g., SPRAT or IRATA Level 1) prior to working on ropes.

Beginning rope-access workers will continue on-the-job training under close supervision following completion of basic training. Before starting any job, provide refresher practice or developmental training, as needed. Document all training.

16.2.10 Site Supervision. Each rope-access jobsite will have a supervisor who has sufficient knowledge and experience in the type of work to be performed, ability to analyze and plan rope-access jobs to be safe and efficient, ability to design and implement rescue in all situations, ability to write a Job Hazard Analysis (JHA), and ability to verify the rope-access personnel's experience and physical qualifications. Persons who have been independently certified to SPRAT or IRATA Level 2 or 3 meet these requirements.

16.2.11 Physicals. Rope-access personnel must successfully complete a medical examination annually and be cleared to perform rope-access work.

16.2.12 Rope-Access Team. A rope-access team consists of at least two trained personnel onsite who meet the above requirements, one of which may be a supervisor (as defined above). A third person will remain at the top to ensure that the anchorages remain secure and undisturbed, keep additional personnel away, and help respond to emergencies.

16.2.13 Communications. Maintain reliable voice communications between onsite employees. If distance or background noise interferes with voice communications, use two-way radios.

16.2.14 Rescue. Before starting rope-access work, make arrangements for rescue. Arrangements for rescue include self-rescue, rescue using onsite personnel, and/or rescue requiring offsite personnel.

16.2.15 Job Planning. Before starting a job that requires rope-access work, submit a JHA that is compliant with Subsection 4.2, "Requirements for Job Hazard Analysis," to the Contracting Officer's Representative or the appropriate office head. The JHA must address, at a minimum, the following additional items:

a. Emergency procedures, including medical assistance.

b. PPE required, including hand, eye, and head protection. Helmets with a chin strap must be designed for industrial rope-access work.

c. Descriptions of the equipment to be used for rope-access work. For example, type and sizes of rope to be used, hardware, types of anchorages, communications equipment, and auxiliary equipment.

d. Descriptions of the rope and hardware inspection process before using such equipment.

e. Methods for ensuring safe entrance and exit from the worksite. f. Procedures for protecting employees and the public from falling material.

g. Provisions for rescue, including both rescue by onsite personnel and/or arrangements for rescue services by offsite personnel.

Section 17

Hand Tools, Power Tools, Pressure Vessels, Compressors, and Welding

This section sets forth the requirements for using hand tools, pressure vessels, compressors, and for welding. It specifically addresses hand and power tools; pneumatic tools; airless spray guns; grinding tools; woodworking tools; power saws; hydraulic-powered tools; powder-actuated tools; hand-powered winches and hoists; lever and ratchet, screw, and hydraulic jacks; boilers and unfired pressure vessels; compressors; compressed gas cylinders; gas welding and cutting; arc welding and cutting; and inert gas metal-arc welding.

17.1 General Requirements for Hand and Power Tools

17.1.1 Maintenance. Maintain hand tools, power tools, and jacks in safe operating condition. Immediately remove damaged and defective tools from service and repair or replace them.

17.1.2 Proper Use. Use tools only for their designed purpose. Do not use electrical cords, air hoses, and hydraulic hoses to raise or lower tools.

17.1.3 Storage. Do not leave tools on scaffolds or elevated work spaces. Provide containers on the jobsite for hand tools.

17.1.4 Guarding. If a tool accommodates guards, operate the tool with the guards in place. Safeguard moving part hazards as set forth in the current edition of the American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME) B15.1, "Safety Standard for Mechanical Power Transmission Apparatus."

17.1.5 Point of Operation Guarding. Point of operation is the area on a machine where work is actually performed. Provide guards at the point of operation on machines that expose the operator to injury. The guards must meet all applicable specific standards. If no standards exist, the guards must prevent the operator from having any body part in the danger zone during the operating cycle.

17.1.6 Grounding. Double insulate or effectively ground electric tools.

17.1.7 Switches. On-off switches controlling the operation of hand-held power tools must conform to the following requirements:

a. Equip hand-held power platen sanders, grinders with 2-inch or less diameter wheels, routers, planers, laminate trimmers, nibblers, shears, scroll saws, jigsaws with blade shanks 0.25 inch wide or less, concrete vibrators, and power tampers with only positive on-off switch.

b. Equip hand-held power drills, tappers, fastener drivers, horizontal, vertical, and angle grinders with wheels more than 2 inches in diameter, disk sanders, belt sanders, reciprocating saws, and similar tools with a momentary contact "on-off" control. These may have a lock-on control if the operator can shut off the power with a single motion of the same finger or fingers that turn it on and if the switch is adequately guarded to prevent accidental operation.

c. Equip jackhammers and similar pneumatic-powered hand tools and other hand-held power tools, including chain saws, circular saws, and percussion tools, with a constant pressure switch that shuts off power when pressure is released.

17.1.8 Personal Protective Equipment. Provide hand tool and power tool operators with personal protective equipment and ensure its use as set forth in the section on "Personal Protective Equipment." Original equipment guards or manufactured guards must be used on all grinders, drills, lathes, sanders, and other equipment to prevent injury to the operator.

17.1.9 Anchoring Fixed Machinery. Securely anchor machines designated for fixed locations to prevent movement.

17.1.10 Hazardous Conditions. Use only nonsparking or intrinsically safe tools where sources of ignition may cause an explosion or fire. Do not use gasoline-powered tools underground, in buildings, or in partially enclosed locations where toxic exhaust gases can accumulate. Place gasoline powered portable compressors, generators, and pressure washers outdoors and away from air intakes to prevent drawing engine exhaust indoors.

17.2 Requirements for Pneumatic Tools

17.2.1 Impact Tools. Operate pneumatic impact tools with safety clips or retainers installed to prevent accidental discharge from the chuck.

17.2.2 Air Hoses. For air lines more than one-half inch inside diameter, provide whip-check devices attached to the hose at each connection or splice. As a substitute, provide a safety device at the source of supply or branch line that will automatically reduce pressure in case of a line failure if the device effectively prevents whipping.

17.2.3 Operating Pressures. Do not exceed the manufacturer's safe operating pressure for hoses, pipes, valves, and fittings. Remove defective hoses, valves, and fittings from service.

17.2.4 Compressed Air Used for Cleaning. Never direct compressed air at any part of the body. Use compressed air for cleaning purposes only if the pressure is less than 30 pounds per square inch, and then only with effective chip guarding and personal protective equipment. The 30-pound-per-square-inch requirement does not apply to sandblasting, green cutting, removing mill scale, cleaning concrete forms, and similar cleaning operations.

17.2.5 Care of Air Hoses. Protect pneumatic hoses from physical damage while they are in use and in storage.

17.2.6 Nailers and Staplers. Pneumatic nailers, staplers, and similar equipment with an automatic fastener feed that operates at more than 100 pounds per square inch must have a single-action trigger and a safety device on the muzzle to prevent the ejection of the fasteners unless the muzzle is in contact with the work surface.

17.3 Requirements for Airless Spray Guns

17.3.1 Airless Spray Guns. Equip airless spray guns that atomize fluids at pressures of 1,000 pounds per square inch or greater with one of the following safety systems to prevent accidental fluid injection into the operator.

a. Automatic or Visible Manual Safety Device. The safety device must prevent pulling of the trigger to release the paint or fluid until the operator manually releases the safety device.

b. Diffuser Nut and Nozzle Guard. The diffuser nut must prevent high-pressure high-velocity release when the nozzle tip is removed. The nozzle tip guard must prevent the tip from contacting the operator.

c. Other Equivalent Protection. Any system that provides an equivalent level of protection as above is acceptable.

17.4 Requirements for Using Grinding Tools

17.4.1 General. Installing, guarding, using, and caring for grinding tools must comply with the standards set forth in the current standard ANSI B7.1, "The Use, Care and Protection of Abrasive Wheels" and manufacturer's instructions. Use grinding tools only if the safety guards and protective flanges are installed and properly adjusted.

17.4.2 Power Supply. Supply all grinding machines with sufficient power to maintain the spindle speed at safe levels under all conditions of normal operation.

17.4.3 Guarding. Safety guards must cover the spindle end, nut, and flange projections. Mount guards to maintain proper alignment with the wheel. Where the work provides a suitable measure of protection to the worker, the safety guards may expose the spindle end, nut, and outer flange. Where the work entirely covers the side of the wheel, the side covers of the guard may be omitted. The spindle end, nut, and outer flange may be exposed on portable saws.

17.4.4 Abrasive Wheels. Do not operate abrasive wheels faster than their rated safe speed. Inspect wheels according to manufacturer's instructions before mounting and, periodically, to ensure the abrasive wheel is not cracked or otherwise defective. Remove cracked or defective abrasive wheels from service immediately and destroy them.

17.4.5 Grinding Wheels. Grinding wheels must fit freely on the spindle. Do not force them on. Tighten the spindle nut only enough to hold the wheel in place.

17.4.6 Bench and Pedestal Grinders. Provide bench-mounted and pedestal grinders with safety guards that are strong enough to withstand the effect of a bursting wheel. The guard must not expose more than 90 degrees of the grinding wheel periphery and sides. However, if the work must contact the wheel below the horizontal plane of the spindle, the angular exposure must not exceed 125 degrees. The guard must have a readily adjustable toolrest that is maintained within one-eighth inch of the wheel and an adjustable tongue maintained within one-fourth inch of the periphery of the wheel to prevent injury to the operator by containing the wheel failure inside the housing.

17.4.7 Cup-Shaped Wheels. Protect cup-shaped wheels used for external grinding by either a revolving cup guard or a band guard.

17.4.8 Special Conditions

a. Safety Flanges. Use a wheel equipped with safety flanges when work location prevents the use of guarding. Use only safety flanges with wheels designed to fit the flanges. Use only safety flanges of a type and design and properly assembled so as to ensure that the pieces of the wheel will be retained in case of accidental breakage.

b. Small Diameter Wheels. Wheels 2 inches or less in diameter that are securely mounted on the end of a steel mandrel do not require guards.

c. Internal Grinding. Guarding is not required if a grinding wheel is entirely within the work being ground while in use.

17.4.9 Side Grinding. Do not permit side grinding unless the abrasive wheel is specifically designed for this purpose.

17.5 Requirements for Woodworking Tools

17.5.1 Requirement. Installing, guarding, using, and caring for power-operated woodworking tools must comply with the standards set forth in 29 CFR Part 1910.213, "Woodworking Machinery Requirements."

17.5.2 Switches. Locate switches so the operator is able to shut off the power without leaving the operating position. Provide fixed power-driven tools with a disconnect switch that can be locked in the off position.

17.5.3 Automatic Feed. Whenever the nature of the work permits, install automatic feeding devices on fixed, power-driven woodworking tools. Feeder attachments must have the feed rolls and other moving parts guarded to protect the operator.

17.5.4 Electrical Equipment. When automatic restarting would create a hazard, control electrically driven equipment with a device to prevent automatic restarting following a power failure.

17.5.5 Push Sticks. Use a push stick, block, or similar safe means for all operations close to high-speed cutting edges.

17.5.6 Combs. Provide combs (featherboards) or suitable jigs when standard guards cannot be used.

17.5.7 Planers and Joiners. Equip planers and joiners with cylindrical cutting heads and fully guard them.

17.5.8 Cleanup. Keep work areas clean. Provide a brush or vacuum system near each machine to remove sawdust, chips, and shavings.

17.5.9 Portable Belt Sanding Machines. Provide belt sanding machines with guards at each nip point where the sanding belt runs onto a roller. These guards must prevent the operator’s hands or fingers from coming in contact with the nip points. Guard the unused run of the sanding belt against accidental contact.

17.6 Requirements for Power Saws

17.6.1 Circular Saws. Equip bench saws with spreaders, anti-kickback devices, and guards that automatically enclose the exposed cutting edges. Equip portable hand-held circular saws with guards above and below the baseplate or shoe. The upper guard must cover the saw to the depth of the teeth, except for the minimum arc required to permit tilting the base for bevel cuts. The lower guard must cover the saw to the depth of the teeth, except for the minimum arc required to allow proper retraction and contact with the work. As the blade is withdrawn, the lower guard must automatically and instantly return to the covering position.

17.6.2 Operating Speeds. Permanently mark the operating speed on all circular saws that are more than 20 inches in diameter or that operate at speeds of more than 10,000 peripheral feet per minute. Use only blades designed for use at the marked operating speed. When the saw is retensioned for a different speed, change the marking to indicate the new speed.

17.6.3 Radial Arm Saws. Equip radial arm saws and swing cutoff saws with: (1) limit stops that prevent the leading edge of the blade from traveling beyond the edge of the table, (2) hoods or guards that protect the operator from flying material, direct the sawdust toward the back of the blade, and enclose all parts of the blade not in contact with the material being cut, and (3) automatic brakes or automatic return devices. Install nonkickback fingers or dogs and a spreader when ripping.

17.6.4 Bandsaws. Fully enclose bandsaw blades except at the point of operation. Adjust the adjustable guide within one-half inch of the work.

17.6.5 Unattended. Never leave running power saws unattended.

17.6.6 Sawdust Collectors. Equip bench-type circular saws and radial saws used for production work with sawdust collectors.

17.6.7 Cleanup. Clean up scrap and sawdust. Clean up the shop area as needed to maintain safe working conditions and at the end of each shift.

17.6.8 Defective Blades. Remove cracked, bent, or otherwise defective blades from service and destroy them.

17.7 Requirements for Hydraulic-Powered Tools

17.7.1 Safe Operating Pressures. Adhere to the manufacturer's safe operating pressure for hoses, valves, pipes, filters, and fittings.

17.7.2 Hydraulic Fluid. Ensure fluid in hydraulic-powered tools is fire resistant and approved by a nationally recognized testing laboratory.

17.7.3 Stationary Hydraulic-Powered Presses. Presses must have guards that adequately contain flying particles forcibly expelled from the compressed material.

17.8 Requirements for Powder-Actuated Tools

Design, maintain, and use powder-actuated tools in accordance with the standards set forth in the current edition of ANSI A10.3, "Safety Requirements for Powder-Actuated Fastening Systems"; the tool manufacturer’s instructions; and the requirements of this subsection. These standards cover three types of tools: high velocity, low-velocity piston, and hammer-operated piston—low-velocity.

17.8.1 Operator Qualification. Allow only employees trained and certified in the safe use of powder-actuated tools to operate and service them. Operators must possess an operator's card issued by a firm or person authorized to issue such cards.

17.8.2 Unauthorized Use. Take safeguards to prevent unauthorized persons from possessing or using these tools and their charges.

17.8.3 Flammable Atmospheres. Do not use powder-actuated tools in explosive or flammable atmospheres.

17.8.4 Studs and Fasteners. Use only the powder charges, studs, or fasteners specified by the manufacturer for the specified tool.

17.8.5 Safety Features

a. All Tools. All powder-actuated tools must have the following safety features:

1. The firing mechanism design must prevent the tool from firing during loading or preparation to fire or if it is dropped while loaded.

2. Firing of the tool must depend on at least two separate and distinct operations of the operator. The final firing movement must be separate from the movement to bring the tool into the firing position.

3. The tool design must allow all breeching parts to be reasonably visible to allow a check for any foreign matter that may be present.

4. The tool design must allow the operator to select a power level adequate to perform the desired work without excessive force.

b. High-Velocity Tools. High-velocity tools must have the following features in addition to the common features listed above.

1. The muzzle end of the tool must have a protective shield or guard at least

3-½ inches in diameter, mounted perpendicular to and concentric with the barrel, and designed to confine any flying fragments or particles that might otherwise create a hazard at the time of firing.

2. The tool design must not allow firing unless the guarding or shielding device is in place.

3. The tool design must not allow operation unless the operator is holding the tool against the work surface with a force at least 5 pounds greater than the total weight of the tool.

4. The tool design must not allow operation when equipped with the standard guard indexed to the center position if any bearing surface of the guard is tilted more than 8 degrees from contact with the work surface.

c. Low-Velocity Piston. Low-velocity-piston tools must have the following features in addition to the common features listed in the subparagraph on safety features.

1. The muzzle end of the tool design must allow mounting, perpendicular to the barrel, suitable protective shields, guards, jigs, or fixtures, designed and built by the manufacturer. Supply a standard spall shield with each tool. Choose and use the proper shields, guards, jigs or fixtures in accordance with the manufacturer's instructions.

2. The tool design must not allow operation unless the operator is holding the tool against the work surface with a force at least 5 pounds greater than the total weight of the tool.

d. Hammer-Operated Piston Tools - Low Velocity. In addition to the common safety features, hammer operated tools must have suitable protective shields, guards, jigs, or fixtures, designed and built by the tool manufacturer, that can be mounted perpendicular to the barrel. Supply a standard spall shield with each tool. Choose and use the proper shields, guards, jigs, or fixtures according to the manufacturer's instructions.

17.8.6 Materials. Drive fasteners into soft or easily penetrated material only if the material is backed to prevent complete penetration. Do not use tools on very hard or brittle materials such as cast iron, glazed tile, surface-hardened steel, glass block, live rock, face brick, or hollow tile. Never drive a fastener into a spalled area caused by an unsatisfactory fastening.

17.8.7 Safe Use. Load tools just before firing. Always attend loaded tools. Never point a tool at anyone. Keep all body parts clear of the muzzle.

17.8.8 Inspection and Testing. Inspect and test tools each day before loading to ensure that the safety devices are in proper working order. Conduct the inspection in accordance with the manufacturer's recommended inspection procedures.

17.8.9 High-Velocity Tools. Use high-velocity tools only for those applications in which low-velocity tools will not meet the job requirements.

17.9 Requirements for Hand-Powered Winches and Hoists

17.9.1. Use hand-powered winches and hoists within the manufacturer's rated capacity, and legibly mark the capacity on the winch or hoist. Hand-powered hoists must have worm gear drives or with positive self-locking dogs. Handwheels must not have projecting spokes or knobs.

17.9.2 Legibly mark the manufacturer's rated capacity on all come-alongs. Do not exceed the rated capacity. Remove come-alongs from service when they have worn or kinked cables or links, deformed hooks, or defective ratcheting devices. Take care not to overstress structures or structure supporting systems when using come-alongs for leveling, plumbing, or positioning structures.

17.10 Requirements for Lever and Ratchet, Screw, and Hydraulic Jacks

17.10.1 Capacity. Legibly mark the manufacturer's rated capacity on all jacks. Do not exceed the rated capacity.

17.10.2 Overtravel. Jacks of any type must have a positive stop to prevent overtravel.

17.10.3 Footing and Blocking. Set jacks on a stable and firm footing, and crib or block where necessary to prevent settlement or dislodgement. If slippage is possible, place a wood block between the jack and the load.

17.10.4 Operation. After a load has been raised, crib, block, or otherwise secure it at once.

17.10.5 Maintenance. Properly lubricate all jacks at regular intervals. Supply adequate antifreeze liquid to hydraulic jacks exposed to freezing temperatures. Examine for possible defects and repair or replace defective parts as necessary.

17.10.6 Inspection. Thoroughly inspect jacks periodically, depending on how they are used. Inspect jacks according to the manufacturer’s instructions, but no less frequently than the following:

a. For constant or intermittent use at one locality, once every 6 months.

b. For jacks sent out of shop for special work, when sent out and when returned.

c. Before returning to service after a jack is subjected to abnormal loads.

17.11 Requirements for Hand Tools

Hand tools must be inspected periodically, maintained in a safe condition, and replaced and removed from service when worn, defective, broken, or cracked.

17.11.1 Wrenches. Do not use wrenches, including adjustable, pipe, and socket wrenches, when jaws are sprung to the point that slipping occurs.

17.11.2 Wood Handles. Keep the wooden handles of tools free of splinters or cracks, and keep tool handles tight.

17.11.3 Impact Tools. Keep impact tools, including drift pins, wedges, and chisels, in a dressed condition or equipped with nonmushrooming heads.

17.12 General Requirements for Boilers and Unfired Pressure Vessels

17.12.1 Applicable Codes and Regulations. Design, construct, install, test, and maintain boilers and unfired pressure vessels according to all of the following:

The current ASME "Boiler and Pressure Vessel Code"
The current National Board Inspection Code, ANSI/NB 23
The current codes or regulations of the State

17.12.2 Inspection and Testing. Inspect and test boilers and unfired pressure vessels before placing them in service and after any alteration or major repair. Perform subsequent inspections within 24 months for the first inspection, followed by inspections no more than 60 months apart (providing deterioration is shown to be low and at a predictable rate). When any part of a vessel rapidly deteriorates, the interval between inspection and testing must be according to the National Board Inspection Code or every 24 months, whichever is less. Make hydrostatic or State acceptable tests when the qualified person performing the inspection recommends them.

17.12.3 Inspector Qualifications. To perform inspections, use qualified personnel who meet Federal or State certification requirements or personnel who satisfy the "Owner-User Inspector" education and experience of the National Board Inspection Code, issued by the National Board of Boiler and Pressure Vessel Inspectors.

17.12.4 Posting Reports. Post a copy of the inspector's approval or certification reports near or on the boiler or unfired pressure vessel.

17.13 Requirements for Unfired Pressure Vessels

17.13.1 Installation. Install pressure vessels so that all drains, handholes, and manholes are easily accessible. Do not bury them underground or locate them in inaccessible places. Locate pressure vessels used to store compressed air in a cool place to facilitate condensation of moisture and oil vapors.

17.13.2 Drain Valves. Install a readily accessible drain valve on the lowest point of every air receiver to remove accumulations of oil and water. Operate the valve as recommended by the manufacturer or as determined by experience to remove accumulations of oil and water.

17.13.3 Piping. Install piping with traps or other effective means of removing liquid from the lines. Properly design and install air discharge piping to eliminate possible oil pockets.

17.13.4 Stop Valves. Install a stop valve between the receiver and each piece of stationary utilization equipment and also at each outlet to which an airhose may be attached.

17.13.5 Hose Connections. Hose connections must withstand the pressure and service to which they are subjected.

17.13.6 Safety Relief Valves. Equip each pressure vessel with a readily visible indicating pressure gauge and with one or more spring-loaded safety relief valves. The total relieving capacity of such safety relief valves must prevent pressure in the receiver from exceeding the maximum allowable working pressure of the receiver by more than 10 percent.

17.14 Requirements for Compressors

17.14.1 Air Intake. The design and location of compressor intakes must prevent any flammable or toxic gas, vapor, or dust from being drawn into the compressor. Never install a valve in the air intake pipe to an air compressor with an atmospheric intake.

17.14.2 Governors. Install a speed governor, independent of the unloaders, on all compressors except those driven by electric synchronous motors. Equip engine- or turbine-driven compressors with an auxiliary control to the governor to prevent racing when the unloader operates.

17.14.3 Limit and Bypass. Every air compressor must automatically stop compressing before the discharge pressure exceeds the maximum allowable working pressure of the weakest portion of the system. The design and installation of electrical contacts must prevent locking or fusing in a position that would permit the compressor to continue compressing when the allowable pressure is exceeded. As a substitute, install an air bypass and alarm for the automatic stop system.

17.14.4 Safety Relief Valves. Equip each stage of a multistage compressor with a safety relief valve.

17.14.5 Discharge Piping. The diameter of air discharge piping between the compressor and the receiver must be at least as large as the discharge opening on the compressor. If you install a stop valve between the compressor and the receiver, install spring-loaded safety valves between the stop valve and the compressor. The total capacity of the safety valves must be sufficient to limit pressures in the air discharge piping to less than 10 percent or 3 pounds per square inch, whichever is greater, above the working pressure of the piping.

17.15 Requirements for Gas Cylinders

Construct, inspect, and test compressed gas cylinders in accordance with Department of Transportation requirements.

17.15.1 Cylinder Storage. Onsite storage of gas cylinders must conform to the following requirements:

a. Separation. Store cylinders containing the same gas in segregated groups. Do not intermingle with other gas cylinders. Store empty gas cylinders in the same manner. Protect cylinders from damage or tipping by chains or other security means.

b. Confined Spaces. Store cylinders in well-ventilated spaces. Do not store or take cylinders containing oxygen, acetylene, or fuel gases into confined spaces.

c. Flammable or Combustible Material. Separate cylinders in storage from flammable or combustible material by at least 20 feet or by a fire-resistive partition of at least 1-hour fire-resistive rating and at least 5 feet high.

d. Oxidizing Gases. Separate cylinders containing oxygen or oxidizing gases from fuel gas cylinders by at least 20 feet or by a fire-resistive partition of at least 1-hour fire-resistive rating and at least 5 feet high.

e. Smoking Restrictions. Do not permit smoking or open flame where cylinders are stored. Post the area with "DANGER—NO SMOKING OR OPEN FLAME" signs.

f. Toxic Gas. Post areas containing toxic gas in storage with signs warning of the danger.

17.15.2 Upright Position. Secure compressed gas cylinders in an upright position at all times except when hoisting them or using them in special services or arrangements approved in writing by the manufacturer or gas supplier.

17.15.3 Cylinder Valves. Close cylinder valves when cylinders are in storage, in transit, or not in use.

17.15.4 Valve Caps. Ensure cylinder valve caps are securely in place when they are in storage, in transit, and at all times when the regulator is disconnected from the cylinder. Cylinders may be moved secured on specialty trucks within a jobsite without removing the regulators when you adequately protect the regulators and cylinder valves.

17.15.5 Transporting. Transport compressed gas cylinders by crane, hoist, or derrick in cradles, nets, or skips. Never transport them by slings, chains, or magnets.

17.15.6 Valve Wrenches. The valve wrench or wheel must be in the operating position when the cylinder is in use.

17.15.7 Restricted Use. Use cylinders only for the designated purpose of containing a specific compressed gas for which they were designed. Only authorized entities may refill them.

17.15.8 Handling. Handle cylinders in a manner that will not weaken or damage the cylinder or valve. Do not expose cylinders to extremes of temperature, physical damage, or electrical current.

17.15.9 Oxygen. Keep oxygen cylinders and fittings free of oil or grease and do not handle them with oily hands or gloves. Do not direct oxygen at oily surfaces, greasy cloths, or into a container, storage tank, or vessel. Do not use oxygen or other compressed gases as a substitute for compressed air.

17.15.10 Defective Cylinders. Move leaking cylinders to an isolated location out of doors, away from personnel and sources of ignition. Then, open the valve, allowing the gas to escape slowly. Tag the cylinder "DEFECTIVE" and return it to the supplier. Only qualified personnel, protected by appropriate personal protective equipment, may handle leaking cylinders containing toxic gas.

17.16 Standards for Welding and Cutting

All welding and cutting apparatus, equipment, and operations must be according to the standards and recommendations set forth in the current edition of ANSI Z49.1, "Safety in Welding, Cutting, and Allied Processes," and the requirements of this section. Provisions of the current NFPA Standard 51B, "Fire Prevention During Welding, Cutting, and Other Hot Work," also apply.

17.16.1 Responsibility. The facility management is responsible for ensuring the safety of hot work operations and establishing the following controls:

a. Based on fire potentials of plant facilities, establish areas for cutting and welding, and establish procedures for cutting and welding, in other areas.

b. Designate an individual who is responsible for authorizing cutting and welding operations in areas not specifically designed for such processes. This person must not be the hot work operator.

c. Ensure that cutters or welders and their supervisors are suitably trained in the safe operation of their equipment and the safe use of the process.

These individuals must be aware of the inherent risks and understand the emergency procedures in the event of a fire.

d. Ensure use of only approved apparatus, such as torches, manifolds, regulators or pressure reducing valves, and acetylene generators.

e. Advise all contractors of flammable materials or hazardous conditions they may be unaware of.

17.16.2 Hot Work Permit. Before hot work operations begin in a nondesignated location, obtain a written hot work permit from the authorizing individual. Before issuing the hot work permit, the authorizing individual must ensure that the equipment is in satisfactory condition and in good repair and that all fire protection measures are followed.

17.16.3 Daily Inspection. Inspect welding apparatus and equipment daily before use. Remove defective apparatus and equipment from service, replace it, or repair it and reinspect it before using it again.

17.16.4 Fire Extinguishers. Fire extinguishers rated 2-A:40-B:C units or larger must be immediately available wherever welding, gouging, or cutting is being carried out.

17.16.5 Fire Protection. Take the following precautions, as applicable, when welding or cutting:

a. Flammable Material. Confine welding, whenever possible, to areas free of combustible materials. When this is not possible, remove all combustible material within 35 feet horizontally from the work site or protect it from fire, sparks, and slag.

b. Fireguards. The fireguards must be on duty when hot work is performed in a location where other than a minor fire might develop, or where the following conditions exist:

1. Combustible materials are closer than 35 feet to the point of operation.

2. Combustible materials are more than 35 feet away, but are easily ignited by sparks.

3. Wall or floor openings within a 35-foot radius expose combustible materials in adjacent areas, including concealed spaces in wells and floor.

4. Combustible materials are adjacent to the opposite side of partitions, walls, ceilings, or roofs and are likely to be ignited.

The fireguards must be on duty during the operations and for a sufficient period of time following the completion of the work to ensure that no possibility of fire exists. Provide fireguards with necessary fire protection equipment and instruct them in its use. They must watch for fires in all exposed areas, try to extinguish them only when obviously within the capacity of the equipment available, or otherwise sound the alarm.

c. Tests. Test for flammability before welding, cutting, or heating any material covered by a preservative coating with unknown flammability. Do not weld or cut in any area that could contain flammable vapors or gases until the atmosphere has been tested and found safe.

d. Shafts. Install noncombustible barriers below welding or burning operations in or over a shaft or raise.

e. Flammable and Combustible Liquids. Do not weld, cut, or burn in areas containing flammable or combustible liquid, vapor, or dust.

f. Walls. When welding or cutting on walls, floors, or ceilings where direct penetration of sparks or heat transfer may cause a fire in an adjacent area, take the same precautions on both sides of the wall, floor, or ceiling. Precautions include keeping the floor wet, covered with damp sand, or protected with a fire-retardant shield or guard.

17.16.6 Warning Sign. After completing welding operations, the welder must mark the hot metal or provide some other means of warning other workers.

17.16.7 Goggles, Protective Clothing, and Screens. Welders and helpers must wear protective clothing and eye protection as specified in the "Personal Protective Equipment" section, subsections on "Eye and Face Protection" and "Protective Clothing." Protect other people near welding and cutting from exposure to welding rays, flashes, sparks, molten metal, and slag. Use welding screens in repair shops and other areas where welding is regularly performed.

17.16.8 Preservative Coatings. When preservative coatings are highly flammable, remove them from the area to be heated to prevent ignition. Take the following precautions when the coatings are determined to be toxic:

a. Enclosed Spaces. Strip the coating of all coated surfaces for a distance of at least 4 inches on each side of the cut or weld.

b. Open Air. Protect employees in open air with either an air line respirator, an appropriate respirator meeting the requirements of the "Respiratory Protection" subsection or adequate local ventilation.

17.16.9 Confined Spaces. Ventilation and protection of employees welding, cutting, or heating in confined spaces must conform to requirements contained or referenced in the "Confined Spaces" section, including the use of an outside attendant and a preplanned written rescue procedure.

a. Ventilation. Ventilation is a prerequisite to work in confined spaces. Adequately ventilate all welding and cutting operations conducted in confined spaces to prevent: (1) the accumulation of toxic materials or (2) oxygen deficiency. This requirement applies not only to the welder but also to helpers and other nearby personnel. All replacement air must be clean and respirable.

b. Airline Respirators. When you cannot provide such ventilation, use airline respirators approved for this purpose by the National Institute for Occupational Safety and Health (NIOSH) under 42 CFR part 84.

c. Self-Contained Units. In areas immediately dangerous to life and health (IDLH) or where hazards are unknown, use a full-facepiece, pressure-demand, self-contained breathing apparatus or a combination full-facepiece, pressure-demand supplied-air respirator with an auxiliary, self-contained air supply approved by NIOSH under 42 CFR part 84.

d. Securing Cylinders and Machinery. When welding or cutting in any confined spaces, leave the gas cylinders and welding machines outside the space. Before operations begin, securely block heavy portable equipment mounted on wheels to prevent accidental movement.

e. Gas Cylinder Shutoff. To prevent gas from escaping through leaks of improperly closed valves during gas welding or cutting whenever the torch is not used for a substantial period of time, such as during the lunch hour or overnight, close the torch valves and positively shut off the gas supply to the torch at some point outside the confined area. Where practicable, also remove the torch and hose from the confined space.

f. Accidental Contact. When suspending arc welding for any substantial period of time, such as during lunch or overnight, remove all electrodes from the holders and carefully locate the holders to prevent accidental contact and disconnect the machine from the power source.

17.16.10 Toxic Materials. Protect employees who are welding, cutting, heating, or brazing, or using fluxes, coatings, and filler products containing any of the following materials in accordance with the requirements in subsections on Job Hazard Analysis, Exposure Limits, Respiratory Protection, and ANSI Z49.1 Section 5, "Ventilation."

- Cadmium
- Fluorides
- Mercury
- Chlorinated hydrocarbons
- Stainless steel
- Zinc or galvanized materials
- Beryllium
- Lead

Other materials or compounds determined to be toxic by the manufacturer or a nationally recognized source referenced in 29 CFR Part 1910.1000

17.16.11 Flammable Liquid Containers. When it is necessary to cut or weld closed containers or hollow structures that have contained flammable materials, follow the recommendations in the pamphlet, F4.1, "Recommended Safe Practices for Preparation of Welding and Cutting of Containers and Piping," published by the American Welding Society.

17.17 Requirements for Gas Welding and Cutting

17.17.1 Equipment. Gas welding and cutting equipment must be as listed by a nationally recognized testing laboratory.

17.17.2 Gas Cylinders. Transport, handle, store, use, and maintain gas cylinders required in this section and with DOT requirements. Only DOT stamped or labeled gas cylinder are permitted.

17.17.3 Regulators. Use pressure-reducing regulators only for the gas for which they were designed. Except for cracking the valve slightly to remove dust or dirt, do not release gas from a cylinder under pressure without attaching the pressure-reducing regulator to the cylinder valve. Do not adjust acetylene regulators to permit a discharge greater than 15 pounds per square inch (gauge).

17.17.4 Torches. Close torch valves and shut off the gas supply when suspending work. Check torch valves for leaks at the beginning of each shift. Light torches with friction lighters or other approved devices and not with matches or hot work.

17.17.5 Check Valves and Flash-Back Protection. Equip all oxygen, acetylene, or other fuel gas-oxygen combinations used in cutting or welding with an approved device to prevent oxygen from flowing into the fuel-gas system or fuel from flowing into the oxygen system. Use an approved device to provide flash-back protection to prevent flame from passing into the fuel-gas system. Install these protective devices according to the manufacturer's instructions.

17.17.6 Welding Hose. Use only properly marked and identified hose in good condition and specifically manufactured for oxyacetylene service for gas welding and cutting. Remove from service a hose that has been subjected to flashback or that demonstrates severe wear or damage. Ventilate containers used to store fuel gas hose.

17.18 Requirements for Arc Welding and Cutting

17.18.1 Applicable Standards. Electric arc welding apparatus must comply with the National Electrical Manufacturer's Association EW1 "Electric Arc Welding Power Sources." Install, operate, and maintain this apparatus in accordance with ANSI Z49.1, "Safety in Welding, Cutting, and Allied Processes."

17.18.2 Power Circuits. Install and maintain power circuits for electric arc welding equipment in accordance with applicable provisions of the current National Electrical Code (NEC).

17.18.3 Grounding. Effectively ground frames of all electric welding machines operated from power circuits according to current NEC standards. The current carrying capacity of grounding conductors and clamps must equal or exceed the maximum output of the welder they serve. Do not use pipelines containing flammable gases or liquids, electrical conduits, chains, wire rope, cranes, hoists, or similar devices for grounding.

17.18.4 Cables. Do not allow splices or repaired insulation within 10 feet of the electrode holder. Position cables so as not to obstruct walkways, scaffolds, stairs, or ladders.

17.18.5 Gasoline-Driven Arc Welders. Do not use gasoline-driven arc welders in confined spaces or underground in tunnels, shafts, or conduits.

17.19 Requirements for Inert-Gas Metal-Arc Welding

17.19.1 Chlorinated Solvents. Do not apply chlorinated solvents within 200 feet of the exposed arc. Thoroughly dry surfaces prepared with chlorinated solvents before permitting welding on such surfaces.

17.19.2 Arc Protection. Employees exposed to the arc must wear goggles with filter lenses. When two or more welders are exposed to each other's arc, they must wear filter lens goggles of suitable design under their welding helmets. Welders must use hand shields designed to dissipate radiant energy when the welder either lifts the helmet or removes the shield.

17.19.3 Radiation. Welders and people exposed to radiation must wear protective clothing completely covering the skin to prevent the harmful effects of ultraviolet rays.

Section 18

Slings and Rigging Hardware

Section 18, "Slings and Rigging Hardware," sets forth the requirements for using slings, chains, and accessories. It specifically addresses using alloy steel chains, wire rope slings, synthetic web slings, synthetic roundslings, shackles, and other rigging hardware.

18.1 General Requirements

18.1.1 Standard Criteria. The *Rigging Manual*, latest edition, published by the Construction Safety Association of Ontario, 21 Voyager Court South, Etobicoke, Ontario, Canada, M9W 5M7, is the designated Bureau of Reclamation (Reclamation) Rigging Manual. Reclamation will use this manual as a guide to determine if rigging practices are safe and conform to industry-wide practices. Although used by Reclamation and contractors, both as a rigging manual and a training text, contractually, it is advisory in nature (except where specifically referenced) and intended only to complement the safety requirements set forth in Section 18.

18.1.2 Safe Usage. Use of ropes, slings, and chains must conform to equipment manufacturer's recommendations, Section 18, applicable current American Society of Mechanical Engineers/American National Standards Institute (ASME/ANSI) standards (table 18-1), and Occupational Safety and Health Administration (OSHA) regulations.

Table 18-1.— Rigging Standards

Standard No.	Title
ASME/ANSI B30.9	Slings
ASME/ANSI B30.10	Hooks
ASME/ANSI B30.20	Below-the-Hook Lifting Devices
ASME/ANSI B30.26	Rigging Hardware

18.1.3 Safe Working Loads. Determine the safe working load of slings, chains, accessories, and rigging equipment before use. The safe working loads of slings must not exceed the rated capacities or working load limit. The rated load is based upon material strength, a design safety factor, the type of hitch, and the specific angle of loading.

18.1.4 Job-Fabricated/Purpose-Built Rigging Hardware. A professional engineer must design and certify the use of any job-fabricated/ purpose-built rigging hardware and test it at twice the rated safe working load or in accordance with applicable standards.

18.1.5 Use, Repair, and Maintenance. The use, repair, and maintenance of ropes, chains, slings, and rigging accessories must conform to the manufacturer's written instructions. Test repaired slings and accessories at twice their rated load before use.

18.1.6 Protection. Appropriately protect slings with a material of sufficient strength, thickness, and construction to prevent damage to the strands, fibers, wires, or links from sharp, rough, or square corners. Properly store slings when they are not in use to protect them from mechanical damage, corrosive action, moisture, temperature extremes, ultraviolet light, ozone, or other factors as appropriate.

18.2 Rigger Responsibilities

18.2.1 Responsibilities of Rigger

a. Ensure that the rigging equipment and materials have the required capacity for the job, that all items are in good condition and are properly used, and that inspections are current.

b. Verify that rigging equipment and material are in compliance with local written job procedures, if applicable.

c. Confirm that the load path is clear of personnel and obstacles.

d. Participate in the formulation of critical lift plans.

18.3 Qualifications for Riggers

Only personnel who have received rigger training, have demonstrated proficiency, and have been deemed qualified will perform rigging operations. A qualified rigger is a person who possesses a recognized degree, certificate, or professional standing—or has extensive knowledge, training, and experience—and who can successfully demonstrate the ability to solve problems related to rigging loads. Initial training, and retraining at least every 5 years, are required and will be taught by a third party.

18.4 Inspections

Make frequent and periodic inspections of slings and rigging hardware. Immediately remove defective equipment from service.

18.4.1 Frequent Inspections. The user must inspect rigging equipment before each shift.

18.4.2 Thorough Periodic Inspections. A designated person must thoroughly inspect slings and rigging hardware. The field location must determine the frequency of the periodic inspection on the basis of use, severity of service conditions, nature of the lifts, and experience on the service life of slings used in similar circumstances. Conduct and document inspections periodically and at least once every 12 months.

18.4.3 Special or Infrequent Service. For slings that are used infrequently, inspect before each use. At the time of use, document the inspection.

18.5 Removal from Service

Routinely inspect chain, wire rope, fiber, synthetic webbing, and sling hooks. Remove them from service if any are deformed, damaged, or otherwise do not meet inspection criteria and are not safe for use. Cut up and discard slings removed from service due to defects or plainly mark them as being unfit for load-bearing service. Do not repair cracked, broken, or bent end attachments. Damaged equipment must be replaced.

18.6 Availability and Retention of Records

Keep written records of periodic inspections and proof tests, identifying the type and nature of the inspection and testing. Make these records readily accessible to operating personnel and available upon request to employees or compliance officials. Records will be readily available and maintained until the next periodic/annual inspection or in accordance with Reclamation records management requirements.

18.7 Requirements for Using Alloy Steel Chains

18.7.1 Safe Working Load. Do not exceed the manufacturer's safe working load for any configuration. When heated in excess of 400 degrees Fahrenheit (°F), or used in temperatures below -40 °F, adjust the chain’s safe working capacity to conform to the manufacturer’s instructions.

18.7.2 Grade. In hoisting operations, use only heat-treated alloy steel chains that meet at least grade 80. Each link of heat-treated alloy steel chains must be marked with an “A,” “T,” or “8.” The marking designates heat- treated alloy steel meeting at least grade 80.

18.7.3 Identification. Durable identification tags must be permanently affixed to welded alloy steel chain slings. The tags must state the size, grade, number of legs, rated load for at least one hitch type at the angle upon which it is based, length (reach), identification or serial number, and sling manufacturer.

18.7.4 Accessories. The rated capacity of hooks, rings, links, or other attachments used with alloy steel chains must at least equal that of the chains. Do not use job-made hooks, links, or makeshift fasteners made from bolts or rods.

18.7.5 Impact Loading. Do not subject chains to impact loading.

18.7.6 Excessive Wear. Whenever the wear at any point in any chain link, or the depth of gouge or rounded out portion, exceeds the measurements in table 18-2, remove it from service. Use a device capable of measuring to one one-thousandth of an inch to measure chain wear. Remove any sharp nicks by hand filing.

Table 18-2.—Minimum Allowable Thickness on a Link

Original nominal chain stock diameter (inches)	Minimum allowable thickness at any point on a link (inches)
7/32 = 0.219	0.189
9/32 = 0.281	0.239
5/16 = 0.313	0.273
3/8 = 0.375	0.342
1/2 = 0.500	0.443
5/8 = 0.625	0.546
3/4 = 0.750	0.687
7/8 = 0.875	0.750
1 = 1.000	0.887
1-1/4 = 1.250	1.091

18.7.7 Removal from Service. Remove from service any assemblies with deformed master or coupling links or cracked hooks or attachments. Permanently remove from service alloy steel chains heated above 1,000 °F, and reduce their capacities if exposed to temperatures at or above 400 °F.

18.7.8 Proof Testing. When repaired, a chain sling must be permanently marked to identify the repairing agency. Before use, proof test each new, repaired, or reconditioned alloy steel chain sling and all welded parts in the sling assembly to twice the rated capacity. Make a copy of the proof test certificate, including the date and weight, and make the records available for examination.

18.8 Requirements for Using Wire Rope Slings

18.8.1 Safe Working Load. Do not exceed the manufacturer's safe working load for any configuration. For angles other than those shown on the manufacturer's tag, use the rated load for the next lower angle, or a qualified person shall calculate the load.

18.8.2 Grade. Wire rope slings covered by Subsection 18.8, "Requirements for Using Wire Rope Slings," are based on nominal wire rope strength as shown in Federal Specification RR-W-410, "Wire Rope and Strand," and Military Specification MIL-W-83420, "Wire Rope, Flexible, for Aircraft Control" (except for fatigue requirements). Wire rope will be manufactured and tested in accordance with American Society for Testing Materials (ASTM) A 1023/A 1023M, "Standard Specification for Stranded Carbon Steel Wire Ropes for General Purposes," and ASTM A586, "Standard Specification for Zinc-Coated Parallel and Helical Steel Wire Structural Strand and Zinc-Coated Wire for Spun-in-Place Structural Strand."

18.8.3 Identification. Each sling will be marked to show the trademark or manufacturer, diameter or size, and safe working load for at least one hitch and the angle upon which it is based, and number of legs if there is more than one leg. If the wire rope sling identification tag is missing or it is illegible, send it back to the manufacturer for recertification and identification, or replace it with a new sling.

18.8.4 Proof Test. Proof test all job-made or repaired slings. Proof test all swaged socket and poured socket assemblies to the wire rope or fitting manufacturer's recommendations but, in no case, to more than 50 percent of the component wire ropes' minimum breaking strength. The proof test for a single-leg, hand-tucked sling must be at least 1 time to a maximum of 1.25 times the rated load. The proof test for mechanical splice single-leg slings and endless slings must be 2 times the vertical load. Apply the proof load for multiple-leg bridle slings to the individual legs at 1 to 1.25 times the rated vertical load for hand tucked splice, or 2 times the rated vertical load for mechanical splice. Load any master link connected to multiple-leg slings to 2 times the force of the combined legs. Make a copy of the proof test certificate, including the date and weight, and make the records available for examination.

18.8.5 Environmental Effects. Do not expose fiber core wire rope slings to temperatures above 180 °F. Consult sling manufacturers before using slings in chemically active environments or in temperatures above 400 °F or below -40 °F.

18.8.6 End Fittings and Connections. Do not form eyes in wire rope slings or chokers with wire clips or a fold back eye with pressed metal sleeve.

18.8.7 Protruding Ends. Cover or blunt protruding ends of strands in splices on slings and bridles.

18.8.8 Sling Inspection and Replacement. Inspect slings periodically and remove them from service if one or more of the following conditions are present:

a. Missing or illegible sling identification

b. Ten randomly distributed broken wires in one rope lay, or five broken wires in one strand in one rope lay.

c. Wear or scraping on one-third of the original diameter of outside individual wires.

d. Kinking, crushing, bird caging, or any other damage resulting in distortion of the rope structure.

e. Evidence of heat damage.

f. Hooks that have any visibly apparent bend or twist from the plane of the unbent hook or an increase in the throat opening of 5 percent, and not to exceed ¼ inch.

g. Cracked, deformed, or worn end attachments.

h. Corrosion of the rope or end attachments.

i. Evidence of unauthorized alterations such as drilling, machining, grinding, or other modifications.

Permanently remove from service fiber core rope slings if exposed to temperatures above 180 ºF. Nonfiber core rope temperatures must not exceed 400 ºF or -40 ºF with manufacturer’s recommendation.

18.9 Requirements for Using Synthetic Web Slings

18.9.1 Synthetic Webbing. Synthetic webbing will be manufactured and tested in accordance with Web Sling & Tie Down Association standards.

18.9.2 Safe Working Load. Do not use a webbing sling at a load greater than the manufacturer’s established safe working load. Follow the manufacturer's recommended safe working load for the specific angle of loading.

18.9.3 Identification. Synthetic web slings must be marked or coded with the manufacturer's name or trademark, code or stock number, type of material, the rated capacity for the type of hitches used, and number of legs if there is more than one leg.

18.9.4 Care and Maintenance

a. Webbing. Synthetic webbing must be of uniform thickness and width; do not split selvage edges from the webbing's width.

b. Fittings. The minimum breaking strength of fittings must equal twice the rated load of the sling, and the fittings must be free of all sharp edges that could damage the webbing.

c. Storage and Use. Do not use or store nylon web, polyester, and polypropylene web slings and web slings with aluminum fittings where caustic fumes, vapors, sprays, mists, or liquids are present. Store slings out of direct sunlight to avoid deterioration from ultraviolet light, away from sources of ozone generation, and protect them from mechanical damage

d. Temperature. Do not use synthetic web slings of polyester and nylon in temperatures above 180 °F or below -40 °F. Do not use polypropylene web slings in temperatures above 200 °F.

18.9.5 Removal from Service. Immediately remove synthetic web slings from service if one or more of the following visible defects are present:

a. Missing or illegible sling identification.

b. Acid or caustic burns.

c. Melting or charring of any part of the surface.

d. Snags, punctures, tears, or cuts.

e. Broken or worn stitches.

f. Wear or elongation exceeding the amount recommended by the manufacturer.

g. Fittings that are pitted, corroded, cracked, gouged, broken, or distorted.

h. Knots in any part of the sling.

18.9.6 Repairs. Do not use repaired synthetic web slings unless a sling manufacturer, or an equivalent entity, repairs them. Proof test each repaired sling to twice the rated load before returning it to service. Maintain documentation of the proof test.

18.10 Requirements for Synthetic Roundslings

18.10.1 Composition. Core yarn will be of a synthetic fiber, and the cover will be woven from synthetic yarns. The thread used in synthetic roundslings will be manufactured and tested in accordance with Web Sling & Tie Down Association standards.

18.10.2 Safe Working Load. The safe working load for single-leg polyester roundslings must conform to the values shown in appendix E, table E-21. Load capacities are in the temperature range of -40 °F to 194 °F. When using roundslings in temperatures outside this range, in chemical environments, or when they are constructed with yarns of nonpolyester materials, consult the sling manufacturer.

18.10.3 Identification. Each roundsling must be tagged to show the manufacturer's name or trademark, code or stock number, type of material in the core and cover (if different), the rated capacity for the type of hitches used, and the number of legs if there is more than one leg.

18.10.4 Removal from Service. Immediately remove roundslings from service if any of the following conditions are present:

a. Missing or illegible sling identification.

b. Acid or caustic burns.

c. Melting or charring of any part of the sling surface.

d. Snags, punctures, tears, cuts, or weld splatter that expose core yarns.

e. Broken or damaged core yarns.

f. Fittings that are pitted, corroded, cracked, gouged, broken, or distorted.

18.10.5 Repairs. Do not make temporary repairs to either roundslings or fittings. Do not repair load-bearing yarns or fittings. Allow only a roundsling manufacturer or qualified person to repair protective covers. When repaired, the roundsling must be marked and proof tested to twice the rated vertical load before it is returned to service.

18.11 Wire Mesh Slings and Synthetic Rope Slings

If either wire mesh slings or synthetic rope slings are selected for special use, consult with the appropriate section of ANSI B30.9.

18.12 Requirements for Shackles and Other Rigging Hardware

18.12.1 Shackles

a. Safe Working Load. Load rating will be in accordance with the shackle manufacturer. The design factor for shackles up to and including 150 ton-rated load will be a minimum of 5. The design factor for shackles over 150 ton-rated load shall be a minimum of 4.

b. Hoisting. Shackles used for hoisting must be made of forged alloy steel and must be of the screw pin or bolt type.

c. Shackles Body and Pin Identification. Each shackle body will have forged, cast, or die stamped markings by the manufacturer to show the name or trademark of the manufacturer, the rated load, and the size. Shackle pins will be similarly marked and show the manufacturer, grade, material type, or load rating.

d. Inspections. Conduct a preuse and postuse inspection of the rigging hardware and document the periodic/annual inspection.

e. Removal from Service. Immediately remove shackles from service if any of the following conditions are present:

- Shackles are bent, distorted, or worn in the crown or pin by more than 10 percent of their original diameter

- Other conditions exist such as welding damage or arc strike, pitting or corrosion, or excessive thread damage

18.12.2 Rings, Links, and Swivels. Hardware items, including rings, links, and swivels, must be made of forged alloy steel of weldless construction and have a minimum design factor of 5. Follow the manufacturer's safe working loads.

a. Identification. Each hardware item will have forged, cast, or die stamped markings by the manufacturer to show the name or trademark of the manufacturer, the grade, rated load, or size.

b. Inspections. Conduct a preuse and postuse inspection of the rigging hardware and document the periodic/annual inspection.

c. Removal from Service. Immediately remove rigging hardware from service if any of the following conditions are present:

- Missing or illegible identification

- Indications of welding damage or arc strike
- Excessive pitting or corrosion
- Bent, twisted, distorted, stretched, elongated, or cracked load-bearing components
- Excessive nicks or gouges
- A 10-percent reduction of the original dimension at any point
- Inability of swivels to freely rotate when not loaded
- Other visible damage

18.12.3 Eyebolts, Eye Nuts, Turnbuckles, and Swivel Hoist Rings. This hardware used for hoisting must be designed with a minimum safety factor of 5. Load rating will be in accordance with the hardware manufacturer's specifications. If found defective, the rigging hardware will not be repaired; it will be removed from service.

a. Identification. Each hardware item will be marked to show the name or trademark of the manufacturer, size or rated load, grade for alloy eyebolts, and torque value for swivel hoist rings.

b. Inspections. Inspect the rigging hardware before each use and document the periodic/annual inspection.

c. Removal from Service. Immediately remove eyebolts, eye nuts, turnbuckles, and swivel hoist rings from service if any of the following conditions are present:

- Missing or illegible identification
- Indication of heat damage, including weld splatter or arc strikes
- Excessive pitting or corrosion
- Bent, twisted, distorted, stretched, elongated, or cracked load-bearing components
- Excessive nicks or gouges
- A 10-percent reduction of the original dimension at any point
- Excessive thread damage or wear
- The inability of swivel hoist rings to freely rotate when not loaded

- Other visible damage

d. Rigging Practices

1. Tapped Hole. The minimum depth of the tapped hole for screwed eyebolts and swivel hoist rings must be one and one-half times the bolt diameter.

2. Application of Load. Apply loads in the plane of the eye of the eyebolt. Do not reeve slings through eyebolts or attach hooks directly to the eyebolt. Use a shackle to distribute the load.

Section 19

Hoisting and Pile Driving Equipment

Section 19 of *Reclamation Safety and Health Standards* (RSHS) covers hoisting and pile driving equipment. It specifically addresses the following:

- General requirements
- Responsibilities
- Inspections and testing
- Recordkeeping
- Qualifications of hoisting equipment operator
- Operating requirements
- Critical lifts
- Crane supported personnel platforms (manskips)
- Hooks
- Wire rope
- Overhead, gantry, monorail, and underslung cranes
- Portal, tower, and pillar cranes
- Derricks
- Floating cranes and derricks
- Material hoists
- Overhead hoists
- Elevators and personnel hoists
- Cableways
- Base-mounted drum hoists
- Specialized hoisting systems
- Pile driving equipment
- Helicopter operations

19.1 General Requirements for Hoisting Equipment

Maintain and operate equipment covered by this subsection in a safe manner. Use the more stringent of the manufacturer's recommendations, Occupational Safety and Health Administration (OSHA) regulations, American Society of Mechanical Engineers/American National Standards Institute (ASME/ANSI) standards, or Bureau of Reclamation (Reclamation) standards for the installation, setup, and operation and maintenance (O&M) of all covered equipment. Reclamation's crane program is comprised of this subsection, which covers policy requirements and Facilities Instructions, Standards and Techniques (FIST) 2-11, *Crane and Rigging Manual*, which provides detailed procedures for the O&M and inspection of the hoisting equipment.

19.1.1 Equipment Design. Design and install cranes and other hoisting equipment covered by this standard in accordance with the applicable OSHA regulations, standards listed in table 19-1, the Crane Manufacturer's Association of America standards, and the National Electrical Code (National Fire Protection Association 70).

Table 19-1.—Crane and hoisting equipment design and construction standards

Standard No.	Title
ASME/ANSI B30.2	Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist)
ASME/ANSI B30.3	Tower Cranes
ASME/ANSI B30.4	Portal and Pedestal Cranes
ASME/ANSI B30.5	Mobile and Locomotive Cranes
ASME/ANSI B30.6	Derricks Safety Standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings
ASME/ANSI B30.7	Winches
ASME/ANSI B30.8	Floating Cranes and Floating Derricks
ASME/ANSI B30.10	Hooks
ASME/ANSI B30.11	Monorails and Underhung Cranes - Safety Standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings
ASME/ANSI B30.12	Handling Loads Suspended from Rotorcraft
ASME/ANSI B30.14	Side Boom Tractors - Safety Standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings
ASME/ANSI B30.16	Overhead Hoists (Underhung)
ASME/ANSI B30.17	Overhead and Gantry Cranes (Top Running Bridge, Single Girder, Underhung Hoist)
ASME/ANSI B30.19	Safety Standard For Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, And Slings
ASME/ANSI B30.22	Articulating Boom Cranes
ASME/ANSI B30.23	Personnel Lifting Systems
ASME/ANSI HST-6M	Performance Standard for Air Wire Rope Hoists

19.1.2 Modification and Reconfiguration. Do not make modifications, additions, or repairs that affect the structural competence, capacity, or safe operation of the equipment or system without the manufacturer's written approval or the approval of a professional engineer (P.E.) competent in the field. Any modifications will be fully documented. In no case will the original safety factor of the equipment be reduced.

19.1.3 Documentation. The following documents will be immediately available to the operator at all times:

a. The manufacturer's operating manual, or equivalent, for the specific make and model of crane.

b. Operating manuals for any attachments or accessories with which the crane is equipped.

c. The load rating chart for construction cranes; portal, tower, and pillar cranes; mobile and locomotive cranes; floating cranes; floating derricks; and articulating boom cranes. This chart will be completely legible. It will also include the crane make and model and contain a complete range of the manufacturer's approved crane load ratings for all configurations for which the crane is designed.

d. A crane logbook will be used to document inspections, unusual conditions, operations, maintenance, repairs, and testing,

19.2 Responsibilities

19.2.1 Supervisor or Manager, Hoisting and Rigging Operations. While the operator is responsible for each lift, a supervisor or manager will be responsible for overall hoisting and rigging operation and will ensure that:

a. Qualified personnel are assigned to operate equipment and perform hoisting and rigging tasks. Qualified personnel are current with required training and certifications.

b. A Job Hazard Analysis (JHA) is developed and followed for all hoisting operations.

c. Equipment is operated safely.

d. Preplanned and approved hoisting and rigging instructions are used when necessary and always for critical lifts.

e. Equipment found to be unsafe or requiring restrictive use is properly tagged.

f. All equipment problems have been addressed or resolved.

g. A designated leader (DL)/lift supervisor will be assigned to hoisting and rigging operations that require more than one person.

19.2.2 Maintenance Manager. The maintenance manager will be responsible for selecting qualified personnel for inspection, maintenance, and repair on hoisting and rigging equipment and components and will ensure the following:

a. Equipment is properly inspected, maintained, tested, and repaired and/or replaced by qualified personnel.

b. All hoisting and rigging equipment has preventive maintenance established, as well as detailed and accurate maintenance job plans in accordance with FIST 6-2, *Conduct of Power Maintenance*.

c. Ensure that the maintenance, repair, inspection, and testing are documented and available for review.

d. Hydro Asset Management Partnership equipment assessments are reported annually in accordance with FIST 6-2 as applicable.

e. Inspection, maintenance, and repair personnel follow applicable safety procedures and have the tools to accomplish their work.

f. Responsible inspection, maintenance, and test personnel have access to the information and documents as referenced in FIST 2-11, *Crane and Rigging Manual*.

g. Personnel responsible for inspection or maintenance are familiar with the applicable contents of all equipment manuals.

19.2.3 Lift Supervisor for Critical Lifts. Management will assign a lift supervisor for critical lifts. The lift supervisor must be a qualified crew member or other qualified person. The lift supervisor for critical lifts will perform those activities listed in Subsection 19.7, "Requirements for Critical Lifts," as well as ensuring that:

a. A critical lift procedure is prepared.

b. The critical lift procedure is properly approved before implementation.

c. A documented prelift meeting is held, and personnel understand how the job will be done.

d. Management provides qualified personnel (e.g., operators, riggers, flagman, and lift supervisor).

e. Proper equipment and hardware are identified in the critical lift procedure.

f. He or she is available to direct the lifting operation and to ensure that the job is done safely and efficiently.

g. Involved personnel are familiar with, and follow, the critical lift procedure.

h. After the critical lift is completed, critical lift documentation is transmitted to the manager who requested the lift. Documentation will remain available for review and audit purposes for 1 year following the date of the lift.

19.2.4 Designated Leader. A DL will be appointed to hoisting and rigging activities that involve more than one person. The DL may be the operator, a competent crew member, or other competent person. The DL will:

a. Ensure that a flagman or signaler, if required, is assigned and identified to the operator.

b. Ensure that management provides qualified personnel and that personnel understand how the job is to be done.

c. Ensure that the weight of the load is determined, that the proper equipment and hardware are selected and inspected, and that the capacity of the lifting device is not exceeded.

d. Ensure that the equipment is properly set up and positioned.

e. Examine the work area for hazardous or unsafe conditions.

f. Direct the lifting operation to ensure that the job is done safely and efficiently.

g. Ensure that the job is stopped when any potentially unsafe condition is recognized.

h. Be present at the jobsite during lifting operations.

i. Ensure that the preparation of the ground conditions needed to support crane operations has been completed before crane operations commence when mobile cranes are used. If the operator, DL/lift supervisor, or Assembly/Disassembly Director (A/D director) (defined in Paragraph 19.2.8 of the RSHS) have concerns pertaining to ground conditions, they will notify the controlling entity (e.g., property owner, prime contractor, or contracting officer).

j. Ensure that swing radius hazards are addressed, when applicable, and that only authorized personnel are allowed in identified hazard areas.

k. Ensure that only authorized personnel enter the fall zone to perform or conduct activity that cannot be performed except when a load is suspended or being landed.

l. Use hoisting routes that minimize the exposure of employees to hoisted loads .

m. Ensure that necessary traffic controls are in place to restrict unauthorized access to the crane's work area.

n. Establish a means of communication when the spotter or signaling person is not within sight of the operator.

o. Ensure that if an injury or accident takes place, the emergency is promptly reported. Take charge of the accident scene until emergency services personnel arrive.

19.2.5 Operator. The operator will be responsible for each hoisting and rigging operation and will perform the following activities:

a. Safely operate equipment.

b. Follow the equipment operating guidelines and, for mobile cranes, the load charts.

c. Perform the preuse and shift equipment inspection.

d. Ensure that the load will not exceed the rated capacity of the equipment.

e. Abide by any restrictions placed on the use of the equipment.

f. Ensure that inspections are current via inspection sticker, other documentation, or verbal confirmation from the equipment custodian.

Note: It is important that equipment users know the process for correcting problems that are discovered when operating the equipment. A method should be in place so that equipment users can easily identify and contact the equipment maintenance manager.

19.2.6 Dedicated Spotter(s) and Signal Person(s). Individuals assigned these functions will:

a. Communicate to the crane operator precise directions to move the load.

b. Be competent in the application of standard crane and hoist signals.

c. Relay any communications from the rigger or DL to the operator that may affect the lift.

d. Use hoisting routes that minimize risk to personnel, property, and the load.

e. Ensure that the job is stopped when any potentially unsafe condition is recognized.

f. Ensure that all signal equipment is operating properly and reliably.

19.2.7 Assembly/Disassembly Director (Mobile Cranes/Tower Cranes). The A/D director is responsible for directing both the assembly and/or disassembly of equipment (cranes) or attachments covered under 29 Code of Federal Regulations [CFR] 1926, Subpart CC, and ASME/ANSI B30 standards. With regard to tower cranes, "erecting and climbing" replaces the term "assembly," and "dismantling" replaces the term "disassembly." Regardless of whether the crane is initially erected to its full height or is climbed in stages, the process of increasing the height of the crane is an erection process. The A/D director must meet the criteria for both a competent person and a qualified person, or must be a competent person who is assisted by one or more qualified persons. Where the A/D is being performed by only one person, that person must meet the criteria for both a competent person and a qualified person. The A/D director has the following responsibilities:

a. The A/D director must understand the applicable A/D procedures.

b. The A/D director must review the applicable A/D procedures immediately prior to the commencement of A/D unless the A/D director understands the procedures and has applied them to the same type and configuration of equipment (including accessories, if any).

c. Before commencing A/D operations, the A/D director must ensure that the crew members are qualified and familiar with the equipment and perform a job briefing meeting.

d. The job brief will include

- Their tasks
- The hazards associated with their tasks
- The hazardous positions/locations that they need to avoid

19.3 Requirements for Cranes and Hoisting Devices, Inspections, and Testing

Cranes and hoisting devices used in Reclamation activities are subject to inspection and load-performance tests as required by this subsection, applicable ASME/ANSI standards, OSHA regulations, and the manufacturer's recommendations.

19.3.1 Inspection Forms. Inspection forms will be developed for each crane based on the applicable ASME/ANSI standard and the manufacturer's recommendations. Sample inspection forms are located in FIST 2-11.

19.3.2 Inspections. A designated person will conduct all inspections. For the purposes of this subsection, a designated person is a person selected or assigned by the employer as qualified to perform specific duties. For inspection of non-Reclamation owned equipment, notify a Reclamation representative at least 24 hours before the inspection to observe the inspection.

a. Frequency. Required inspections and frequency will be in accordance with table 19-2.

Table 19-2.—Crane and hoisting equipment inspection criteria

Type of inspection	When to inspect	Notes
Initial/startup inspection	Before initial use. Performed when cranes have been altered in a manner that affects safe operation or load handling equipment components.	Performed by manufacturer or qualified P.E. on all **new or modified/repaired cranes.**
Daily/shift inspection	Performed prior to use on each shift.	Performed by a competent person.
Frequent/monthly inspection	Performed monthly or more frequently as conditions require.	Applies cranes in regular use. Standby cranes (not in use for greater than 1 month but less than 3 months) are inspected prior to use. Performed by a competent person.
Periodic/annual inspection	Performed annually or more frequently as conditions require.	Perform inspection based on time interval since last inspection. Performed by a qualified third party. Hoisting devices rated below 5 tons (nonconstruction and other hoists) will be inspected by a qualified Reclamation employee or by a qualified third party.
Frequent/monthly inspection	Contractor crane and hoisting equipment brought to a Reclamation jobsite and prior to onsite use.	Same as frequent/monthly inspection including load test.

b. Crane Inspections. Periodic/annual inspections, inspections of modified/repaired cranes, or inspections of cranes not in regular use will be conducted by a third-party qualified crane inspector in accordance with the applicable OSHA regulations, ASME/ANSI standards, and manufacturer's instructions. Hoisting devices rated below 5 tons (nonconstruction and other hoists) will be inspected by a qualified Reclamation employee or by a qualified third party.

c. Inspection Records. All completed inspection reports and records will be readily available upon request.

d. Removal from Service. Whenever any crane and/or hoisting equipment is found to be unsafe, or whenever a deficiency that affects the safe operation of a crane and/or hoisting equipment is observed, the affected equipment will be immediately taken out of service, and its use will be prohibited until unsafe conditions have been corrected. If the qualified person determines that, though not presently a safety hazard, the deficiency needs to be monitored, the qualified person's manager or supervisor will ensure that the deficiency is checked in the frequent/monthly inspections.

19.3.3 Load Tests. Conduct load tests, under the direction of a competent person, as follows:

- Before initial use of cranes in which a load-bearing or load-controlling part or component, brake, travel component, or clutch has been altered, replaced, or repaired. This does not include minor brake adjustments, or when wire rope is replaced with identical new wire rope.
- Each time the mobile crane is reconfigured or reassembled after disassembly
- Annually for mobile cranes
- Contractor cranes prior to first use after crane is brought to the site
- Prior to a critical lift, and for overhead cranes if not load tested within the last 4 years
- At the discretion of the facility manager or qualified person
- When directed by the Contracting Officer's Representative (COR) or facility manager

a. Load tests will be conducted in accordance with applicable ASME/ANSI standards and manufacturer's recommendations, and are not considered critical lifts as defined in Subsection 19.7.

b. Test loads for mobile cranes will be performed at 100 percent of the load rating chart. Cranes with fixed length or extendable booms will be tested with the boom angle between 30 and 60 degrees.

c. Overhead and gantry cranes, operating in accordance with ASME/ANSI B30.2, “Overhead and Gantry Cranes (Top Running Bridge, Single or Multiple Girder, Top Running Trolley Hoist)”; and ASME/ANSI B30.17, “Overhead and Gantry Cranes (Top Running Bridge, Single Girder, Underhung Hoist”) may exceed their rated capacities for performance load testing purposes (up to 125 percent) or for planned engineered lifts.

19.4 Availability and Retention of Records

Keep written records of inspections and performance tests, identifying the type and nature of the inspection and testing, readily accessible to operating personnel and make such records available upon request to employees or compliance officials. Records will be maintained until the next periodic/annual inspection or in accordance with Reclamation’s *Information Management Handbook*, Volume I, “Policies, Procedures, and Responsibilities,” and Volume II, “Records Retention Schedules.”

19.5 Qualifications for Operating Hoisting Equipment

19.5.1 Operators. Only operators qualified and designated to operate a particular type of crane or hoisting device will operate that equipment. The operator is qualified to operate equipment that is furnished with materials that are written in the language of the certification.

19.5.2 Proficiency

a. Crane Operator Certification - Construction Cranes and All Mobile Crane Activities. Employers will ensure that mobile crane operators, as well as crane operators involved in construction activities, meet the OSHA 29 CFR 1926.1427 standard for certification. Operators will be certified, and recertified every 5 years, by an accredited crane operator testing organization such as the National Commission for the Certification of Crane Operators.

Refer to FIST 2-11 for the types of equipment that are specifically excluded from operator certification requirements.

Operators of permanently installed overhead and gantry cranes used for construction and maintenance activities are exempt from operator certification requirements above, but not the operator qualification requirement in subparagraph b. below

b. Crane Operator Qualifications - Nonconstruction Activities. Operators of all other cranes and hoisting equipment will be qualified through formal training, testing, and demonstrated proficiency (initially and every 5 years) by a qualified third-party trainer.

c. Contractor Operators of Contractor-Owned Equipment. Contractors will provide evidence of operator qualification and certification before beginning work on Reclamation activities.

d. Maintenance Operations. Employees who operate cranes to perform crane maintenance will be trained and qualified to operate the cranes on which maintenance is being performed. Crane operation by maintenance personnel will be limited to those crane functions necessary to perform maintenance on the crane or to verify the performance of the crane after maintenance has been performed.

e. Exemption. The preceding certifications and qualifications do not apply for operators of hoisting equipment with manufacturer-rated lifting capacity of 2,000 pounds or less. However, hoisting operators for equipment less than 2,000 pounds will be qualified and designated by the immediate supervisor.

19.5.3 Physical Qualifications. Operators of cranes, derricks, and hoisting systems used to lift personnel will be physically qualified.

a. Physician's Certification. Operators will have a physician's certification that the operator meets physical qualifications to operate hoisting equipment. Operators will meet the following physical qualifications:

- Vision of at least 20/30 in one eye and 20/50 in the other eye, based on the Snellen Eye Chart, with or without corrective lenses
- Normal depth perception and field of vision
- Color vision sufficient to distinguish at least red, green, and amber (yellow)
- Adequate hearing, with or without a hearing aid, for the specific operation
- Sufficient strength, endurance, agility, coordination, manual dexterity, and speed of reaction to meet the demands of equipment operation

- No evidence that the operator is subject to seizures or loss of physical control unless medically cleared
- No evidence by physical examination and medical history of psychiatric conditions (including alcohol or substance abuse) likely to present a safety risk or to worsen as a result of carrying out the essential functions of the job
- No tendencies toward dizziness or similar undesirable characteristics

b. Examination Validity. The certificate of qualification will be valid for the period stated by the medical provider, not to exceed 3 years.

c. Temporary Disqualification Factors. Assigned operators who report or appear to suffer from a temporary disabling condition will not be permitted or required to operate a crane.

19.6 Operating Requirements for Hoisting Equipment

19.6.1 Duty Periods. Operators will not work, or be at the jobsite, more than 12 hours in any 24-hour period.

19.6.2 Authority. Operators will be responsible for any operations under their direct control. When the operator determines that the conditions are unsafe, they will have the authority to stop or to refuse to handle loads until safety has been ensured. Other onsite personnel will alert the operator if they believe unsafe operating conditions exist.

19.6.3 Other Duties. The operator will not engage in any activity that will divert their attention while operating the equipment, nor will the operator leave their position while a load is suspended.

19.6.4 Environmental Conditions

a. Excessive Winds. Outdoor crane activities will have available adequate means for monitoring local weather conditions, including a wind speed device located where it can measure maximum wind speed for the area. Cranes will not be operated when wind speeds at the site attain the maximum wind velocity based on the recommendations of the manufacturer or 25 miles per hour (mph), whichever is less.

- At wind speeds greater than 20 mph, the operator, rigger, and lift supervisor will evaluate conditions and determine if the lift will proceed. This determination will be based on wind calculations per manufacturer's recommendations.

- The determination whether or not to proceed will be documented in the crane operator's logbook.

b. Brake Maintenance. Use storm brakes, thruster wheel chocks, and/or other similar devices, as appropriate, to secure outdoor cranes – especially during rehabilitation or other work when brakes may be inoperable. Contractors will submit their engineering or manufacturer's designs for temporary restraints to the COR for review prior to the commencement of crane rehabilitation work

c. Impaired Visibility. If dust, darkness, fog, snow, ice, rain, or other environmental conditions impair the operator's visibility, shut down the crane operation until steps are taken to compensate for the lack of visibility.

d. Lightning. Shut down crane and hoisting operations when lightning is present and equipment is vulnerable to lightning strikes. See Section 4, "Work Planning," of the RSHS for specific practices.

e. Operator Responsibility. As stated in Paragraph 19.6.2 of the RSHS, it is the operator who has the authority and responsibility to only perform lifts that can be conducted safely.

19.6.5 Maximum Lifts. Do not lift loads greater than the rated capacity of the crane, except for overhead and gantry cranes, when load testing, as specified in subparagraph 19.3.3.c.

19.6.6 Hoist Drums. No less than two full wraps of rope will remain on the drum when the hook is in the extreme low position.

19.6.7 Riding Loads. No person may ride loads, blocks, buckets, hooks, scaffolding, boatswain's chairs, cages, or other devices attached to hoist lines, booms, or attachments of any crane, derrick, or materials hoist. Designated maintenance personnel may ride the carriage service platform of a cableway to perform inspection testing or maintenance. Where employees cannot perform work through other means, crane-supported personnel platforms (manskips) may be used in accordance with Subsection 19.8, "Crane Supported Personnel Platforms (Manskips)." Operations using crane-supported personnel platforms are considered critical lifts.

19.6.8 Work Area Control

a. Control. Barricade the rear-swing radius area of rotating superstructures of cranes to physically prevent people or equipment from entering the hazard area. Only operation-essential personnel will be allowed in the fall zone. Loads will not be lifted or suspended over personnel.

b. Training. Train each employee assigned to work on or near equipment to recognize struck-by, pinch/crush, and fall zone hazards in accordance with 29 CFR 1926.1424 and 1425.

19.6.9 Communications. During critical lifts, or lifts involving use of crane-supported personnel platforms, maintain and use audio communications between the operator, personnel on the work platform (when applicable), and the signal person.

19.6.10 Crane and Hoist Signals

a. Signal Systems. Use a uniform standard signal system in operating cranes, derricks, and hoists. Hand signals, as illustrated in Attachment 19-1, "Hand Signals for Cranes and Hoisting Equipment," will be used. A signal person must be provided in each of the following situations:

- The point of operation (the load travel or the area near or at load placement) is not in full view of the operator.
- When the equipment is traveling, the view in the direction of travel is obstructed.
- Due to site-specific safety concerns, either the operator or the person handling the load determines that it is necessary.

When hand signals are insufficient, or when the distance between the operator and the signal person is over 100 feet, or they are not in the line of sight, the operator and signal person will use voice or other telecommunication means as long as it is hands-free. In the event of communication loss, operations will cease. The operator, signal person, and designated leader/lift supervisor must be able to effectively communicate in the language used.

b. Signal Person Training. The employer of the signal person will ensure that the employee is qualified and trained prior to giving any signals. Training can be delivered through a third-party evaluator or the employer's qualified evaluator. Such training must meet the requirements of 29 CFR 1926.1428. The signal person will demonstrate competency through an oral or written test and a practical test. Documentation of the training will be available when requested.

c. Posting. Post signals at the operator's position and, as practical, at signal control points and at other locations, as necessary, to inform persons using the signals.

d. Signal Visibility. Protect signal systems from unauthorized use, damage, or interference. Predesignate a signal person and identify that person by special color of hard hat, armband, or other distinguishing marking. The predesignated person will give crane and hoist signals.

19.6.11 Power Line Safety. Perform a hazard assessment and identify the work zone with flags or barricades when equipment operates adjacent to power lines. The owner of the power line will be contacted and informed of work near the power line.

a. Power Lines up to 350 Kilovolts. Maintain a clearance of 20 feet between the power line and the equipment's maximum operating radius. If the 20-foot distance will be entered, perform one of the following:

1. Deenergize and visibly ground the line with confirmation from the utility owner or operator.

2. Use all of the following to ensure the 20-foot clearance is maintained:

- Develop a JHA and conduct a meeting to discuss methods to prevent encroachment or electrocution.
- Use nonconductive tag lines.
- Erect a high visibility elevated warning line, barricade, or line of signs that are visible to the operator.
- Implement at least one of the following:
  - Proximity alarm
  - Dedicated spotter
  - Range control warning device
  - Range limiting device
  - Insulating link/device installed between the load and the end of the load line

3. Determine line voltage and minimum clearance distances permitted under table 19-3. Implement all of the measures listed in the bullets in subparagraph 19.6.11.a.2 above.

4. Where the employer determines that it is infeasible to do the work without breaching the minimum approach distance under table 19-3, see 29 CFR 1926.1410(c).

Table 19-3.–Minimum clearance distances

Voltage (nominal, kV, alternating current)	Minimum clearance distance (feet)
Up to 50	10
Over 50 to 200	15
Over 200 to 350	20
Over 350 to 500	25
Over 500 to 750	35
Over 750 to 1,000	45
Over 1,000	As established by the utility owner or registered P.E. who is a qualified person with respect to electrical power transmission and distribution

Note: kV = kilovolts

b. Voltage Information. The utility owner or operator will provide voltage information within two working days of the employer's request as required by 29 CFR 1926.1407(e).

c. Power Lines Presumed Energized. The employer will assume all power lines are energized unless the utility owner or operator confirms that the line has been, and continues to be, deenergized and visibly grounded at the worksite.

d. Communications/Transmitter Tower. Deenergize the transmitter where equipment is close enough for an electrical charge to be induced.

e. Training. The employer will train each operator and crew member who works adjacent to power lines on 29 CFR 1926.1408 through 1411, as well as the following:

- Procedures to be followed in the event of electrical contact with a power line
- Electrocution hazard created if the operator simultaneously touches the equipment and the ground
- The importance of the operator staying in the cab unless there is an imminent danger of fire, explosion, or other emergency
- Safe evacuation methods for exiting the cab
- The danger of the potentially energized zone around the equipment (step potential)

- Danger of the crew approaching the equipment or touching the equipment or load
- Safe clearance distances
- The presumption that all power lines are energized

f. Power Lines Over 350 kV. For power lines at or below 1,000 kV, the same criteria above apply, except that the 20-foot clearance will be increased to 50 feet. For power lines over 1,000 kV, the clearance distance will be determined by the utility owner or operator.

g. Power Line Safety (All Voltages) – Equipment Operations Closer Than the Minimum Clearance Zone. Where the employer determines that it is infeasible to do the work without breaching the minimum clearance distances under table 19-3, see 29 CFR 1926.1410 (c).

h. Traveling Under or Near Power Lines With No Load. The following procedures will be followed when traveling under a power line without a load:

- Lower the boom/mast and boom/mast support system and lock it in the travel position.
- Maintain the minimum clearances distances specified in table 19-4.

Table 19-4.– Minimum clearance distances while traveling with no load

Voltage (nominal kV, alternating current)	While traveling – minimum clearance distance (feet)
Up to 0.75	4
Over 0.75 to 50	6
Over 50 to 345	10
Over 345 to 750	16
Over 750 to 1,000	20
Over 1,000	As established by the utility owner or registered P.E. who is qualified with respect to electrical power transmission and distribution

- Consider the effects of speed and terrain on equipment movement (including movement of the boom/mast) so that those effects do not cause the minimum clearance distances specified in table 19-4 to be breached.

- Use a dedicated spotter with continuous communication to the operator/driver if any part of the equipment can come within 20 feet of the power line.
- If visibility is limited, or during night operations, illuminate the power lines or otherwise clearly mark them, and identify and use a safe path of travel.

19.6.12 Tag Lines. Use nonconductive tag lines to control loads when their use is practical and will not create additional hazards to personnel, equipment, or structures. Nonconductive rope tag lines that become soiled with oil and dirt can become conductive if used inside minimum approach distance of high voltage lines, and they must be cleaned or replaced.

19.6.13 Ground Conditions. The responsible employer will ensure that ground conditions support hoisting equipment. Inform the equipment user of the locations of underground tanks, voids, and utilities that may present a hazard.

19.6.14 Assembly/Disassembly. A/D operations for lattice boom and tower cranes will be supervised by both a competent and qualified person (in some instances, they could be the same person). This individual will understand the manufacturer's procedures and ensure that the crew receives instructions that include specific hazards such as blocking parts, working under the boom, rigging, and power line safety.

19.6.15 Qualified Riggers. The employer **will** ensure that rigging work is performed by a qualified rigger. A rigger who meets the criteria for a qualified person is considered a qualified rigger. See Section 18, "Slings and Rigging Hardware," of the RSHS.

19.6.16 Construction of Electric Transmission and Distribution Lines and Equipment. The safety and health standards contained in 29 CFR 1926, Subpart V, "Power Transmission and Distribution," and 29 CFR 1910.269, "Electric Power Generation, Transmission, and Distribution," will apply to the construction of electric transmission and distribution lines and equipment.

19.7 Requirements for Critical Lifts

A critical lift is a nonroutine lift requiring detailed planning and additional or unusual safety precautions. Critical lifts include the following:

- Lifts made when the load weight is 75 percent or more of the crane's rated capacity or hoisting device, based on the operating parameters for that lift for mobile, construction, tower, or pillar cranes, or 90 percent for overhead or gantry cranes
- Lifts made with more than one crane or more than one hoist on the same crane or trolleys
- Hoisting personnel with a crane
- Lifts where the center of gravity could change
- Lifts involving nonroutine or technically difficult rigging arrangements
- Lifts when the item is unique; vital to a system, facility, or project operation; and if damage would be irreplaceable or unrepairable
- Lifts when the load, although noncritical, is to be lifted above, or in close proximity to, a critical item or component
- When the cost to replace or repair the item being lifted, or the delay in operations of having the item damaged, would have a negative impact on the facility or budget to the extent that it would affect commitments
- Any lift that the crane/hoist operator or responsible official believes is critical.

19.7.1 Critical Lift Plans. Prepare a written critical lift plan before making any critical lift. The critical lift supervisor will prepare the plan in coordination with the crane/hoisting equipment operator and rigger. The critical lift supervisor will obtain the technical approval for a qualified engineer, safety professional, or others as appropriate. All personnel involved in the lift must review and sign the critical lift plan. See FIST 2-11 for critical lift plan details, as well as the information presented below.

19.7.2 Critical Lift Plan Details. The plan must include the following information:

- Exact size and weight of the load, including all crane and rigging components that add to the weight. Include the manufacturer's maximum load limits for the complete range of the lift.
- Exact information about the sequence of events and procedures.
- Rigging plans with lift points, procedures, and hardware requirements.
- Conditions and procedures under which the lifting operation must be stopped.
- Coordination and communications procedures.

- Names of the lift supervisor, hoisting equipment operator, rigger, and other personnel who have key roles in the operation.
- For tandem lifts, general information on the hoisting equipment, including make, model, operating speeds, and other information to ensure that the equipment is compatible.
- Ground conditions and other information necessary to ensure that there is a level, stable foundation with sufficient bearing capacity for the lift supports of the hoisting equipment. This includes outrigger, crawler track, and support mat design calculations.

19.8 Crane-Supported Personnel Platforms (Manskips)

19.8.1 General Requirements. Use crane-supported personnel platforms to reach the worksite only when conventional means of erection, use, and dismantling (for example, personnel hoists, ladders, stairways, aerial lifts, elevated work platforms, or scaffolding) are impossible or hazardous. Use of crane-supported personnel platforms requires specific authorization, must comply with the requirements of this subsection, and requires supporting justification.

The written request must be specific to the operation and must: (1) describe in detail the proposed operation, with supporting data that show why employees cannot safely reach the worksite using other standard procedures; and (2) confirm, with sufficient manufacturing and design engineering data, that the proposed system and equipment fully comply with the requirements contained herein. Approvals will be for the specific operation described.

Do not use the platform system for any other operation unless an additional request has been submitted and approved. Place approved systems in operation only after a JHA has been developed. The JHA must contain provisions for initially and periodically instructing the crane operator and all affected employees.

Personnel must not work from crane-supported scaffolding, except when under constant supervision by a general foreman or superintendent, or a designated lift supervisor. In addition, the crane and operation must meet the requirements of this subsection, as well as other requirements of Section 19.

19.8.2 Specific Requirements

a. Hoist-Line Suspended Personnel Platforms

1. Suspend platform only from the main boom nose.

2. Do not hoist personnel above ground when wind velocity exceeds 10 mph, when any dangerous weather condition exists, or when other danger is impending.

3. Select sites so that, when locating cranes for platform operation, no part may come within 20 feet of an energized power line that is up to 350 kV or within 50 feet of an energized line over 350 kV. Do not use barriers, manufacturer’s locks, or control level restraints to meet these requirements.

4. Do not handle material lifts when personnel are on the platform. Detach the platform before rigging the crane for material handling.

5. Do not belt off or otherwise attach a platform to an adjacent pole, structure, or equipment.

6. Lifting and lowering speeds must not exceed 100 feet per minute.

7. Engage load and boom hoist drum brakes, swing brakes, and locking devices (such as pawls or dogs) when the occupied personnel platform is in the stationary position.

8. When employees occupy platforms, they must wear body harnesses with lanyards appropriately attached to a structural member of the platform. Harnesses, lanyards, and structural support members used as anchorages must meet requirements contained in Subsection 16.1, “Fall Protection,” of the RSHS that discusses personal protective equipment for fall protection. When working over water, where the danger of drowning exists, employees will be provided with U.S. Coast Guard-approved life jackets or buoyant work vests.

9. Do not move a mobile crane when employees are aloft.

10. Employees must keep all body parts inside the platform during raising, lowering, and positioning.

11. Platform occupants must not stand, sit on, or work from the top or intermediate rail or toeboard, or use any other means or device to raise their working height.

b. Cranes

1. Install and test the crane periodically using Subsection 19.3, “Requirements for Cranes and Hoisting Devices, Inspections, and Testing.”

2. Use only cranes equipped with planetary or worm gears, torque converters, automatic braking systems, or other equivalent systems that prevent placing the boom hoist and load lines in a freewheeling or

neutral position controlled by manual brake and/or dogs only. Use only the main hoist for personnel handling.

3. The crane must be able to sustain a static load (as shown on the crane's capacity chart) of two times the rated platform capacity for all radii and configurations through which the platform will be hoisted.

4. The minimum load hoist line wire rope safety factor must be 7 or 10 when using rotation-resistant rope.

5. Install an anti-two-blocking device or two-block damage prevention feature and ensure that it is operating. The anti-two-blocking device must have automatic capabilities for controlling functions that may cause two-blocking conditions.

6. Mark telescoping booms or equip them with a device that clearly shows the boom's extended length to the operator at all times.

7. All critical components of hydraulic or pneumatic systems must have a minimum bursting strength of at least four times the system's designed operating pressure. (Critical components are those in which a failure could result in free rotation or lowering of the boom or platform.)

8. Equip all critical hydraulic cylinders with pilot-operated check valve, or other appropriate devices, to prevent free fall or uncontrolled movement of boom or platform in the event of a hydraulic line failure. Electrical systems used for positioning platforms must provide equal protection in the event of power failure.

9. Keep cranes within one degree of level during operation with outriggers fully extended and jack pads set on firm, level terrain or on substantial shoring as determined by a qualified person.

c. Platforms

1. The crane manufacturer or a P.E. must design the personnel platform.

2. Suspension systems must be designed to minimize tipping of the platform due to movement of employees on the platform.

3. The entire platform must be designed with a minimum safety factor of five.

4. Provide 6-foot minimum headroom for employees on the platform.

5. Provide each personnel platform with perimeter protection from the floor to 42 inches. Perimeter protection must be either solid

construction or expanded metal beginning with the toeboard and extending to at least the mid-rail with openings no greater than one-half of an inch.

6. Provide a grab rail inside the personnel platform.

7. If an access gate is provided, make sure it swings inward and equip it with a latch (restraining device) to prevent accidental opening.

8. Provide overhead protection on the personnel platform when employees are exposed to falling objects.

9. Grind smooth all exposed rough edges that employees on the platform could contact.

10. A certified welder, qualified for the weld grades, types, and material specified in the design, must perform all welding.

11. Conspicuously post a plate or other permanent marking on the personnel platform showing the weight and the rated load capacity of the personnel platform.

12. Personnel platforms must be easily identifiable by color or marking. Use personnel platforms only to hoist personnel and approved tools and equipment.

13. Use a wire rope bridle sling to connect the personnel platform to the loadline. Each bridle leg must be connected to a masterlink or be shackled in a manner that ensures that the load is evenly divided among the bridal legs.

14. Close and lock hooks, headache ball assemblies, lower load blocks, or other attachment assemblies, thus eliminating the hook throat opening. Alternatively, use a shackle with a screw pin, nut, and retaining pin.

15. Wire rope, shackles, rings, and other rigging hardware must have a minimum safety factor of five.

d. Additional Inspections and Tests

1. At the beginning of each shift, a competent person must inspect cranes that are used to hoist personnel platforms. In addition, inspect the crane again after using it for any material handling operations and before using it to hoist employees.

2. Before further use, correct any defects that were found during such inspections that may create a safety hazard.

3. Before hoisting employees for the first time at each new setup location, or after any repairs to the platform or rigging, make a

full-cycle operational test lift at 125 percent of the intended load of the personnel platform. The platform must be lowered by controlled load lowering, braked, and held in a suspended position for a minimum of 5 minutes with the test load evenly distributed on the platform.

Note: Setup location means the location where the crane or derrick is brought and set up, including assembly and leveling.

4. Immediately after lift testing, visually inspect the crane, personnel platform, and base support to determine if the testing has adversely affected any component or structure.

5. At the beginning of each shift, and after using the crane to hoist materials, make a trial lift (with the platform loaded to at least the anticipated lift weight) with the personnel platform unoccupied to make sure all systems, controls, and safety devices are functioning properly.

6. Immediately prior to each lift, the platform must be hoisted a few inches, with the personnel and materials/tools on board, and inspected by a competent person to ensure that it is secure and properly balanced.

7. Before the lifting of personnel, the following conditions must be verified each time by a competent person:

- Hoist ropes must be free of deficiencies.
- Multiple part lines must not be twisted around each other.
- The primary attachment must be centered over the platform.
- If the load rope is slack, the hoisting system must be inspected to ensure that all ropes are properly seated on drums and in sheaves.

8. Any condition found during the trial lift and subsequent inspection(s) that fails to meet this standard, or otherwise creates a safety hazard, must be corrected before hoisting personnel.

e. Work Practices

1. The crane operator must remain at the controls at all times when the personnel platform is raised.

2. Employees being hoisted must remain in direct communication with the crane operator at all times.

3. Hold a prelift meeting before each personnel hoisting operation. The crane operator, employees involved, and the responsible general foreman, superintendent, or designated lift supervisor must attend the

prelift meeting to review the applicable requirements of this subsection and the procedures that will be followed.

19.9 Hooks

19.9.1 Requirement. Manufacturing, testing, inspecting, and use of hooks must conform to the more stringent requirements contained in ANSI B30.10, "Hooks," manufacturer's specifications and recommendations, FIST 2-11, and this subsection.

19.9.2 Safe Working Load. Follow the manufacturer's recommendation to determine the safe working load for the specific size and type of hook used. The rated load will be in accordance with the design requirements for the equipment or system in which the hook is being used. If a manufacturer's recommendation is not available, test hooks in accordance with ANSI B30.10. Maintain a record of the dates and results of the tests.

19.9.3 Inspection. Inspect hooks frequently and remove them from service if they are missing a manufacturer's identification and load rating; are cracked, nicked, or gouged; are severely corroded; exhibit wear exceeding 10 percent of the original section dimension of the hook or its load pin; have any visible bend or twist from the plane of the unbent hook; or have an increase in the throat opening of 5 percent, not to exceed ¼ inch.

19.9.4 Hook Latches. Hook latches (keepers) are required on lifting hooks. Latch equipped hooks will be used for all hoisting and rigging operations unless the application makes the use of the latch impractical or unsafe. Hooks without latches, or with latches that are removed or disabled, must not be used unless a qualified person has determined that it is safer to hoist and place the load without latches (or with the latches removed/tied back).

19.10 Requirements for Working with Wire Rope

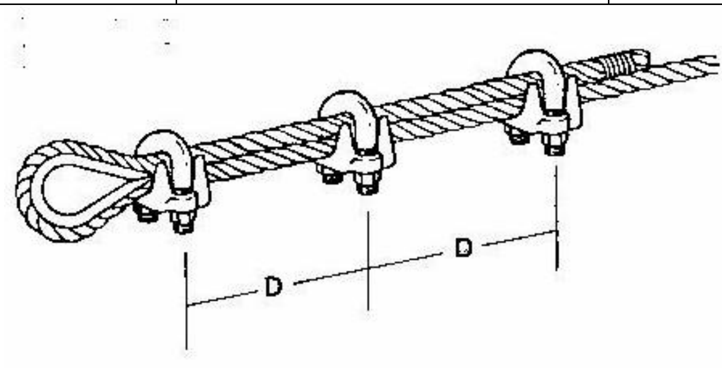
19.10.1 Safe Working Load. Do not exceed the manufacturer's rated load capacity.

19.10.2 End Fasteners and Connectors. Use only commercial wire rope fittings.

a. Wire Rope Clips. Install wire rope clips as specified by the manufacturer and table 19-5. When U-bolt wire rope clips are used to create end terminations, the saddle will be placed on the live end of the wire rope, with the U-bolt on the dead-end side. The size, number of clips, the turnback, and tightening to the torque will be as recommended by the manufacturer. Always use new clips; reused clips will not develop the proper efficiency. Always use a thimble installed in the eye to reduce rope wear. When twin base clips are used, they will be installed in the size, number, spacing, and torque as recommended by the manufacturer. Twin base clips are designed without a top or bottom; thus, they cannot be installed incorrectly on either the live or dead-end side of the wire rope. After assembly, the connections will be loaded to at least the expected working load, inspected, and retightened to the manufacture's recommended torque.

Table 19-5. Size and spacing of U-bolt clips

Diameter of rope (inches)	Number of clips	Minimum spacing (inches)
1/2	3	3
5/8	3	3-3/4
3/4	4	4-1/2
7/8	4	5-1/4
1	5	6
1-1/8	6	6-3/4
1-1/4	6	7-1/2
1-3/8	7	8-1/4
1-1/2	7	9
1-5/8	7	9-3/4
1-3/4	7	10-1/2
2	8	11-1/4



D=6 times rope diameter
Clip Spacing

b. Wedge Sockets. Wedge sockets are extensively used in the construction industry because they attach easily to a wire rope. In applying the socket, the live rope will lead out of the socket in a straight line with the pin. The assembler will match the proper wedge with the socket for the wire rope to be installed. The dead-end tail of the wire rope will not be secured to the live end of the wire rope in a way that restricts the movement of the live end (figure 19-1). After assembly, the connection will be loaded to fully seat the wedge before use.

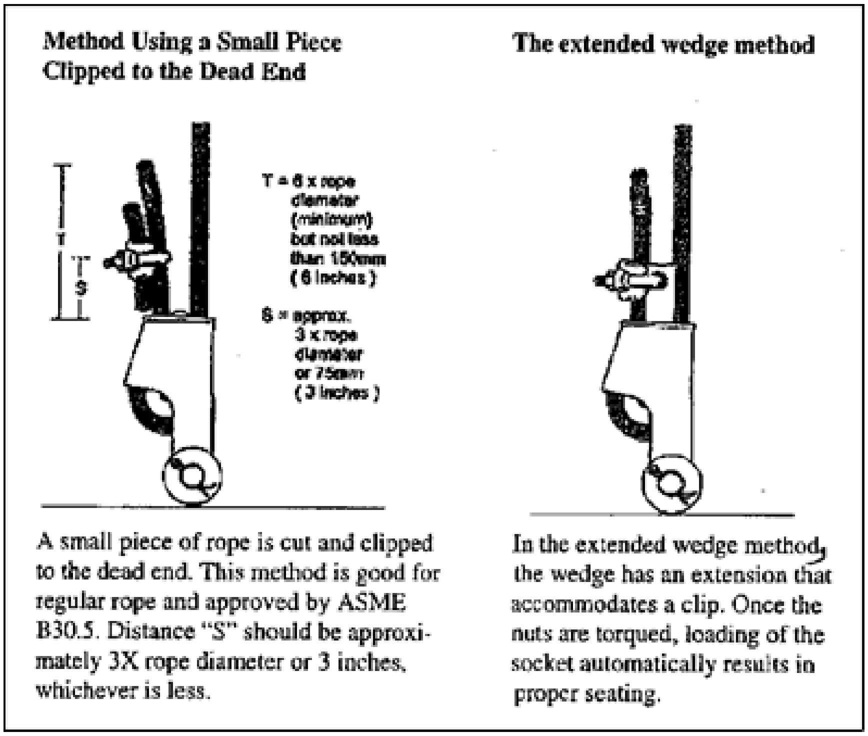


Figure 19-1.—Two recommended methods of attaching the socket to the wedge before use.

19.10.3 Hoisting Rope. Except for end fasteners, wire rope used to hoist or lower loads will be continuous, without knots or splices.

19.10.4 Spooling of Rope. Overwind or underwind wire rope correctly from right to left, or left to right, in accordance with the lay, to avoid twisting, spreading, or overlapping on winch drums in accordance with the wire rope manufacturer's instructions.

19.10.5 Sheave Diameter. The ratio between the rope diameter and the drum or sheave diameter will not be less than specified by the rope manufacturer. When not specified, the ratio will be in accordance with the appropriate ASME/ANSI standard. Drums, sheaves, and pulleys will be smooth and free of defects that could damage the rope.

19.10.6 Sheave Groove Tolerance. Use the sheave groove tolerances as recommended by the sheave manufacturer.

19.10.7 Lubrication. Lubricate wire rope with manufacturer-approved lubricants and follow the manufacturer's approved methods at the intervals required by the type of service.

19.10.8 Wire Rope Inspection. The inspection will consist of observing wire ropes (running and standing) that are likely to be used, to determine any apparent deficiencies. Opening of wire rope or booming down is not required as part of the daily/shift inspections. Refer to table 19-2 and FIST 2-11 for additional requirements.

a. Category I. Apparent deficiencies in this category include the following:

- Significant distortion of the wire rope structure such as kinking, crushing, unstranding, birdcaging, signs of core failure, or steel core protrusion between the outer strands.
- Significant corrosion.
- Electric arc damage (from a source other than power lines) or heat damage.
- Improperly applied end connections
- Significantly corroded, cracked, bent, or worn end connections (such as from severe service)

b. Category II. Apparent deficiencies in this category are:

- Visible broken wires, as follows:
    - In running wire ropes: Six randomly distributed broken wires in one rope lay, or three broken wires in one strand in one rope lay, where a rope lay is the length along the rope in which one strand makes a complete revolution around the rope.
    - In rotation resistant ropes: Two randomly distributed broken wires in six rope diameters, or four randomly distributed broken wires in 30 rope diameters.
    - In pendants or standing wire ropes: More than two broken wires in one rope lay located in rope beyond end connections, and/or more than one broken wire in a rope lay located at an end connection.
    - A diameter reduction of more than 5 percent from nominal diameter.

c. Category III. Apparent deficiencies in this category include the following:

- In rotation resistant wire rope, core protrusion or other distortion indicating core failure
- Prior electrical contact with a power line
- A broken strand

d. Critical review items. The competent person will give particular attention to all of the following:

- Rotation resistant wire rope in use
- Wire rope being used for boom hoists and luffing hoists, particularly at reverse bends
- Wire rope at flange points, crossover points, and repetitive pickup points on drums
- Wire rope at or near terminal ends
- Wire rope in contact with saddles, equalizer sheaves, or other sheaves where rope travel is limited

19.10.9 Removal from Service

a. Category I. If a deficiency in Category I is identified, an immediate determination will be made by the competent person as to whether the deficiency constitutes a safety hazard. If the deficiency is determined to constitute a safety hazard, operations involving use of the wire rope in question will be prohibited until:

- The wire rope is replaced, or
- If the deficiency is localized, the problem is corrected by severing the wire rope in two; the undamaged portion may continue to be used. Joining lengths of wire rope by splicing is prohibited.

b. Category II. If a deficiency in Category II is identified, operations involving use of the wire rope in question will be prohibited until:

- The employer complies with the wire rope manufacturer's established criterion for removal from service or a different criterion that the wire rope manufacturer has approved in writing for that specific wire rope
- The wire rope is replaced, or

- If the deficiency is localized, the problem is corrected by severing the wire rope in two; the undamaged portion may continue to be used. Joining lengths of wire rope by splicing is prohibited

c. Category III. If a deficiency in Category III is identified, operations involving use of the wire rope in question will be prohibited until:

- The wire rope is replaced, or
- If the deficiency (other than power line contact) is localized, the problem is corrected by severing the wire rope in two; the undamaged portion may continue to be used. Joining lengths of wire rope by splicing is prohibited. Repair of wire rope that contacted an energized power line is also prohibited.

19.10.10 Socket Brakes. Resocket or remove from service the wire rope when any broken or corroded wires are next to a socket or end fitting.

19.10.11 Hazardous Location. Guard running lines of stationary hoisting equipment that is located within 8 feet of the ground or working level, or enclose or barricade the hazardous area.

19.11 Requirements for Overhead and Gantry Cranes

In addition to requirements set forth in these standards, overhead and gantry cranes will conform to requirements contained in the current edition of ASME/ANSI B30.2, "Overhead and Gantry Cranes"; ASME/ANSI B30.17, "Overhung and Gantry Cranes (Top Running Bridge, Single Girder, Underhung Hoist"); and 29 CFR 1910.179.

19.11.1 Design. The manufacturer or a P.E. will design crane installations and equipment.

19.11.2 Performance Inspections and Tests. Conduct and record inspections and performance testing in accordance with the requirements of Subsection 19.3. During performance tests, the load will be transported for the full length of the supporting structure.

19.11.3 Crane Access. Provide safe access to the cab or bridge walkway with a fixed ladder, stairs, or platform, with no step or gaps exceeding 12 inches. Fixed ladders and stairways will comply with the requirements set forth in Section 13, "Walking and Working Surfaces," of the RSHS. Provide means of egress from the cab under emergency conditions.

19.11.4 Platforms and Walkways. Install maintenance platforms and walkways, which are protected by standard guardrails and toeboards, and provide a way to safely access the trolley and bridge. Where it is impractical to install platforms and walkways, install a fall protection system to enable safe inspection and maintenance.

19.11.5 Markings. Mark the rated load of the crane on both sides of the crane. Mark the rated load of each hoist on the crane on the hoist, trolley unit, or load block. All markings will be legible from the ground or floor.

19.11.6 Hoist Identification Markings. For cranes with multiple hoists, distinctively mark each hoist so that it is visible from the ground or floor. Clearly mark operator controls to correspond to the hoist markings to indicate which controls operate each hoist.

19.11.7 Warnings. As required by ASME/ANSI B30.2, cranes will have appropriate warning labels.

19.11.8 Fire Extinguisher. Mount a fire extinguisher of 2-A:40-B:C rating in the cab or near the operator’s position.

19.11.9 Outdoor Equipment. Secure outdoor cranes from unauthorized access when not in use.

19.12 Requirements for Monorail and Underhung Cranes

In addition to requirements set forth in these standards, monorail and underhung cranes will conform to the standards in the current edition of ASME/ANSI B30.11, “Monorails and Underhung Cranes - Safety Standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings.”

19.12.1 Design. The manufacturer or a P.E. will design crane installations and equipment.

19.12.2 Performance Inspections and Tests. Conduct and record inspections and performance testing in accordance with the requirements of Subsection 19.3. During performance tests, the load will be transported for the full length of the supporting structure.

19.12.3 Crane Access. Provide safe access to the cab for cab-operated cranes with a fixed ladder, stairs, or platform, with no step or gaps exceeding 12 inches. Fixed ladders and stairways will comply with the requirements set forth in Section 13 of the RSHS. Provide a means of egress from the cab under emergency conditions.

19.12.4 Platforms and Walkways. Install maintenance platforms and walkways which are protected by standard guardrails and toeboards, and provide a way to safely access the trolley and bridge. Where it is impractical to install platforms and walkways, install a fall protection system to enable safe inspection and maintenance.

19.12.5 Markings. Mark the rated load of each hoist on the crane on the hoist, trolley unit, or load block. All markings will be legible from the ground or floor.

19.12.6 Hoist Identification Markings. For cranes with multiple hoists, distinctively mark each hoist so that it is visible from the ground or floor. Clearly mark operator controls to correspond to the hoist markings to indicate which controls operate each hoist.

19.12.7 Warnings. As required by ASME/ANSI B30.11, cranes will have appropriate warning labels.

19.12.8 Fire Extinguisher. Mount a fire extinguisher of 2-A:40-B:C rating in the cab or near the operator's position.

19.13 Requirements for Mobile and Locomotive Cranes

In addition to the requirements set forth in these standards, mobile and locomotive cranes will conform to the standards in the current edition of ASME/ANSI B30.5, "Mobile and Locomotive Cranes"; side boom wheel or crawler tractors will conform to ASME/ANSI B30.14, "Side Boom Tractors - Safety Standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings"; and articulating boom cranes will conform to ASME/ANSI B30.22, "Articulating Boom Cranes."

19.13.1 Operating Instructions. Rated load capacities and recommended operating speeds, special hazard warnings, or instruction will be conspicuously posted on all equipment. Instructions or warnings will be visible to the operator while at the control station.

19.13.2 Performance Inspection and Testing. Conduct and record inspections and performance testing in accordance with the requirements of Subsection 19.3 and FIST 2-11.

19.13.3 Boom Angle/Radius Indicator. Equip mobile cranes with a boom angle or radius indicator located within the operator's view.

19.13.4 Boom Stops. Provide cranes or other hoisting devices with cable-supported booms with stops to resist the boom falling over backwards. Design boom stops to provide increasing resistance from the initial point of contact to a stopping point no more than 87 degrees above horizontal.

19.13.5 Boom Hoist Disengagement Device. Provide mobile crane booms with a functional boom hoist disengagement device that will automatically stop the boom hoist mechanism when the boom reaches its highest rated angle.

19.13.6 Anti-Two-Blocking Device. Equip all mobile cranes with a two-block damage prevention feature or an anti-two-blocking device. Two-block damage prevention features will prevent damage to the crane or hoist line in case of a two-block condition. Anti-two blocking devices will have automatic capabilities to disengage all crane functions in which movement can cause two-blocking. For lattice-boom cranes manufactured before 1992, two-block warning features may be used to alert the operator to an impending two-blocking condition. Cranes lacking automatic capabilities to disengage all crane functions in a two-block condition are prohibited for use in critical lifts or personnel hoisting operations.

19.13.7 Level Indicator. Provide a way for the operator to visually determine the levelness of the crane.

19.13.8 Jib Stops. In addition to boom stops, jibs will have a positive stop to prevent overtopping.

19.13.9 Cab Windows. Windows in crane cabs will be safety glass or equivalent. Cab windows will not introduce any distortion that interferes with the crane's safe operation.

19.13.10 Audible Warning Device. Mobile cranes will have an audible warning signal device that is distinguishable and audible above background noise.

19.13.11 Foot Pedal Brakes. Equipment with foot pedal brakes will have locks, except for portal and floating cranes.

19.13.12 Hydraulic Outrigger Jacks. Hydraulic outrigger jacks will have an integral holding device (check valve).

19.13.13 Fire Extinguisher. Provide the cab with a 2-A:40-B:C rating fire extinguisher.

19.13.14 Load Weighing or Similar Device. Equipment manufactured after March 29, 2003, with a rated capacity over 6,000 pounds will have a load weighing device, load moment (or rated capacity) indicator, or a load moment (or rated capacity) limiter.

19.13.15 Outrigger/Stabilizer Position and Hoist Drum Rotation Indicators. Equipment manufactured after November 8, 2011, will be equipped with:

- An outrigger/stabilizer position sensor or monitor if the equipment has outriggers or stabilizers.
- A hoist drum rotation indicator if the drum is not visible from the operator's station.

19.13.16 Securing Booms. When they are not in use, lower crane booms to the ground or otherwise secure them to prevent displacement by wind or other outside forces.

19.14 Requirements for Floating Cranes and Floating Derricks

In addition to the requirements set forth in these standards, floating cranes and floating derricks will conform to the requirements contained in the current edition of ASME/ANSI B30.8, "Floating Cranes and Floating Derricks."

19.14.1 Design. The manufacturer or a qualified P.E. will design and certify all floating cranes and floating derricks.

19.14.2 Inspections and Performance Tests. Conduct and record inspections and performance testing in accordance with the requirements of Subsection 19.3.

19.14.3 Fire Extinguisher. Mount a fire extinguisher with a 2-A:40-B:C rating at the operator's station.

19.14.4 Personal Flotation Devices. All personnel will wear U.S. Coast Guard-approved personal flotation devices while onboard, except while in enclosed cabins. Additionally, provide and make readily accessible at least two U.S. Coast Guard-approved, type IV life rings (30-inch diameter) with at least 90 feet of line. For night operations, equip at least one ring with a water-activated flashing light.

19.14.5 Rescue Skiff. Make available a rescue skiff meeting the requirements in Section 8, "Personal Protective Equipment," of the RSHS.

19.14.6 Load Rating Chart. When reducing load ratings to compensate for "barge list," provide a new rating chart. The manufacturer will rate barge-mounted cranes designed and constructed as a unit. All other barge-mounted cranes will be large enough to limit the "list" under maximum load to 5 degrees.

19.14.7 Wave Action. Suspend crane operation when significant wave action affects the stability of the barge.

19.14.8 Mobile Cranes. Block and secure mobile cranes mounted on barges or pontoons to prevent shifting.

19.15 Requirements for Tower Cranes

In addition to the requirements set forth in Section 19, tower cranes will conform to the applicable standards in the current edition of ASME/ANSI B30.3, "Construction Tower Cranes."

19.15.1 Design. All load bearing foundations, supports, and rail tracks will be constructed or installed as determined by a registered P.E. with knowledge in this area in accordance with the crane manufacturer's recommendations.

19.15.2 Performance Inspections and Tests. Conduct and record inspections and performance testing in accordance with the requirements of Subsection 19.3.

19.15.3 Fire Extinguisher. Mount a fire extinguisher of 2-A:40-B:C rating in the cab or near the operator's position.

19.15.4 Crane Erection and Dismantling. Erect and dismantle cranes in accordance with the manufacturer's recommendations and applicable ASME/ANSI standards. Following are the minimum requirements:

a. Supervision by a qualified person.

b. Provide the manufacturer's or a qualified person's written instructions and the weights of each component.

c. Develop and implement a JHA during the planning, erection, and dismantling process. The JHA will include consideration of temporary guying and bracing requirements during the erection and dismantling.

19.15.5 Environmental Conditions. Place the crane into its most favorable protected position to protect personnel and property when environmental conditions require lifting operations to cease.

19.15.6 Unattended Tower Cranes. Place unattended tower cranes in a weathervane configuration.

19.15.7 Limiting Devices. Where applicable, install the following limiting devices:

a. Trolley limit switches to prevent further trolley motion beyond predetermined points on tower crane booms.

b. Anti-two-block switches that cause the hoist drum to automatically stop, preventing contact between the load hook and the head block.

c. Load-limiting switches to avoid exceeding crane capacities.

d. Limit switches and stops or buffers at each end of the tracks of track-mounted cranes

19.15.8 Boom Angle Indicator. Install boom angle indicators on machines having booms capable of moving in the vertical plane.

19.16 Requirements for Derricks

In addition to the requirements set forth in Section 19, derricks will conform to the requirements contained in the current edition of ASME/ANSI B30.6, "Derricks Safety Standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings."

19.16.1 Design. A P.E. will design derrick installations and equipment.

19.16.2 Inspections and Performance Tests. Conduct and record inspections and performance testing in accordance with the requirements of Subsection 19.3.

19.16.3 Foundation. Set derricks on foundations designed and constructed to support the weight of the crane plus the maximum rated load.

19.16.4 Boom Angle Indicator. Provide a boom angle or radius indicator and place it within the operator's view.

19.16.5 Fire Extinguisher. Mount a fire extinguisher of 2-A:40-B:C rating at the operator's station.

19.17 Requirements for Base-Mounted Drum Hoists

Base-mounted drum hoists will conform to the requirements of ANSI B30.7, "Winches." Air-powered hoists must conform to the requirements of ANSI/ASME HST-6M, "Performance Standard for Air Wire Rope Hoists," or more stringent requirements of this subsection. Hoisting machines used in personnel related systems must also meet the requirements in Subsection 19.18, "Requirements for Overhead Hoists."

19.17.1 Design. The hoist manufacturer or a P.E. must design base mounted hoisting systems.

19.17.2 Restrictions. Base-mounted drum hoist systems involving personnel use or exposure (e.g., movable work platforms, raising or lowering drilling machines, and personnel hoists) must conform to the provisions of this subsection.

19.17.3 Inspections and Performance Tests. Conduct and record inspections and performance tests using the requirements of Subsection 19.3 and FIST 2-11.

19.18 Requirements for Overhead Hoists

Install, operate, and maintain overhead hoists in compliance with the more stringent provision of this subsection and ASME/ANSI B30.16, "Overhead Hoists (Underhung)."

19.18.1 Design. The manufacturer or a P.E. will design hoists and hoist suspensions and anchorages.

19.18.2 Inspections and Performance Tests. Conduct and record inspections and performance testing in accordance with the requirements of Subsection 19.3.

19.18.3 Safe Working Load. Indicate the safe working load, as determined by the manufacturer, on the hoist. Do not exceed the safe working load.

19.18.4 Support. Design the supporting structure to withstand the loads and forces imposed by the weight of the hoist and its rated load. The support will provide unobstructed movement of the hoist and load. It will also permit the operator to stand clear of the load in all hoisting positions.

19.18.5 Limit Switch. Equip power-operated overhead hoists with a limit switch to prevent the load hook from exceeding the upper travel limit.

19.18.6 Hoist Controls. Controls on powered hoists will return to a neutral position when released, and load hook movement will stop.

19.18.7 Brakes. Except for hand-powered hoists, all overhead hoists will have brakes that apply automatically when the controls are in neutral.

19.18.8 Air-Operated Hoists. Connect air hoists to an air supply of sufficient capacity and working pressure to safely operate the hoist with maximum load.

19.18.9 Hand-Powered Hoists. Hand-powered hoists will be worm-gear driven or equipped with a pawl or ratchet system that provides continuous effective control and braking reliability.

19.19 Requirements for Material Hoists

Construct, install, test, operate, and maintain material hoists as set forth in the latest edition of ANSI A10.5, "Safety Requirements for Material Hoists," and the requirements of Subsection 19.3. The manufacturer or a P.E. will design material hoist installations.

19.19.1 Assembly. A qualified individual will directly supervise erecting and dismantling of hoist towers and material hoists.

19.19.2 Inspection. A qualified person will inspect the hoist, including all its components, after initial installation and before it is placed into service. A competent individual will inspect it monthly thereafter in accordance with ANSI A10.5.

19.19.3 Car-Arresting Devices. Test car-arresting devices before initial use and every 4 months thereafter. Conduct tests in accordance with ANSI A10.5.

19.19.4 Posting. Post operating rules, including signals, line speeds, and loading, at the operator's station and on the cage frame or crosshead. A copy of the hoist operating manual will be available at all times of operation.

19.19.5 Riding. Do not permit anyone to ride a material hoist, except for inspection and maintenance. Conspicuously post with "NO RIDERS ALLOWED."

19.19.6 Hoistway Entrances. Protect entrances to the hoistway with substantial gates or bars that are installed the full width of the landing entrance. Paint entrance bars and gates with diagonal contrasting colors, such as black and yellow stripes. Bars will not be less than 2- by 4-inch wood, or equivalent, and not less than 36 inches or more than 42 inches above the floor. Bars will be at least 2 feet from the hoist and equipped with a latching device. When gates are used, they will be at least 66 inches high, with a maximum underclearance of 2 inches, and will be no more than 4 inches from the hoist sill. Gate grilles or lattice will have openings no larger than 2 inches.

19.19.7 Overhead Protection. Protect the top of the cage or platform with 2-inch planking, 3/4-inch plywood, or material of equivalent strength.

19.19.8 Tower Enclosures. The following requirements will apply:

a. Enclosed. An enclosed hoistway or tower will be enclosed on all sides for its entire height, with 1/2-inch wire mesh screen, No. 18 U.S. American Wire Gauge (AWG) or equivalent, except at access points.

b. Open Sides. For an unenclosed hoist tower, totally enclose the hoist cage or platform on all sides between the floor and the protective top with 0.5-inch wire mesh screen, No. 14 AWG, or equivalent. The hoist cage or platform enclosure will include the required gates for loading and unloading. Install an enclosure at least 6 feet high on the unused sides of the hoist tower at ground level.

19.19.9 Operator's Station. Protect the operator's station with overhead planking not less than 2 inches thick or with material of equivalent strength.

19.19.10 Towers and Shaftways. A P.E. will design towers and shaftways with a safety device capable of stopping and holding the platform with maximum load in the event of a cable failure.

19.19.11 Tower Support. Towers will rest on solid foundations. Ensure that the towers are plumb and well guyed or otherwise anchored in four directions at the top and at least every 30 feet in height.

19.19.12 Hinged Roof. The car or platform roof may be hinged to accommodate long material.

19.19.13 Electric Hoists. Electric hoists will be provided with an automatic motor brake to stop and hold the load in case of a power failure.

19.19.14 Operating Restrictions. One hoisting machine, or one operator, will operate only one cage, bucket, or hoist platform at a time.

19.19.15 Hoisting Machines. Design and install hoisting machines to raise and lower the maximum rated load, plus the weight of equipment and ropes. Hoisting machines will incorporate the following features:

a. Brakes. The brakes will be capable of stopping and holding 125 percent of the rated hoisting capacity under all operating conditions.

b. Mechanical Brakes. Install mechanical brakes to stop movement of the hoist drum, and equip the mechanical brakes with a positive acting device that will hold the brake in the engaged position.

c. Ratchet and Pawl. Equip friction-clutch-driven winding drum hoisting machines with an effective pawl and ratchet capable of holding the rated load capacity when suspended.

d. Controls. All controls will, when released, automatically return to neutral and set the brake. Plainly mark each control to indicate its function; it will be within easy reach of the operator.

19.19.16 Position Indicator. Use a positive system to indicate when the hoist car or platform has reached specific locations, including the top and bottom landings.

19.19.17 Signal System

a. Hand Signals. Hand signals may be used on a single drum hoist when the hoist tower is no more than 50 feet high and the signals are clearly visible to the operator at all times.

b. Communications. Use audio communications on all other material hoist installations. The system will be two-way, with a speaker located at the hoist operator’s station and at each landing. The hoist operator will be able to communicate by voice to and from each station.

19.19.18 Fire Extinguisher. Mount a fire extinguisher of 2-A:40-B:C rating at the operator’s station.

19.19.19 Inspections and Performance Testing. Performance test material hoists under the direction of the design engineer or his or her designee. Conduct the test in accordance with the requirements of ANSI A10.5, “Safety Requirements for Material Hoists,” and Subsection 19.3. Include the car-arresting device in the test.

19.20 Requirements for Personnel Hoists

Construct, install, test, operate, and maintain personnel hoists as set forth in the current edition of ANSI/American Society of Safety Engineers (ASSE) A10.4, “Safety Requirements for Personnel Hoists on Construction and Demolition Sites,” and the requirements of this subsection.

19.20.1 Design and Installation. Observe manufacturer’s drawings, specifications, and limitations when installing and operating personnel hoists. A qualified person will design all personnel hoists, and a P.E. will certify them.

19.20.2 Inspections and Performance Tests. A qualified person will inspect and performance test personnel hoists at initial installation and inspect them annually thereafter. Conduct the tests in accordance with ANSI/ASSE A10.4. Maintain a comprehensive report detailing test and inspection procedures and results.

19.20.3 Posting. Post rated load capacities, recommended operating speeds, and special hazard warnings on cages, platforms, and at the operator’s station.

19.20.4 Hoistway Enclosure. Hoist towers that are installed outside buildings or structures will be enclosed for the full height of the side, or sides, used to enter or exit the building or structure. Enclose the other sides to a height of at least 10 feet above the lowest landing. Enclose the sides of the tower adjacent to floors or scaffold platforms to a height of 10 feet above the level of such floors or scaffolds. Enclose towers inside buildings or structures on all four sides throughout the full height.

19.20.5 Tower Anchorage. Anchor towers to the structure at no less than 25-foot intervals. Where tie-ins are not practical, anchor the tower by wire rope guys that are at least 0.5 inch in diameter and securely fastened to anchorages to ensure stability.

19.20.6 Cage Enclosure. Fully enclose cages on all sides and the top, except sides used for entrance, which will have car gates or doors that completely cover the opening and are interlocked to prevent movement of the cage unless the gates are closed.

19.20.7 Overhead Protection. Overhead protection of 2-inch planking, 0.75-inch plywood, or other material of equivalent strength will cover the top of the cage.

19.20.8 Overspeed Safety Device. Equip the cage with an overspeed safety device that will stop and hold the cage, plus the maximum rated load, if the cage exceeds governor tripping speed or the hoist rope fails.

19.20.9 Brakes. Equip the hoist with two independent braking systems. One braking system will automatically operate when the controls are in neutral or when there is a power failure. The other braking system may be manually operated and attached to the hoist drum. Each braking system will be capable of stopping and holding 125 percent of the rated load in any position.

19.20.10 Power Up and Power Down. Design the hoist power unit to provide power up and power down at all times.

19.20.11 Controls. On manually controlled hoists, the controls will return to the stop position when pressure is removed from the control lever.

19.20.12 Maximum Speed. The speed of the cage will not exceed 200 feet per minute.

19.20.13 Travel Limit Stops. Equip hoists with upper and lower travel limit switches.

19.20.14 Hoist Ropes. Hoist wire ropes will meet the following minimum requirements:

a. Minimum Number. Drum hoists will have at least two hoisting ropes, and traction hoists will have at least three hoisting ropes.

b. Safety Factor. Hoisting ropes will have a minimum safety factor as identified in table 19-6, but in no event may the ropes be less than 0.5 inch in diameter.

Table 19-6.—Safety factors for hoisting ropes used in personnel hoists

Rope speed (feet per minute)	Minimum safety factor
0-100	8.00
101-125	8.10
126-150	8.25
151-175	8.40
176-200	8.60
201-225	8.75
226-250	8.90
251-300	9.20
301-350	9.50
351-400	9.75
401-500	10.25
501-600	10.70

19.20.15 Emergency Stop Switch. Install an emergency stop switch in the cage and mark it “STOP.”

19.20.16 Maintenance Access. Provide safe access for inspection and maintenance of hoist towers and equipment.

19.20.17 Bridge Tower Construction. A P.E. will design and supervise the erection of personnel hoists used in bridge tower construction. Inspect these hoists at least weekly and whenever exposed to winds exceeding 35 mph.

19.20.18 Wire Rope. Inspect hoisting rope daily and remove it from service when any of the conditions described in Subsection 19.10, “Requirements for Working with Wire Rope,” exist.

19.20.19 Signals. When a hoist operator controls personnel hoists, users will signal the operator either: (1) through direct radio communications with that operator or (2) through a visual and audible, electrically operated signal system between the operator and each cage access point.

19.21 Requirements for Elevators

Design, construct, test, inspect, and maintain permanent elevators in accordance with the current editions of ANSI/ASME A17.1, "Elevators and Escalators," ANSI/ASME A17.2, "Inspectors' Manual for Elevators and Escalators," and FIST 2-10, "Maintenance, Inspection, and Testing of Electric and Hydraulic Elevators." Design, install, and test elevators under the direction of the manufacturer or a P.E. Following installations, inspect, test, and certify elevators in accordance with referenced standards.

19.21.1 Inspection. In States with elevator codes, elevators will be inspected in accordance with State standards by an inspector acceptable to the State authorities. In States that do not have an elevator code, elevators will be inspected annually following the requirements of ANSI/ASME A17.2 and FIST 2-10.

19.22 Requirements for Cableways

In addition to the requirements of this subsection, cableways will comply with the installation, testing, operation, and maintenance requirements in Section 19 and the standards in the current edition of ASME/ANSI B30.19, "Safety Standard for Cableways, Cranes, Derricks, Hoists, Hooks, Jacks, and Slings."

19.22.1 Design and Installation. A P.E. will design cableways. Install and operate cableways according to the P.E.'s design drawings, specifications, and operating, maintenance, and inspection instructions.

19.22.2 Inspection and Performance Tests. Conduct inspections and performance tests in accordance with the requirements of this subsection and ASME/ANSI B30.19.

19.22.3 Inspection and Maintenance. Inspect all cableway components daily and provide daily routine maintenance and lubrication.

19.22.4 Cableway Log. Maintain a log for each cableway to record inspections, lubrication, maintenance, and repair activities. The log will also include operating time and downtime, and the employee responsible for performing the maintenance or repair work will sign it. Make the log available for review.

19.22.5 Signal System. Continuously maintain at least two systems of communication between the operator and the signalperson. At least one of the systems will provide voice communication by telephone or radio. The second system may use lights or bells as the signaling means. When the dual system is not functioning properly, the operator may deliver the load suspended from the cableway, but the operator will rig no further load until both communication systems are functioning.

19.22.6 Control Consoles. During operation of the cableway, permit only the operator(s) in the control console room. The console room windows will be safety glass that introduces no distortion that would interfere with the safe operation of the cableway.

19.22.7 Operating Controls. All controls will automatically return to neutral and set the brakes when released. Plainly mark each control to indicate its function and ensure that it is within easy reach of the operator.

19.22.8 Cableway Platforms and Carriages. Provide cableway inspection platforms, moving and stationary, with standard guardrails and toeboards. Enclose open areas on carriages and moving platforms with wire mesh to reduce the hazard from falling objects.

19.22.9 Concrete Buckets. Design concrete buckets with a safety device to prevent accidental opening of the bucket while in transit to the discharge site. Construct buckets to prevent aggregate from lodging on any part of the bucket. Refer to Section 25, “Concrete, Masonry, Construction, and Formwork,” of the RSHS.

19.22.10 Riding Cableways. Prohibit riding the cableway, except for designated maintenance personnel who may ride the carriage service platform of a cableway to perform inspections or maintenance. Prepare and review a JHA before performing inspections or maintenance.

19.22.11 Track-Mounted Towers. Equip track-mounted cableway towers or structures with both limit switches and rail stops, or with buffers at each end of the tracks. Equip the wheel with track or rail sweeps that extend below the top of the rail and are effective in all directions of travel. When two or more towers operate on the same track, install an automatic control system to prevent the towers from colliding.

19.23 Requirements for Specialized Hoisting Systems

19.23.1 Draglines. Do not use draglines as hoisting devices without the manufacturer’s approval. When used for lifting, they will meet all of the requirements of Subsection 19.13, “Requirements for Mobile and Locomotive Cranes.”

19.23.2 A-Frame Trucks. The design and operation of A-frame trucks will conform to this subsection and Section 20, “Mobile and Stationary Mechanized Equipment,” of the RSHS. Do not use A-frame trucks to hoist personnel.

19.23.3 Mobile Hydraulic Excavators and Hoes, Crawlers, Wheel Loaders, and Similar Machines

a. Requirement. Do not use mobile hydraulic excavators and hoes, crawlers, wheel loaders, and similar machines to hoist personnel. Use them to hoist materials only when they conform to the requirements of this paragraph and appropriate Society of Automotive Engineers recommended practices. Applicable standards are identified in Appendix L, "Referenced Material," of the RSHS.

b. Restrictions. Use only machines that are certified for hoisting by the manufacturer and are equipped with manufacturer-installed, closed lifting eyes or lugs for hoisting. The maximum load in any machine position will not exceed the rated capacity in the least stable position.

c. Testing. Load test the machine at 100 percent of the load rating chart. Hoist test loads clear of the ground at the maximum load radius and move them through the maximum angle of articulation or arc radius in both directions from the longitudinal centerline of the machine.

19.23.4 Facility Maintenance Hoisting Systems. Design, construct, install, and use hoisting systems to inspect and maintain facilities, such as penstocks, spillways, and airshafts, and for external building maintenance such as window washing, in accordance with ANSI/ASSE A10.22, "Safety Requirements for Rope-Guided and Nonguided Workers' Hoists for Construction and Demolition Operations," or ANSI/ASME A120.1, "Safety Requirements for Powered Platforms and Traveling Ladders and Gantries for Building Maintenance." The manufacturer or a P.E. will certify such hoisting systems for the intended use. Hoisting systems used on an incline or other nontraditional use will undergo a peer review by an independent P.E. The review will include the structure, controls, operating procedures, and a performance test of the completed and assembled system.

19.24 Requirements for Pile Driving Equipment

19.24.1 Qualifications. Pile driving will be carried out only under the supervision of a competent person. Only qualified persons will be permitted to operate pile drivers.

19.24.2 Preliminary Inspection. Prior to start of operations, thoroughly inspect the site to determine conditions that require special safety measures. Locate all underground and overhead utilities. Safe clearance requirements will be met for overhead utilities, and all underground services in the area will be rendered safe.

19.24.3 Setup. Pile driving equipment will be erected on a firm foundation. If necessary, use adequate guylines, outriggers, thrustboards, counterbalances, or rail clamps to stabilize pile driving equipment during operation.

19.24.4 Boilers and Pressure Vessels. Boilers and pressure vessels used in pile driving operations will conform to the requirements and standards set forth in Subsection 17.12, "General Requirements for Boilers and Unfired Pressure Vessels," of the RSHS.

19.24.5 Hoisting Equipment. Cranes used to drive or extract piling will conform to the requirements and standards set forth in the applicable parts of Section 19 of the RSHS. Do not equip pile driving equipment hoist drums with dogs that automatically disengage by relieving the load or by rotating the drum. Install guards to prevent the hoist line from jumping out of the headblock.

19.24.6 Driving Leads. Provide pile driving equipment leads with fixed ladders and attachment points for safety harness lanyards.

19.24.7 Hose Connections. Secure high-pressure hose connections (air, steam, hydraulic) with a whip-check device that is adequate to prevent whipping if a connection breaks.

19.24.8 Hammer. Adequate precautions will be taken to prevent the hammer from missing the pile. When employees will work under the hammer, place a blocking device in the leads that can support the hammer. Provide pile driver leads with stops to prevent the hammer from being raised into the headblocks.

19.24.9 Floating Pile Driving Equipment. Hulls for floating pile driving equipment will be at least as wide as 45 percent of the height of the lead above the water. Protect the operating deck to prevent suspended piling from swinging or drifting in over the deck. The weight of machinery on floating pile driving equipment will be evenly distributed so that the deck is horizontal.

19.24.10 Overhead Protection. Provide overhead protection for the operator equivalent to 2-inch planking. Position the overhead protection in a way that does not interfere with the operator's view of the pile driver.

19.24.11 Inspection. Pile driving equipment will be inspected prior to being used on the jobsite and daily prior to each start of each shift.

19.24.12 Operation

a. Noise Survey. A noise survey using a sound level meter, A-scale, fast response will be conducted at the beginning of piledriving operations to determine a distance from the pile driver where noise levels do not exceed 85 decibel A-weighting. Employees working inside of the boundary will wear hearing protection at all times when pile driving operations are conducted.

b. Preparation of Piles. As far as practicable, piles will be prepared at a distance at least equal to twice the length of the longest pile from the pile driving equipment.

c. Moving the Pile Driver. When moving the pile driver, lower the hammer to the bottom of the leads. When not in use, the pile driver hammer will be blocked at the bottom of the leads.

d. Signals. Suitable signals for the control of the pile driving operation will be developed prior to the start of the job.

e. Cutting Piles. Do not trim piles within a distance from the pile driver of twice the length of the longest pile.

f. Hoisting Piling. Remote release shackles will be used when possible; if not used, provide a closed shackle or other positive means of attachment. The length of the operating rope will be less than the length of the pile, and the rope will be secured around the pile to prevent snagging or being blown out of reach by the wind. Employees will be kept in the clear when hoisting piles. Use tag lines to control unguided piles and flying hammers.

g. Pulling Piles. Use extractors to pull piling that cannot be pulled without exceeding the safe load rating of the pulling rig. When pulling piling, do not elevate the crane boom more than 60 degrees from the horizontal.

19.25 Helicopter Operations

19.25.1 Requirement. Operators and aircraft will be licensed and will comply with the applicable requirements of the Federal Aviation Administration; the U.S. Department of the Interior’s Office of Aviation Services; ASME/ANSI B30.12, “Handling Loads Suspended from Rotorcraft”; and this subsection.

19.25.2 Briefing. Before each day’s operation, conduct a briefing for pilots and ground personnel and discuss in detail the plan of operation.

19.25.3 Loads. Secure suspended loads with pressed sleeves, swaged eyes, or equivalent means to prevent hand splices from spinning open or cable from loosening. Tag lines will be short enough to avoid being drawn into the rotors.

19.25.4 Cargo Hooks. Use self-locking cargo hooks that are equipped with a quick-release device that can be activated from the pilot's location. Electrically operated cargo hooks will have the electrical activating device designed and installed to prevent accidental operation. Also, equip these hooks with an emergency control to release the load. Test the hooks before each day's operation to ensure that they function properly.

19.25.5 Personal Protective Equipment. Employees who receive the load will wear safety goggles and hard hats equipped with chinstraps. Employees will not wear loose-fitting clothing that may become snagged on the hoist line.

19.25.6 Downwash. Remove or secure material and loose gear within 100 feet of the lift or delivery site.

19.25.7 Operator Responsibility. The helicopter pilot is responsible for the size, weight, and manner in which loads are connected to the helicopter. Do not make the lift if the pilot considers it unsafe.

19.25.8 Hooking and Unhooking. Employees will not perform work under the hovering helicopter, except as necessary to hook and unhook loads. Provide a safe means of access and egress for employees to approach the hook to engage or disengage cargo slings.

19.25.9 Static Charge. Unless ground personnel use a grounding device to dissipate the static charge, they will wear appropriate electrically rated rubber gloves.

19.25.10 Weight Limitations. The weight of the load and rigging will not exceed the aircraft manufacturer's rating, considering altitude and ambient temperatures that exist at the time.

19.25.11 Ground Lines. Do not attach hoist wires or other gear, except for pulling lines or conductors that "payout" from a container or roll off a reel, to any fixed ground structure or allow wires or other gear to foul on any fixed structure. Use only pulling lines or conductor stringing systems designed with stress release hardware located so that it protects the aircraft against overload and line entanglement with rotors.

19.25.12 Visibility. When dust or other conditions reduce visibility, ground personnel will exercise special caution to keep clear of the rotor blades. The employer will reduce the possibility of dust to the extent practical.

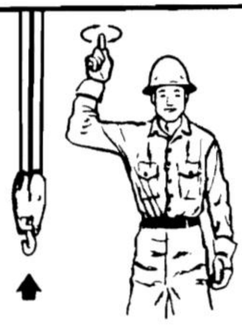
19.25.13 Approaching Helicopters. Permit only authorized personnel to approach within 50 feet of a helicopter with turning rotor blades. People approaching or leaving a helicopter with the blades turning will keep within full view of the pilot and assume a crouched position. Persons will stay out of the area from the cockpit or cabin rearward unless the pilot authorizes them to enter that area.

19.25.14 Radio Communication. Provide reliable radio communication between the pilot and a designated member of the ground crew during all loading, unloading, and rigging operations.

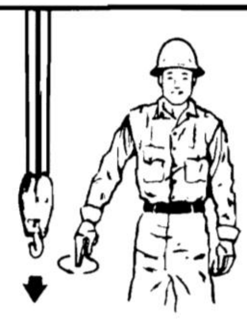
19.25.15 Hand Signals. When personnel use hand signals, they will use standard "Helicopter Hand Signals" (see figure N-1, 29 CFR 1910.183(n)]. The signal person on the ground will be distinguishable from other ground personnel.

Attachment 19-1

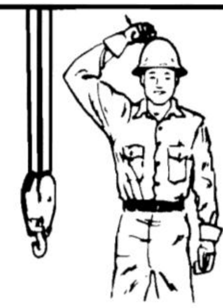
Hand Signals for Cranes and Hoisting Equipment



HOIST With forearm vertical, forefinger pointing up, move hand in small horizontal circle.

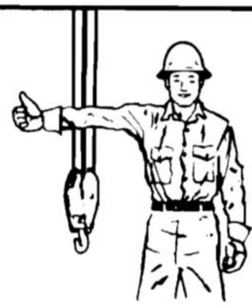


LOWER With arm extended downward, forefinger pointing down, move hand in small horizontal circle.

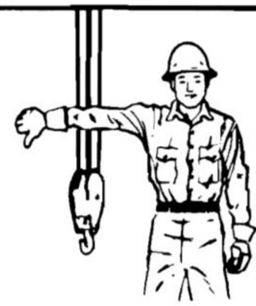


USE MAIN HOIST. Tap fist on head; then use regular signals.

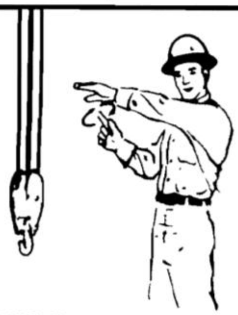
USE WHIPLINE (Auxiliary Hoist). Tap elbow with one hand; then use regular signals.



RAISE BOOM. Arm extended, fingers closed, thumb pointing upward



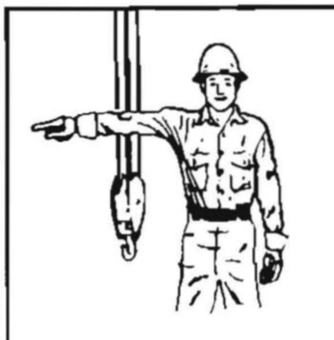
LOWER BOOM. Arm extended, fingers closed, thumb pointing downward.



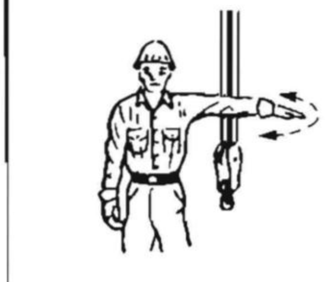
MOVE SLOWLY Use one hand to give any motion signal and place other hand motionless in front of hand giving the motion signal. (Hoist slowly shown as example.)

RAISE THE BOOM AND LOWER THE LOAD. With arm extended, thumb pointing up, flex fingers in and out as long as load movement is desired

LOWER THE BOOM AND RAISE THE LOAD. With arm extended, thumb pointing down, flex fingers in and out as long as load movement is desired.

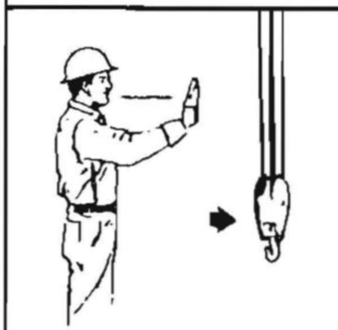


SWING. Arm extended, point with finger in direction of swing of boom

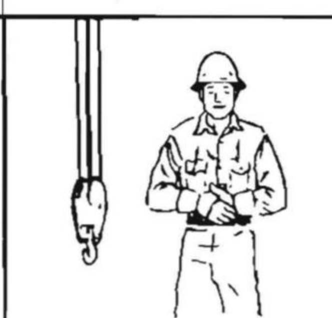


STOP. Arm extended, palm down, move arm back and forth horizontally

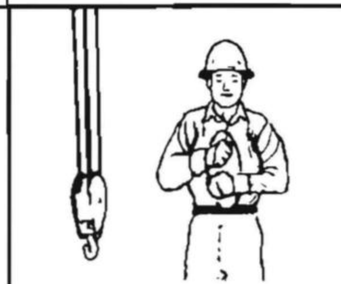
EMERGENCY STOP. Both arms extended, palms down, move arms back and forth horizontally



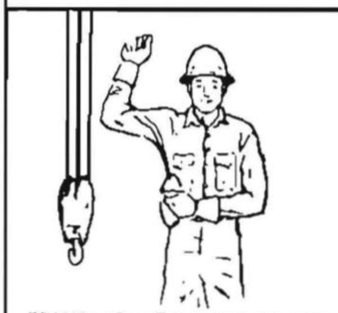
TRAVEL. Arm extended forward, hand open and slightly raised, make pushing motion in direction of travel



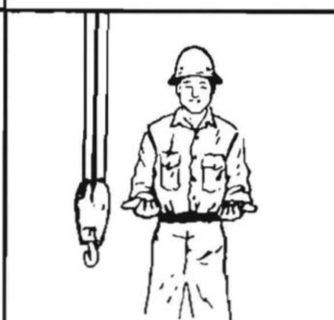
DOG EVERYTHING. Clasp hands in front of body



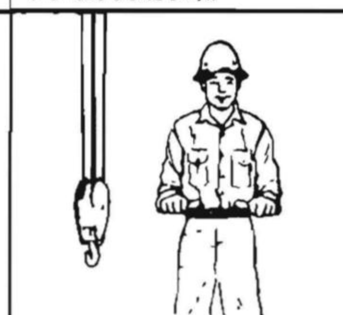
TRAVEL (Both Tracks). Use both fists in front of body, making a circular motion about each other, indicating direction of travel, forward or backward. (For land cranes only.)



TRAVEL (One Track). Lock the track on side indicated by raised fist. Travel opposite track in direction indicated by circular motion of other fist, rotated vertically in front of body. (For land cranes only.)



EXTEND BOOM (Telescoping Booms). Both fists in front of body with thumbs pointing outward



RETRACT BOOM (Telescoping Booms). Both fists in front of body with thumbs pointing toward each other

EXTEND BOOM (Telescoping Boom). One Hand Signal. One fist in front of chest with thumb tapping chest.

RETRACT BOOM (Telescoping Boom). One Hand Signal. One fist in front of chest, thumb pointing outward and heel of fist tapping chest.

Section 20

Mobile and Stationary Mechanized Equipment

This section sets forth the requirements and standards for Reclamation's safety and occupational health programs. It covers the following specific areas:

- Operational Requirements
- Inspections
- Maintenance
- Testing
- Crawler Equipment
- Off-Highway Wheel Construction Machines
- Agricultural and Industrial Equipment
- Industrial Trucks
- A-Frame Trucks
- Aerial Lifts
- Other Mechanized Construction Equipment Standards
- Roads

Mobile mechanized equipment requirements contained and referenced in this section are applicable to all equipment propelled or drawn by mechanical power except rail rolling stock, passenger cars, trucks under 10,000 pounds, trailers under 3,000 pounds gross weight that meet Department of Transportation (DOT) design standards, snowmobiles, motorcycles, and all-terrain recreation machines.

20.1 Operational Requirements

20.1.1 Operators. Allow only authorized personnel to operate mobile equipment. Assign operators only to equipment they are qualified and licensed to operate. Provide operators with the instructions and training that their jobs require and ensure that operators:

- Meet the physical requirements of their job
- Meet the DOT licensing requirements for on-highway operations
- Do not operate mobile equipment for over 12 hours in any 24-hour period
- Comply with applicable operating instructions, limitations, regulations, and written safety programs and plans

Do not allow the operation to begin or continue if the operator is not physically, mentally, and emotionally capable of operating the vehicle or equipment safely.

20.1.2 Unusual Equipment Configurations. Refer to the section, "Hoisting Equipment, Piledrivers, and Conveyors."

a. Examples. Examples of unusual equipment configurations:

- Special use or conditional operations of dozers or other earthmoving equipment
- Anchoring mobile earthmoving or drilling equipment on steep slopes
- Hoisting with hydraulic excavating machines or multiple crane lifts
- Using a crane in conjunction with other equipment to lift loads

b. Requirements. Do not use equipment in unusual configurations until the following information and procedural documents have been obtained or developed:

- Equipment manufacturer or registered professional engineer's (PE) written approval
- Appropriate confirmation that hoisting systems used to raise, lower, suspend, or stabilize equipment on slopes meet applicable design, testing, and certification requirements
- A Job Hazard Analysis (JHA)

c. Exceptions

- Hydraulic excavating machine hoisting operations conforming with applicable provisions in the section, "Hoisting Equipment, Piledrivers, and Conveyors."
- Operation of equipment on 30 percent or less grades when the operational assist system, dozer blades, loader buckets, dippers, winches, etc., are not required to stabilize the working machine in any operational configuration

20.1.3 Parking, Stopping, Standing. Do not stop, park, or leave standing any equipment on any road, ramp, accessway, or other location in such a manner as to endanger personnel or property. Do not leave equipment unattended unless the motor has been shut off, brakes securely set, transmission gears engaged, and all hydraulic components lowered to a supporting surface or otherwise protected against accidental movement. Chock or turn the wheels toward the curb on any equipment parked on a grade.

Transmix concrete trucks, lubrication trucks, fuel trucks, and similar equipment using primary engine-powered auxiliary equipment, also know as power take off (PTO), and/or exterior controls are not considered unattended when:

- The operator is outside the cab but within arms length of the unit or is in contact with auxiliary equipment or controls.
- The primary unit's brakes and gearing arrangements are designed for safe use of auxiliary attachments and/or exterior controls are in the proper position.
- The primary unit is equipped with an automatic lockout device that prohibits operating exterior controls until the brake and gear arrangements are in the proper position.

Diesel-powered earthmoving equipment being refueled or cooled down in a secured area or under visual observation of the operator or a mechanic, with brakes set and wheels chocked and hydraulic components lowered to a supporting surface, is not considered unattended.

20.1.4 Speeds. Do not operate equipment at speeds greater than those that are reasonable and safe considering weather conditions, traffic, road conditions, type and condition of equipment, and manufacturer's recommendations. The operator must have the equipment under control at all times and be able to stop within the clear-sight distance.

20.1.5 Gears Engaged. Do not operate any vehicle on a downgrade with gears in neutral or clutch disengaged.

20.1.6 Towing. Do not permit employees between a towed vehicle and the towing vehicle, except when hooking or unhooking it.

20.1.7 Unattended at Night. Make sure equipment left unattended after hours on or near roadways or in areas where work is in progress has lights, reflectors, or lighted or reflective barricades to identify the location of the equipment.

20.1.8 Unauthorized Riding. Do not allow personnel to ride in or on mobile equipment unless they are sitting in a seat designed and installed for that purpose.

20.1.9 Securing Loads. Properly distribute, chock, tie down, or otherwise secure the load on every piece of mobile equipment according to DOT regulations (table 20-1). Secure tools and material transported in the same compartment as personnel to prevent movement of the tools and material.

Table 20-1.—Applicable standards and regulations

Regulation standard	Title	Reference in section
49 CFR 390-399	Federal Motor Carrier Safety Regulations	20.5
49 CFR 393.93	Seats, Seatbelt Assemblies and Seatbelt Assembly Anchorages – Federal Motor Carrier Safety Regulations	20.6.9
49 CFR 399.207	Truck and Truck Tractor Access Requirements – Federal Motor Carrier Safety Regulations	20.6.8 App. F, (7) App. H, (5)
49 CFR 393.100	General Rules for Protection Against Shifting or Falling Cargo - Federal Motor Carrier Safety Regulations	20.1.9
49 CFR 393.40	Required Brake Systems – Federal Motor Carrier Safety Regulations	20.6.3 App. F (32)
29 CFR 1910.178	Powered Industrial Trucks	20.10 20.10.8
ANSI/ASME B30.5	Mobile and Locomotive Cranes	App. F(1)
ANSI/ASME B56.1	Safety Standard for Low Lift and High Lift Trucks	20.10
ANSI/ASME B56.6	Safety Standard for Trough Terrain Forklift Trucks	20.10
ANSI/SIA A92.2	Vehicle Mounted and Elevating Rotating Aerial Devices	20.12
ANSI/SIA A92.3	Manually Propelled Elevating Aerial Platforms	20.12
ANSI/SIA A92.5	Boom Supported Elevated Work Platforms	20.12
ANSI/SIA A92.6	Self-Propelled Elevating Work Platforms	20.12
ANSI B15.1	Safety Standard for Mechanical Power Transmission Apparatus	20.13.1
ANSI A92.2 Section 5	Predelivery Testing and Inspection of New Aerial Devices	20.12
SAE J682	Fenders and Mudflaps	App. G, 8
J/ISO 3450	Braking Performance - Rubber-tired Construction Machines (Formerly SAE J1152)	20.5.2 20.7.2 App. H (17) App. F (32)
SAE J1040	Performance Criteria for Rollover Protection Structures (ROPS)	20.6.1 App. H (12)
SAE/JISO 3449	Earth Moving Machinery - Protective Structures - Laboratory Tests and Performance Requirements	20.6.2 App. H (13)
SAE J1084	Operator Protective Structure Performance Criteria for Certain Forestry Equipment	20.6.3 App. H (14)
SAE J1116	Categories of Off-Road Self Propelled Work Machines	20.6.9
SAE J386	Operator Restraint Systems for Off-Road Work Machines	20.6.9 App. H (10)
SAE J185	Access Systems for Off-Road Machines	20.6.8 App. F (7) App. H (7)

Table 20-1.—Applicable standards and regulations

Regulation standard	Title	Reference in section
SAE J1029	Lighting and Marking of Construction Earth Moving Machinery	App. H (5)
SAE J321	Tire Guards for Protection of Operators of Earth Moving Haulage Machines	App. H (9)
SAE J1194	Rollover Protective Structures (ROPS) for Wheeled Agricultural Tractors	App. H (10)(12)(13)
SAE J1042	Operator Protection for General Purpose Industrial Equipment	App. H(10)(12)(13)
SAE J167	Overhead Protection for Agricultural Tractors	App. H (13)
SAE J220	Crane Boomstop	App. F (16)
SAE J101	Hydraulic Wheel Cylinders for Automotive Drum Brakes	App. H (12)
SAE J115	Safety Signs	App. H (15)
SAE J1511	Steering for Off-Road Rubber-Tired Machines	App. H (15)
SAE HS-5600	Lighting and Marking of Agricultural Equipment on Highways	App. H(5)

20.1.10 Seats and Seatbelts. Do not allow operators or passengers to ride on or in equipment unless they are seated with installed seatbelts fastened, except for stand-up operation.

20.1.11 Emergency Equipment. Equip all trucks and combination vehicles operated on public roads including all buses, and vehicles carrying flammables, explosives, or hazardous materials with emergency equipment. Equip all mobile machines with appropriate fire extinguishers.

- ***Flags and reflectors***. Use a red flag measuring at least 12 inches square with three reflective markers when parked along public roadways.
- ***Wheel chocks***. Use two-wheel chocks for each vehicle or trailer use where there is a possibility that the vehicle will move or shift because of roadway conditions or loading or unloading of the vehicle or trailer.
- ***Fire extinguishers***. Install one 2-A:40-B:C dry chemical extinguisher. When transporting flammable or explosive cargo, install at least two 2-A:40-B:C dry chemical fire extinguishers.

20.2 Inspection Requirements

20.2.1 Initial. Qualified personnel must inspect mobile equipment before conducting required onsite brake performance tests to ensure that the equipment is in safe condition and that it meets the original design specifications and the standards of this section. Conduct the inspection at the site. Ensure that the inspection is recorded on the applicable form and verified by a Reclamation representative. Repair unsafe equipment and reinspect it before it is returned to service and/or before the brakes are tested. The employer must inspect equipment exempted from brake tests before it is used onsite. Repair and reinspect the equipment if it is unsafe. Make a record of the inspection available for review.

20.2.2 Periodic. Inspect equipment in service at the beginning of each shift. Do not place the inspected unit into service unless applicable equipment and accessories are in safe operating condition, including:

- Service brake
- Secondary brake
- Parking brake
- Windows
- Tires
- Warning devices
- Steering mechanism
- Operating controls
- Wipers
- Defrosters
- Coupling devices
- Fire extinguisher

Keep daily inspection logs with the vehicle.

20.3 Maintenance Requirements

20.3.1 Removal from Service. Remove equipment from service whenever an unsafe condition is detected. Do not place it back in service until it has been repaired.

20.3.2 Repair Shutdown. Shut down and secure equipment while repairs or adjustments are being made unless operation is essential to making the adjustments or repairs.

20.3.3 Refueling. Refueling is subject to the requirements in the section, "Standards for Material Handling, Storage, and Disposal."

20.3.4 Tire Repair. Provide a safety tire cage and use it when inflating, mounting, or dismounting tires installed on "split rims" or rims equipped with locking rings or similar devices. Do not weld on rims unless the tire has been removed. Reference the OSHA specified "Multi-Piece Rim Wheel Matching Chart" or equivalent poster.

20.3.5 Blocking. Block or crib equipment or parts suspended or held aloft by cables, hydraulic cylinders, slings, ropes, hoists, or jacks, or lower it to a supporting surface before permitting employees to work in, under, or between pieces of equipment or parts.

20.3.6 Brake Repair. Use a vacuum with a high efficiency particulate air (HEPA) filter to clean asbestos-lined brake assemblies. Do not use compressed air for this purpose.

20.4 Testing Requirements

Conduct operational tests, required by the manufacturer's maintenance and operational manuals accompanying the machine or equipment, at recommended intervals. Appropriately log test results and make them available. Onsite brake tests for specific equipment are included in operation tests. Loading tests are required for operational testing of cranes.

20.5 Requirements for On-Highway Equipment

Trucks over 10,000 lb (GVW), including but not limited to tractor/trailer combinations, transmix trucks, dump trucks and buses, and self-propelled and rubber-tired truck cranes and excavators shall meet the applicable requirements of this section and subsection, appendix G, and applicable DOT requirements contained in Federal Motor Carrier Safety Regulations 49 CFR 390-399 (see table 20-1).

20.5.1 Dump Trucks and End-Dump Trailers. Equip dump trucks and end-dump trailers of all types with the following safety devices:

a. Trip Handles. Equip trip handles or dump body operating levers that control hoisting or dumping with a latch or similar device that will prevent accidentally starting or tripping the mechanism. Locate the trip handle so the operator remains clear of the load or dumping device.

b. Holding Device. Permanently attach a manually operated strut to the truck body for use in preventing accidentally lowering the dump body or bed during inspection or maintenance operations. Use the holding device when personnel are around or under the dump body and the bed is in the raised position.

c. Cab Protection. Protect the operators of trucks loaded or unloaded by means of a crane, power shovels, loaders, or similar equipment with a cab shield barrier and/or a protective canopy adequate to stop or deflect falling or shifting material. When such protection is not installed, the operator must leave the cab during loading and unloading operations.

d. Tip-Over Safety Device. Under the following circumstances, equip long-bed end-dump trailers used in off-road hauling with a roll-over warning device:

- The material being dumped is subject to being stuck or caught in the trailer rather than exiting the bed freely.

- The dump site cannot be maintained in a nominally level condition (lateral slope less than 3 percent).

Equip the device with a continuous monitoring display at the operator station to give the operator a visible and audible warning of an unsafe condition.

20.5.2 Braking Systems. Equip all on-highway equipment with braking systems as described herein and in appendix G.

a. Equip a bus, truck, tractor-trailer, combination of vehicles, or similar type equipment with the following braking systems that conform to these requirements and the requirements in appendix G:

1. A service brake system
2. A parking brake system
3. A secondary braking system

b. Equip mobile cranes and excavators, mounted on rubber-tired chassis or frames, and manufactured after July 1967 with a service braking system, secondary stopping (brake) system, and a parking brake system. (See provisions of appendices F or G for detailed requirements.)

20.5.3 Brake Performance Test. After satisfactorily completing initial inspection requirements of this section and appendix F or G (whichever appendix is applicable), but prior to initial onsite use, equipment must satisfactorily complete an onsite brake performance test. Subsequent tests must be conducted annually, or following repair or maintenance of braking systems. Equipment owned/leased and operated by suppliers and engaged in limited operation on the project are exempted from brake performance test and inspection requirements. Onsite brake performance tests will be verified by a Reclamation representative on each piece of equipment in accordance with the manufacturer's prescribed method for brake performance testing if:

a. The procedure is in writing.

b. The method verifies the operation of the service, secondary, and parking brake systems.

c. The manufacturer's opinion is adequate to verify that the braking systems would meet the applicable SAE standard requirements.

In lieu of an acceptable manufacturer-approved brake performance test procedure, onsite brake performance tests will be verified by a Reclamation representative on each piece of equipment in accordance with appropriate method and procedures (see appendices F and G). Test results will be recorded on the appropriate form and maintained in the equipment file.

Equipment failing the test shall not be placed into service until repaired and retested.

20.6 Crawler Equipment Requirements

Crawler equipment and operations must meet the requirements of this section, appendix F and applicable references in table 20-1.

20.6.1 Rollover Protective Structures (ROPS). Install ROPS on all crawler tractors and loaders except side-boom crawler tractors when these are equipped with seatbelts and the boom and counterweights are installed.

20.6.2 Falling Objects Protective Structures (FOPS). Equip crawler tractors and loaders with protective structures when they are used in operations that expose the operator to falling objects.

20.6.3 Operator Enclosure. Equip crawler tractors, loaders, or forestry machines with enclosures when used in tree-clearing operations or other operations where objects may intrude into the operator's area.

20.6.4 Certification of Protective Structures (ROPS)(FOPS). Make certain that protective structures, ROPS and FOPS, meet required design criteria available for review before the equipment is used. Acceptable methods of certification are:

- Manufacturer’s or PE's written confirmation that the structures meet required design criteria
- Permanent labels attached to the structure

20.6.5 Modification or Repair of Protective Structures—ROPS and FOPS. Modification or repair of protective structures of ROPS and FOPS without manufacturer or PE's written approval voids certifications. Remove decertified protective structure(s) from service until the modified, repaired, or damaged protective structure is recertified or replaced.

20.6.6 Braking Systems. The service and parking brake systems on crawler equipment must be adequate to stop and hold the machine on all surfaces.

20.6.7 Accessories. Equip all crawler equipment with the following accessories:

a. Lights. Equip machines operated at night or when vision is obscured with two symmetrically mounted lights or flood lamps that illuminate the forward working area and with one light or flood lamp of equal intensity for illuminating the rear working area.

Also provide one bucket lamp on all shovels and excavators. Also equip slow-moving vehicles such as dozers with a rotating amber light or equivalent that is visible in all directions.

b. Warning Devices. Install an automatic functional backup alarm where there is obstructed vision to the rear.

20.6.8 Access Systems. To personnel entering, leaving, or working in or on operator cabs or stations or inspection or on service platforms provide steps, stairways, ladders, walkways, platforms, handholds, guardrails, and entrance openings. Keep the vertical height of the first steps no higher than 28 inches from the ground. Such systems provide the person with three points of support at all times.

20.6.9 Seatbelts. Install and use seatbelts on all equipment protected by rollover protective structures or as required elsewhere. Where seatbelts are installed, use is mandatory.

20.6.10 Equipment Cabs. Equip cabs with shatter-resistant glazing in all windows, heaters, defrosters, windshield wipers, and door restraints. Provide bidirectional machines with rearview mirrors. Equip machines with windshields but not cabs with windshield wipers as appropriate.

20.6.11 Barricades. Barricade the swing radius area of rotating superstructures of track hoes or similar equipment in a manner that physically prevents persons or equipment from being struck by the superstructure.

20.7 Requirements for Off-Highway Wheel Construction Machines

Off-highway wheeled construction machines, including but not limited to loaders and tractors, scrapers, dumpers, graders, rollers and compactors of mass greater than 3 tons, water wagons, and similar-type equipment, must conform with this subsection; applicable provisions of this section, other relevant subsections, and the appendix entitled, "Record of Performance— Inspection and Brake Test." Mobile, self-propelled cranes are also subject to this subsection.

20.7.1 Braking Systems. Equip all equipment regardless of age with a safe and operable service braking system, an emergency stopping (brake) system, and a parking brake system. The braking systems must conform with the criteria contained in appendix H. Units manufactured before 1980 may conform to the SAE Standard under which they were manufactured, if: (1) the standard requires a service brake system, an emergency brake system, and a parking brake system, and (2) failure of any one system or component will not reduce the effectiveness of the machine's stopping capability below the emergency stopping performance criteria shown in appendix H. In no circumstances shall dropping the scraper bowl, loader bucket, grader/tractor blade, or equipment loads be considered an emergency braking system. (See appendix H, item 17, for exemptions on compactors and rollers intended for use on grades of 3 percent or less.)

20.7.2 Brake Performance Test. The employer shall, after satisfactorily completing the initial inspection requirements of appendix H, conduct onsite brake performance tests on all equipment before it is returned to use, annually thereafter, and as whenever needed.

a. A Reclamation representative will verify onsite brake performance tests on each piece of equipment in accordance with the manufacturer's prescribed method for brake performance. The certification will:

- Be in writing
- Provide a method to verify the operation of the service, emergency, and parking brake systems
- Be, in the manufacturer's opinion, adequate to verify that the braking systems would meet the applicable SAE standards

b. No testing is required for roller compactors on slopes less than 3 percent.

c. In lieu of an acceptable manufacturer's approved brake performance test procedure, conduct onsite brake performance tests according to the following procedures:

- Individually test each required braking system (service, emergency, parking) according to criteria set forth in the Reclamation form entitled, "Brake Performance Test Record," shown in appendix H.
- Record each test result on the form, then date and sign.
- Do not return equipment failing the test to service until corrective measures have been taken and a retest confirms the equipment is safe to operate.

20.8 Requirements for Agricultural and Industrial Equipment

Agricultural wheeled tractors and industrial equipment, including but not limited to tractors, loaders, backhoe loaders, trenchers, and similar type equipment will be designed, operated, and maintained in a safe condition. All equipment must have service and parking braking systems that can stop and hold the equipment on any surface.

20.9 Requirements for Personnel Transport Vehicles and Buses

All vehicles transporting personnel shall be operated and maintained in a safe condition.

20.9.1 Type of Equipment. Use only fully enclosed vehicles with seats and seatbelts for operators and passengers to transport personnel.

20.9.2 Operator Qualifications. Operators of buses must be 21 years old and have in their possession a valid State operator's permit or license for the type of vehicle being operated. Operators must have passed a physical examination within the past year showing they are physically qualified to safely operate the vehicle.

20.9.3 Starting. Do not allow vehicles transporting personnel to move until the operator has checked that all persons are seated, seatbelts are fastened, and doors are closed.

20.9.4 Tools and Materials. Place tools and materials in containers or secure when they are transported in vehicles carrying personnel.

20.10 Requirements for Industrial Trucks

All industrial trucks must meet the requirements for design, construction, stability, inspection, testing, maintenance, and operation as required for safe use. High-lift rider trucks shall be equipped with overhead guards (ANSI B56.1).

20.10.1 Inspection. Perform and document industrial truck inspections according to the manufacturer’s operating manual before the trucks are operated.

20.10.2 Lift Trucks and Stackers. Post capacity plates on lift trucks and stackers within the operator’s view. When removable counterweights are used, the operator must not exceed the corresponding rated capacities. Do not make modifications or additions affecting the capacity or safe operation of the equipment without the manufacturer’s written approval or without making corresponding revisions to the capacity plates.

20.10.3 Steering Knobs. Do not attach steering or spinner knobs to the steering wheel unless the steering mechanism is of a type that prevents road reactions from causing the steering wheel to spin. Mount the knob within the periphery of the wheel.

20.10.4 Lifting Personnel. Do not use powered industrial trucks for hoisting personnel.

20.10.5 Rail Car and Semi-Trailer Lifting. Take positive steps to prevent the movement of the car or trailer before using an industrial truck to load or unload a rail car or "over the road" trailer. Positively fasten ramps or dock plates in place to prevent accidental movement.

20.10.6 Multiple Lifting. Do not lift a load using more than one industrial truck, unless a task specific job hazard analysis has been prepared and approved by the office head. The load lifted by each truck must not exceed 80 percent of its rated capacity when used in conjunction with other trucks.

20.10.7 Battery Charging. Recharge battery operated industrial trucks in designated areas that have been evaluated to ensure that ventilation is adequate to prevent the accumulation of flammable and explosive gasses; and, ensure there are no flammables or combustibles in the area.

20.10.8 Operator Training. Train and evaluate employees before assigning them to operate powered industrial trucks. Train operators as specified in 29 CFR 1910.178(l)(3). Include the name of the operator, the date of the training, the date of the evaluation, and the identity of the person(s) performing the training or evaluation in the certification that the training and evaluation has been completed. A training program must consist of the following three parts:

- Formal instruction that includes lectures, discussions, interactive computer learning, videos, or written material.
- Practical, hands-on training that includes demonstrations performed by the trainer and practical exercises performed by the trainee. Conduct the training on the particular equipment the trainee will be operating on the job.
- Evaluate the operator's ability to handle the truck safely in the workplace.

20.10.9 Frequency of Evaluation. Evaluate each operator's performance periodically, but at least once every 3 years.

20.10.10 Refresher Training. Training should include the following:

- Surface conditions
- Load stability
- Lifting different types of loads
- Putting down a load
- Traveling tips
- Hazardous locations
- Activities and environments employee will be working in

If one of the following occurs, provide refresher training:

- The operator was involved in an accident or near miss incident.
- The operator was observed operating the vehicle in an unsafe manner.
- The operator was evaluated as needing more training.

- Changes in the workplace could affect safe operation (such as a different type of paving, reconfigured storage racks, new layouts with narrower aisles or restricted visibility, or the operator is assigned to a different type of truck).

20.11 Requirements for A-Frame Trucks

20.11.1 Design. A-frame trucks and similar job-fabricated mobile hoisting equipment must conform to this subsection and applicable provisions in the section, "Hoisting Equipment, Piledrivers, and Conveyors." Make sure design is by a PE , and provide a written certification attesting that the equipment meets load and capability requirements.

20.11.2 Safety Factor. Incorporate a minimum safety factor of 5 in the design of chains, standing parts or guy cables, boom supports, and other load-carrying boom (A-frame) parts. Live or running cable reevings including boom hoist cables, shackles, hooks, and accessories must have a minimum safety factor of 3.5.

20.11.3 Performance Inspection and Testing and Capacity Charts. Load test, at 110 percent of rated capacity, A-frame trucks and associated equipment, before use, annually thereafter, and after modification or repair. Install capacity charts on the equipment in full view of the operator.

20.12 Requirements for Aerial Lifts

Vehicle mounted and elevating rotating aerial devices must conform with the current edition of applicable ANSI/SAE standards. (See table 20-1.)

- Modification. Aerial lifts may be modified for uses other than those intended by the manufacturer, provided the modification has been certified in writing by the manufacturer or by other qualified equivalent entities such as a testing laboratory to be in conformity with the applicable provisions of the governing ANSI standard and the requirements of this section.
- Ladder trucks and tower trucks. Secure aerial ladders in the lower traveling position by a locking device on top of the truck cab and by a manually operated device at the base of the ladder before permitting the truck to travel.
- Routine testing. Elevate the boom and check the aerial lift before each shift to ensure that all controls and safety devices are functioning properly.
- Operators. Instruct and train operators in the operation of the type of equipment to which they are assigned. Allow only persons specifically authorized to operate aerial lifts to operate this type of equipment.

- Safety harness. Employees working from an aerial lift must wear a safety harness and a lanyard attached to the basket, platform, or boom. They must stand on the floor of the basket or platform and must not sit or climb up on the guardrail or enclosure. Do not allow planks, ladders, or other devices to be used as work platforms.
- Load limits. Post load limits specified by the manufacturer on the equipment and do not allow the limits to be exceeded. The date of the most recent load test must be posted or stenciled on the equipment.
- Stabilization. Stabilize aerial lifts against movement or overturning in accordance with the manufacturer's recommendations.
- Moving. Do not move aerial lift trucks, except for equipment specifically designed for that purpose, when the boom is elevated with people in the basket or on the work platform.
- Controls. Provide both platform (upper) and lower controls for articulating booms and extensible boom platforms. Mount on the basket or platform within easy reach of the operator. Design lower controls to override the upper controls. Plainly marked controls as to their function. A person familiar with the machine lower controls must be on the ground in the vicinity of the aerial lift at all times when employees are elevated. Do not operate lower controls without permission from the employee in the lift, except in an emergency.
- Insulated booms
- Testing and certification. Test and certify any aerial device or component thereof that is represented by the manufacturer or installer as being insulated, as set forth in ANSI A92.2, Section 5, "Predelivery Testing and Inspection of New Aerial Devices."
- Operation. Test, operate, and maintain the insulated aerial lifts, when used to work on or near high-voltage lines or equipment, in strict compliance with the manual or manuals provided by the manufacturer. The manual(s) must contain:
- Descriptions, specifications, and capacities of the aerial device
- Instructions for installing or mounting the device
- Operating pressure of any hydraulic or pneumatic system that is part of the aerial device
- Specific instructions regarding field testing, operation, and maintenance
- Replacement part information
- Manufacturer's Certification Test
- Alteration. Do not insulate portions of the lift, basket, and boom in any manner that might reduce its insulating value

20.13 Requirements for Other Mechanized Construction Equipment Standards

In addition to specific requirements set forth elsewhere in this manual, the requirements set forth in this subsection apply to all stationary mechanized equipment and drives.

20.13.1 Guarding. Guard or isolate belts, gears, shafts, pulleys, sprockets, spindles, drums, flywheels, chains, or other reciprocating, rotating, articulating or moving parts of equipment to protect people and property. Guarding must comply with the standards set forth in the current edition of ANSI B15.1, "Safety Standard for Mechanical Power Transmission Apparatus."

20.13.2 Working Platforms. Provide equipment with adequately designed working platforms, guardrails, and accessories so that operating and maintenance personnel will have a safe footing.

20.13.3 Fuel Tanks. Locate fuel tanks shall be located so that spills or overflows can not contact the engine, exhaust, or electrical parts.

20.13.4 Removal of Guards. Do not remove or render ineffective guards and safety devices except for necessary repairs or maintenance and then only after isolating the power. Replace the guards and safety devices and make them operable before restarting the equipment.

20.13.5 Hot Surfaces. Either isolate, guard, or insulate hot surfaces of equipment, including exhaust pipes and steam pipes to prevent contact by personnel.

20.13.6 Exhaust Fumes. Confine or control exhaust or discharges from equipment so that they do not endanger personnel or obstruct the operator's view.

20.13.7 Rock Crushers. Screen rock crushers and similar equipment to prevent flying chips or rocks from injuring personnel in their vicinity.

20.13.8 Vibrating and Rocker Screens. Equip vibrating or rocker screens with sides and baffles to prevent rock from falling from the screen. Where materials are being processed dry, install exhaust systems to remove the dust.

20.13.9 Lockout/Tagout. Install power-driven equipment with provisions for locking out the controls or switches while under repair. Establish an effective lockout and tagout program in accordance with the section, "Control of Hazardous Energy," prescribing specific responsibilities and procedures to be followed by the person(s) performing the repair work. Lock out and tag this type of equipment during repair.

20.13.10 Certification. Certify the design of all major facilities and equipment built or provided by Reclamation or the contractor for Reclamation's use, such as conveyors, materials handling systems, hoists, personnel hoists, manskips, and concrete forming support systems for major structures as structurally suitable for the use intended. The manufacturer or a PE must submit a written certification before the erection or use of such facilities and equipment on the job site. (Refer to relevant sections of this manual and specifications for information on additional requirements.)

20.14 Requirements for Roads

Design all roads, including haul roads, on the project site in accordance with the requirements contained in this section. Do not move any mobile equipment on any road, accessway, or grade unless the roadway widths, grades, and curves are constructed to safely accommodate the movement of the vehicle or equipment at the speeds that are appropriate.

20.14.1 Haul Road Submittals. Submit the design of haul roads for acceptance by the office head before beginning road construction.

20.14.2 Grades. The maximum allowable grade is 12 percent. Loading and dumping ramps may be exempted if all of the following conditions exist:

- The ramp grade does not exceed the lesser of: 25 percent
- Manufacturer's recommended maximum grade for the equipment
- The maximum grade on which the machine, when loaded to the manufacturer's specified gross weight, can be safely stopped and held
- Acceptable machine gear range and ground speed for safely descending and stopping on the ramp have been determined by field testing or provided by the manufacturer.
- A JHA has been developed, and the office head has approved the action.

20.14.3 Loading and Dumping Ramps. Loading and dumping ramps are defined for the purpose of this subsection as follows:

- Sections of haul roads immediately adjacent to loading and dumping areas and the loading site.
- Ramp sections that are less than 200 feet long, with a lower end that (1) either stops on level ground no closer than 200 feet from foot traffic or congested equipment areas, or (2) is not directly aligned to terminate into these areas.

20.14.4 Curves. Design all curves to have open sight lines and as great a radius as practical.

20.14.5 Embankment Protection. Construct or install berms, curbs, or barricades to prevent vehicles or equipment from overrunning the edge or the end of the embankment when a difference in road or working level exists. Construct berms or curbs to one-half the diameter of the tires of the largest piece of equipment using the roadway.

20.14.6 Drainage. Design roadways to be constructed with a slight crown and with ditches provided to facilitate drainage.

20.14.7 Posting Speed Limits. Post all roads, including haul roads, with curve signs and maximum speed limits. Limit vehicle speeds on curves to those which permit the vehicle to be stopped within one-half the minimum sight distance. Post all curves with acceptable speed limits.

20.14.8 Single-Lane Haul Roads. Provide adequate turnouts on single-lane haul roads with two-way traffic. When turnouts are not practical, provide a traffic control system to prevent accidents. Advise all personnel of the traffic control system and operating restrictions.

20.14.9 Two-Way Haul Roads. Whenever possible, use a right-hand traffic pattern on two-way haul roads. Install signs and traffic control devices to safely control travel when a right-hand traffic pattern is not feasible.

20.14.10 Traffic Control Devices. The employer must install traffic control devices including signal lights, signs, and barricades, or provide trained traffic flagpersons to ensure the safe movement of traffic. Refer to applicable portions in the section, "Signs, Signals, and Barricades."

20.14.11 Road Maintenance. Routinely maintain all roadways, including haul roads, in safe condition and eliminate or control dust, ice, and similar hazards. Whenever dust conditions exist, provide adequate dust control equipment on the jobsite and ensure that it is used to control the dust hazard.

Section 21

Hazardous Waste Site Operations

21.1 Scope

The requirements of this section apply to personnel and operations involved in investigation and remediation efforts associated with improperly disposed of hazardous, toxic, and/or radioactive wastes on Reclamation properties. Operations required by local, State, or Federal agencies will be conducted according to these standards. Voluntary (nonemergency) cleanup operations associated with classified hazardous wastes which may have environmental impact or public exposure fall within the scope of this standard. This section does not apply to activities involving the generation and collection of hazardous wastes which are being temporarily stored prior to proper disposal.

21.2 Hazardous Waste Operations Safety and Health Program

A written program will be immediately available, indicating the specific chain of command, roles, responsibilities, and authorities that govern hazardous waste operations falling within the scope of this standard. The program will reflect the necessary interface between general program and site-specific activities. A written program will exist at each organizational level where management wishes to exert consistent implementation of administrative procedures for specific hazardous waste site operations.

21.2.1 The program will designate, in writing, a program manager who will have the responsibility and authority to direct all hazardous waste operations within the scope of this section.

21.2.2 Each project that falls under the general category of "hazardous waste operation" will have a comprehensive work plan, as well as a site-specific safety and health plan, in place prior to commencing operations.

21.2.3 The written program, work plan, and site-specific safety and health plan will specify the means to implement the requirements of these standards.

21.3 Work Plan

Each facility, site, or project will have a written work plan that reflects the current status of site characterization/analysis and the proposed objectives and tasks.

21.3.1 The plan will identify the personnel requirements and methods to accomplish the identified tasks and objectives.

21.3.2 For uncontrolled hazardous waste sites, characteristics such as location, size, boundaries, topography, accessibility, contaminant concentrations, and contaminant dispersion pathways must be included.

21.3.3 The plan must specify the means for providing required information to employees, contractors, and others who enter the site.

21.3.4 The plan must include the requirements for training, medical evaluations, and record- keeping not specified in site-specific documents.

21.4 Site-Specific Health and Safety Plan (HASP)

A HASP will be available to all employees at the worksite, which is inclusive of all organizations/firms/activities at the site.

21.4.1 The plan must include a risk assessment for each identified hazard and associated task in the work plan and specify the requirements and procedures necessary to protect personnel according to all applicable standards.

21.4.2 The plan must indicate specific expectations for meeting the standards, including programs for inspection, training, medical evaluation, contaminant/exposure monitoring, site control, decontamination, personal protective equipment (PPE), emergency response, confined space entry, and spill containment requirements associated with site operations.

21.5 Hazard Evaluation and Control

21.5.1 Evaluation of the site and operations will be conducted to identify the specific hazards and determine procedures appropriate for controlling exposure to those hazards.

21.5.2 Controls must be implemented prior to initiating site activities.

21.6 Hazard Communication

21.6.1 Personnel must be informed of all identified risks and entry/work requirements before their entry into a contaminated or restricted area and/or before starting a hazardous activity covered by the requirements of this section.

21.6.2 Briefings will be conducted at intervals necessary to ensure personnel are knowledgeable of the most current information and requirements of the site-specific HASP.

21.7 Training

All personnel must receive the proper training required for their assigned duties, the provisions of the program, project work plan, and HASP requirements associated with specific personnel assignments and this section.

21.7.1 Personnel are prohibited from participating in, or providing onsite supervision of, site activities unless:

a. They have been certified as having successfully completed the training requirements for their assigned duties and responsibilities, and

b. Records of required training and certification have been established and are immediately available at the activity site.

21.7.2 Trainers. The training must be conducted by a trainer meeting the qualifications of OSHA standards in 29 CFR 1910.120 (e)(5). Generally, trainer qualification is based upon the satisfactory completion of a training program for teaching the subject matter, or appropriate academic credentials and experience, combined with demonstrated competency in instructional skills and knowledge of the subject matter.

21.7.3 The minimum training requirements are based upon OSHA requirements contained in 29 CFR 1910.120 (e). The courses established to meet these requirements must address both time and content standards. Course content and certification must be conducted according to the guidelines in Appendix E of 29 CFR 1910.120.

a. An offsite hazardous waste orientation course with sessions totaling 40 hours, plus 24 hours of supervised onsite training, will be required of all persons who:

- Enter a site unescorted by trained site personnel
- Enter restricted areas of a site
- May be exposed to hazardous substances
- May be exposed to other health hazards of a physical or biological nature
- May be exposed to safety hazards of any kind
- Are operators of equipment used in site assessment or remediation operations
- Are required or expected to wear respiratory protection or PPE when needed
- Disturb any materials within site boundaries
- Directly supervise site employees

Each year thereafter, 8 hours of supplemental training will be provided which augments the basic knowledge provided by the core course.

b. All onsite managers and supervisors directly responsible for, or who supervise, personnel engaged in hazardous waste operations must receive an additional 8 hours of training specific to the management responsibilities associated with the program elements and site requirements.

c. All employees and their managers and supervisors working onsite who are restricted to duties that are fully characterized as nonhazardous and who are not expected to wear PPE or respond to emergencies under any circumstance must receive:

- A minimum of 24 hours of off-site training from a certifying instructor, and
- An additional 8 hours of supervised onsite guidance by an experienced person before assuming their full duties associated with the operations
- Any personnel trained at this level who are reassigned to hazardous duties will be provided an additional 16 hours of training by a certifying instructor as required for the duties and hazard control measures utilized, as well as an additional 16 hours of supervised onsite guidance.

21.8 Medical Evaluations

Medical evaluations necessary to meet the requirements of these standards (such as respirator clearances or medical qualifications for specific hazardous jobs) must be provided before employees engage in activities requiring such services. Medical surveillance must be provided for employees exposed to or affected by site contaminants.

21.8.1 All medical services required by this standard must be rendered under the direction of a board-certified occupational health physician.

21.8.2 The evaluations must be provided in a timely manner. Timeframes for medical screening tests that may become necessary during operations will be specified in the medical surveillance plan before initiating onsite operations.

21.8.3 All employees whose exposure to contaminants exceeds permissible exposure limits for 30 days or more per year will be placed in a medical surveillance program. Medical requirements for the respiratory protection program are separate, but may be included as part of the medical surveillance on the employee.

21.8.4 All employees who wear a respirator must be medically evaluated according to the respiratory protection requirements of these standards and 29 CFR 1910.134.

21.8.5 All employees who wear respiratory protection for 30 days or more per year must be placed in a medical surveillance program.

21.8.6 All employees who develop signs or symptoms of illness or exposure to hazardous substances, who become ill, or who are injured due to overexposure to contaminants must be placed in a medical surveillance program.

21.9 Inspections

Inspections will be conducted to assess the proper implementation of hazard control. Identified deficiencies and corrective actions must be documented and appropriate changes made to the plan(s) when necessary.

21.10 Contaminant/Exposure Monitoring

Air monitoring will be performed in a manner according to the provisions contained within these standards and as required within the program, work plan, or HASP. Minimum monitoring requirements are:

21.10.1 Upon initial site entry, representative air monitoring will be conducted to identify any Immediately Dangerous to Life and Health (IDLH) condition or potential exposure above permissible exposure limits

21.10.2. Periodic monitoring will be conducted when:

- Work begins on a different portion of the site
- Contaminants other than those previously identified are being handled
- A different type of activity is initiated
- An employees are handling leaking drums or containers, or working in areas with obvious liquid contamination
- There are indications that potentially hazardous conditions exist

21.10.3 Personal monitoring must be performed for personnel who are at high-risk, such as, but not limited to, those handling leaking drums, opening drums containing unknown or hazardous substances, conducting activities in areas with obvious liquid contamination, or during any activity where contaminated substances may be disturbed.

a. After commencing activities, personal exposure monitoring will be performed for employees likely to have the highest exposures to hazardous substances and health hazards or when the airborne concentration of hazardous substances is likely to be above permissible exposure limits.

b. A monitoring result that exceeds permissible exposure limits will be considered a representative exposure of all personnel performing similar duties on the site. The exposure will be accordingly documented until personal monitoring has been accomplished for each person performing similar duties.

21.10.4. Representative sampling will be accepted to document exposures of individuals engaged in similar activities.

21.11 Site Control

The site control program, as a part of the site-specific HASP, must include a site map that characterizes site work zones and identifies any established engineered site safety and health controls, specific work requirements, standard operating procedures, decontamination requirements, safe work practices, site communications including emergency plan, and provisions for medical emergency services. It will identify names of personnel responsible for site safety and health.

21.12 Control of Worker Exposure to Hazardous Substances

Engineering controls will be the primary means of control for occupational exposure to hazardous substances. Administrative controls, such as scheduling employee rotation as a method of controlling hazardous exposures associated with hazardous waste activities and operations, must not be used.

21.13 Personal Protective Equipment

PPE must be provided and used according to the provisions contained in these standards and as stipulated in the program, work plan, or HASP. PPE will be based on the performance characteristics of the equipment, relative to:

- The requirements and limitations of the site
- The task-specific conditions and duration
- The hazards and potential hazards identified at the site

21.13.1 Personal Protective Equipment. The PPE program, as part of the HASP, must address:

- PPE selection based on site-specific hazards
- The use and limitations of PPE
- Activity duration
- Maintenance and storage of PPE
- Decontamination and disposal of PPE
- PPE training and fitting
- Equipment donning and doffing procedures

- Procedures for inspecting equipment before, during, and after use
- Evaluation of the effectiveness of the PPE program
- Medical considerations, including work limitations due to temperature extremes or physical stress

21.13.2 When airline respirators are utilized in hazardous waste operations, an auxiliary self-contained escape air supply system will be incorporated.

21.13.3 When totally encapsulating suits are used, they must be capable of maintaining positive air pressure.

21.14 Communications

All high-risk activities such as, but not limited to, remote or unobservable operations, waste drum opening/sampling, or confined space entry must be conducted in a way that ensures constant communication between the worker and site management team.

21.15 Decontamination

Decontamination must be conducted in a way that prevents the spread of hazardous contaminants and waste beyond the boundaries of the site of operations. Decontamination will apply to equipment and personnel.

21.15.1 Procedures for all phases of decontamination will be developed, communicated to all personnel, and implemented before any employee or equipment may enter areas on a site where potential exposure to hazardous substances exists. Decontamination procedures, as a part of the site-specific HASP, will specify:

- Decontamination methods and procedures for testing and evaluating their effectiveness
- The number and layout of decontamination stations and decontamination equipment needed
- Procedures to prevent contamination of clean areas and to minimize employee contact with hazardous substances or with contaminated equipment that has contacted hazardous substances
- Procedures to take if the nonimpermeable clothing of personnel becomes wetted with hazardous substances
- Methods for disposing of contaminated clothing and equipment
- Methods for disposing of decontamination water and waste

21.15.2 All personnel leaving a contaminated area must be decontaminated; all contaminated clothing and equipment leaving a contaminated area must be appropriately disposed of or decontaminated.

21.15.3 Decontamination procedures must be monitored by the site safety and health officer to determine their effectiveness. If such procedures are found to be ineffective, site work will immediately cease and remain shut down until the situation has been corrected.

21.15.4 Decontamination must be conducted in geographic areas that minimize the exposure of uncontaminated personnel and equipment to contaminated employees or equipment.

21.15.5 All equipment and material used for decontamination must be decontaminated or disposed of properly.

21.15.6 Decontamination of Personal Protective Equipment

a. PPE will be decontaminated, cleaned, laundered, maintained, stored, and replaced as appropriate to maintain their effectiveness.

b. Unauthorized employees will not remove PPE from change rooms.

c. Commercial laundries or cleaning establishments that decontaminate protective clothing or equipment will be informed of the potential harmful effects of exposures to hazardous substances.

d. Where the decontamination procedure indicates the need for regular showers and change rooms outside the contaminated area, or if cleanup or removal operations will require 6 months or more to complete, showers and change rooms must be provided. If temperature effects prevent the use of water, other effective means for cleansing must be provided and used.

21.16 Emergency Planning

Planning for site emergencies must be conducted before commencement of hazardous waste activities.

21.16.1 Site emergency cleaning must address all anticipated emergency situations.

21.16.2 The emergency response plan must be included in the HASP and address:

- Personnel roles, responsibilities, and lines of communication
- Emergency recognition and prevention
- Safe distances and staging areas (safety zones)
- Site security and control
- Evacuation routes and procedures
- Emergency medical treatment
- Emergency alerting and response procedures

- Critique of response and followup
- Procedures for reporting incidents to Federal, State and local governments
- Decontamination

21.16.3 The emergency response plan will be a separate section of the HASP.

21.16.4 The emergency response plan will be exercised regularly as part of the overall training program.

21.16.5 The emergency response plan will be reviewed periodically and, as necessary, amended to keep it current with new or changing site conditions or operations.

21.16.6 A personnel alarm system must be installed to notify personnel of an emergency condition, to stop work activities if necessary, to lower background noise in order to speed communications, and/or to begin emergency procedures.

21.16.7 The emergency planning must be compatible and integrated with the disaster, fire, and/or emergency response plans of local, State and Federal agencies.

21.17 Underground Storage Tank Removal

Hazard analysis for the removal or disposal of an underground storage tank (UST) system must address:

- Hazards of UST system contents and procedures for hazard control, including explosion prevention
- Monitoring requirements and procedures
- UST system draining, purging, and cleaning procedures
- Excavation safety requirements and procedures for blocking free-standing tanks
- Procedures and safety precautions for disassembly, removal, and disposal of system
- Spill contingency planning
- Proper handling of contaminated groundwater and soil

21.18 Handling Drums and Containers

21.18.1 Identification and Inspection

a. Prior to handling or opening a drum or other container, effort will be made to identify their contents.

b. Drums and containers will be inspected and their integrity must be ensured before moving them.

c. Drums or containers that cannot be inspected before being moved because of storage conditions (e.g., buried beneath the earth, stacked behind other drums, stacked several tiers high, in a pile, etc.) must be moved to an accessible location and inspected prior to further handling.

d. Unlabeled drums or containers will be assumed to contain hazardous substances and handled accordingly until the contents are positively identified and labeled

21.18.2 Handling Requirements

a. Before moving drums or containers, all employees exposed to the transfer operation must be warned of the potential hazards associated with the contents of the drums or containers and their handling and instructed to minimize handling as much as possible.

b. Where major spills may occur, a spill containment program must be implemented to contain and isolate the entire volume of the hazardous substance being transferred. U.S. Department of Transportation specified salvage drums or containers and suitable quantities of proper absorbent must be kept available and used in areas where spills, leaks or ruptures may occur.

c. If drums and containers cannot be moved without rupture, leakage, or spillage must be emptied into a sound container, using a device classified for the material being transferred.

d. Subsurface exploration will be used to estimate the location and depth of buried drums or containers. Soil or covering material must be removed with utmost caution to prevent drum or container rupture.

21.18.3 Opening Drums or Containers

a. Where an airline respirator system is used, connections to the source of air supply must be protected from contamination and the entire system protected from physical damage.

b. Personnel not involved in opening drums or containers must be kept at a safe distance from the drums or containers being opened.

c. When personnel must work near or adjacent to drums or containers being opened, place a suitable shield that does not interfere with the work operation between the adjacent person and the drums or containers being opened to protect the employees in case of an accidental explosion.

d. Controls for drum or container opening equipment, monitoring equipment, and fire suppression equipment must be located behind the explosion-resistant barrier.

e. When there is a reasonable possibility of flammable atmospheres being present, material handling equipment and hand tools will be of a type to prevent sources of ignition (e.g., nonsparking tools).

f. Drums and containers will be opened in a manner that allows excess interior pressure to be safely relieved from a remote location. Place appropriate shielding between the employee and the drums or containers, to reduce the risk of personnel injury.

g. Personnel shall not stand upon, or work from, drums or containers.

21.18.4 Transfer. Material handling equipment used to transfer drums and containers must be selected, positioned, and operated to minimize sources of ignition related to the equipment from ignitable vapors released from drums or containers.

21.18.5 Precautions. The following precautions must be taken when drums or containers containing, or suspected of containing, shock-sensitive waste are handled.

a. All non-essential personnel must be kept a safe distance from the area of transfer.

b. Material handling equipment must be provided with explosive containment devices or protective shields to protect equipment operators from exploding containers.

c. An employee alarm system, capable of being perceived above surrounding light and noise conditions, will be used to signal the commencement and completion of explosive waste handling activities.

d. Continuous communications will be maintained between the personnel in charge of the immediate handling area and both the site safety and health officer and the command center until the handling operation is completed. Communication equipment or methods which could cause shock sensitive materials to explode will not be used.

e. Drums and containers under pressure (as evidenced by bulging or swelling) will not be moved until the cause of excess pressure is determined and appropriate containment procedures have been implemented to protect employees from explosive relief of the drum.

f. Drums and containers that contain packaged laboratory wastes will be assumed to contain shock-sensitive or explosive materials until they have been characterized.

21.18.6 Laboratory Waste Packs. When handling laboratory waste packs, the following precautions will be taken.

a. Laboratory wastes will be considered shock-sensitive or explosive until they have been characterized.

b. Lab packs will be opened only when necessary and then only by an individual knowledgeable in the inspection, classification, and segregation of the containers within the pack, according to the hazards of the wastes.

c. If crystalline material is noted on any container, handle the contents as a shock- sensitive waste until the contents are identified.

21.18.7 Sampling. Sampling of drum and container contents must be done in accordance with a sampling procedure which is included in the HASP.

21.18.8 Shipping and Transport

a. Drums and containers must be identified as classified prior to packaging for shipment.

b. Drum or container staging areas must be kept to the minimum number necessary to identify and classify materials safely and prepare them for transport.

c. Bulking of hazardous wastes is permitted only after a thorough characterization of the material has been completed.

21.18.9 Tank and Vault Procedures

a. Tanks and vaults containing hazardous substances will be handled in a manner similar to that for drum and containers, taking into consideration the size of the tank or vault.

b. Avoid entering tanks or vaults if possible. When entry is required, follow appropriate tank or vault entry procedures, as described in the HASP.

Section 22

Excavation Operations

The requirements contained in this section apply to all types of excavation operations, except tunnels and shafts, covered in the section, "Tunnel and Shaft Construction." This section sets forth Reclamation's requirements for excavation operations. It covers the following specific areas:

- General Requirements
- Structural Footings
- Excavation Protective Systems
- Cofferdams

22.1 General Requirements for Excavation Operations

22.1.1 Preliminary Inspection. Before excavation, thoroughly inspect the site to determine conditions requiring special safety measures. Locate underground installations, such as sewer, telephone, gas, water, and electric lines. Make necessary arrangements with the utility company or owner to protect, remove, or relocate the underground installations. In such circumstances, excavate in a manner that does not endanger the underground installation or the employees engaged in the work. Protect utilities left in place by barricading, shoring, or suspending, or by other measures, as necessary.

22.1.2 Protect the Public. Provide necessary barricades, walkways, lighting, public awareness programs, and posting for the protection of the public before the start of excavation operations. Do not start excavation operations on or near State, county, or city streets or accessways or other locations where there is extensive interface with the public or motorized equipment until after you have the following:

a. Written permission to proceed, together with protective measures required from the authority having jurisdiction (authority).

b. An extensive and detailed Job Hazard Analysis (JHA), using the authority's instructions and these standards.

c. A completed JHA, accepted by the designated authority.

d. Proof that the JHA has been discussed with affected employees and the applicable protective measures are in place and functioning.

e. Implementation of a public awareness program, when required by the contracting officer's representative or the office head.

22.1.3 Ingress and Egress. Provide safe access for employees, including installing walkways, ramps, stairs, and ladders.

- A competent person, qualified in structural design, must design the structural ramps used for ingress or egress of equipment. Make sure the structural ramps are constructed according to the design.
- To prevent displacement, connect the structural members of ramps and runways that are constructed of two or more structural members.
- Make sure structural members used for ramps and runways are of uniform thickness.
- Attach cleats (or other appropriate items used to connect runway structural members) to the bottom of the runway or in some other location or fashion that will not contribute to tripping.
- Provide structural ramps used in lieu of steps with cleats or other surface treatments on the top surface to prevent slipping.

Where employees must enter trenches more than 4 feet (1.22 meters) deep, provide stairs, ladders, or ramps at intervals of no more than 25 feet (7.62 meters) of lateral travel. When access to excavations is more than 20 feet (6.10 meters) vertically, provide ramps, stairs, or personnel hoists.

22.1.4 Lighting. Provide either natural or artificial lighting at excavation sites, borrow pits, and waste areas in accordance with illumination requirements.

22.1.5 Personal Protective Equipment. Provide personal protective equipment in accordance with the specific requirements in the section, "Personal Protective Equipment" and make sure that employees use the equipment when it is needed. Protect employees exposed to occupational health hazards. Drillers and helpers must wear approved safety goggles or safety glasses with side shields, hearing protection, and safety shoes, as required.

22.1.6 Removal of Surface Encumbrances. Before excavation, remove trees, brush, boulders, and other surface encumbrances that may present a hazard to employees.

22.1.7 Inspections. Each day, make sure that a competent person does the following:

a. Inspects excavations, the adjacent areas, and protective systems for warning signs of a situation that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres, or other hazardous conditions. The competent person must conduct an inspection before the start of work and as needed throughout the shift. Make inspections following every rainstorm or other hazard-increasing event.

b. If the competent person finds: (1) evidence of a situation that could result in a cave-in; (2) indications of failure of protective systems; (3) hazardous atmospheres; or (4) other hazardous conditions, remove exposed employees from the hazardous area until the necessary precautions are made to ensure their safety.

22.1.8 Structure Foundations and Footings. Except in hard rock, do not permit excavations below the level of the base of any foundation, footing, or retaining wall, unless the wall is underpinned and all necessary precautions are taken to ensure the stability of the adjacent walls. Install shoring, bracing, or underpinning designed by a qualified person if the excavation endangers the stability of adjacent buildings or structures. Have a qualified person inspect such supporting systems at least daily to ensure that the protection is adequate and effectively maintained.

22.1.9 Vertical Cuts and Slopes. Protect employees working below or on slopes or cuts exposed to falling, rolling, or sliding rocks, earth, or to other materials in the following manner:

a. Scaling. Effective scaling must be performed before exposure and at intervals necessary to eliminate the danger.

b. Rock Bolting. Install rock bolting, wire mesh, or equivalent support when material continues to ravel and fall, even after thorough scaling.

c. Barricades. Installing protective timber or wire mesh barricades at the top of the cut and at necessary intervals down the slope.

d. Benching. Use benching, wherever practical, sufficient to retain falling material instead of barricades.

e. Placing Personnel. Do not permit personnel to work above one another where danger of falling rock or earth exists. Protect personnel performing work on vertical cuts or slopes, where balance depends on a supporting system. Use appropriate fall protection.

22.1.10 Supporting Materials. Make sure materials used for sheeting, piling, cribbing, bracing, shoring, and underpinning are in good serviceable condition and timbers are sound and free of large or loose knots.

22.1.11 Backfilled Excavation. Take special precautions in sloping or shoring the sides of excavations adjacent to a previously backfilled excavation or fill area. Do not use compacted backfill as backforms on slopes steeper than 34 degrees measured from the horizontal (1-1/2 horizontal to 1 vertical), unless specified by a design approved by a professional engineer (PE) and properly documented in writing.

22.1.12 Groundwater. Control groundwater. Use a PE to plan and direct freezing, pumping, drainage, and other major control measures. Give full consideration to the existing moisture balances in surrounding soils and the effects on foundations and structures if the moisture balances are disturbed. Provide an emergency power source when continuous operation of groundwater control equipment is necessary.

22.1.13 Surface Water. Do not allow water to accumulate in excavations. Use diversion ditches, dikes, dewatering sumps, or other effective means to control surface water.

22.1.14 Crossovers. Provide walkways or bridges protected by standard guardrails where employees are required or permitted to cross over excavations.

22.1.15 Undercuts. When necessary to undercut a slope or vertical cut, adequately support the residual material. Submit the undercutting method and support system to the contracting officer's representative and be sure that it is accepted. If Reclamation employees conduct the work, submit the undercutting method and support system to the office head for acceptance before starting undercutting operations.

22.1.16 Excavated Materials. Place excavated materials and retain at least 2 feet (0.61 meter) from the edge of the excavation or at a greater distance when required to prevent hazardous loading on the face of the excavation.

22.1.17 Protective Devices. Maintain guardrails and fences, barricades and warning lights, or other illumination systems from sunset to sunrise on excavations adjacent to walkways, driveways, and other pedestrian or vehicle thoroughfares. Effectively barricade or cover and post wells, subsurface exploration holes, pits, shafts, and all similar hazardous excavations. Backfill as soon as possible all temporary excavations at these locations.

22.1.18 Stoplogs. When mobile equipment is permitted adjacent to excavations with steep slopes or cuts, install substantial stoplogs or barricades.

22.1.19 Exposure to Vehicular Traffic. Provide employees exposed to public vehicular traffic with warning vests or other suitable garments marked with, or made of, reflectorized or high-visibility material.

22.1.20 Equipment Operation. Provide equipment operating on loading or waste areas with an automatic backup alarm. Additionally, use a competent signalman to direct traffic when employees are on foot or otherwise endangered by equipment in dumping or waste areas. Do not give the signalman any other assignment that could interfere with signaling duties. If the equipment or truck cab is not shielded, the operator must stand clear of the vehicle during loading. Do not allow excavating or hoisting equipment to raise, lower, or swing loads over workmen unless you provide effective overhead protection.

22.1.21 Hazardous Atmospheres. In locations where oxygen deficiency or gaseous conditions are known or suspected, test the air in the excavation before the start of each shift or more often if directed by the designated authority. Maintain a log of all test results at the site. If the oxygen level is less than 19.5 percent, the concentration of flammable gas exceeds 10 percent of the lower flammable limit, or toxic materials exist at levels exceeding the Threshold Limit Value (TLV), take steps such as increasing the ventilation to control the hazards.

22.2 Requirements for Excavation Protective Systems

22.2.1 Sloping and Benching. Slope or bundle all excavations 5 feet (1.52 meters) or more deep in accordance with one of the systems outlined below.

a. For excavations less than 20 feet (6.10 meters) deep, the maximum slope is 34 degrees, measured from the horizontal (1-1/2 horizontal to 1 vertical), unless one of the other options listed in this subsection are used.

b. Determine the maximum allowable slope and benching systems according to the conditions and the requirements set forth in OSHA 1926, subpart P.

c. Select the design according to written tabulated data, such as charts and tables. Maintain at least one copy of the tabulated data at the jobsite during excavation. Include the following tabulated data:

- Identification of the parameters that affect the selection of a sloping or benching system drawn from the data
- Identification of the limits of use of the data, including the magnitude and configuration of slopes determined to be safe
- Explanatory information as may be necessary to help the user correctly select a protective system from the data
- The PE who approved the data

d. Use a PE to design the sloping or benching system. Maintain at least one copy of the design at the jobsite during excavation. Designs must be in writing and must include:

- The magnitudes and configurations of the slopes that were determined to be safe for the particular excavation
- The identity of the PE who approved the design

22.2.2 Support Systems. Use a PE to design sheeting, sheet piling, bracing, shoring, trench boxes, and other methods of excavation and trench protection. Use qualified personnel to install excavation and trench protection. Designs must be in writing and must include the following:

- A plan indicating the sizes, types, and configurations of the materials to be used in the protective system
- The identity of the PE approving the design

Maintain at least one copy of the design at the jobsite.

22.2.3 Shoring Design Requirements. Design criteria support systems or shoring must meet or exceed the minimum requirements set forth in this subsection and in OSHA 1926, subpart P. Do not subject braces and diagonal shores in a timber shoring system to compressive stresses in excess of the values given in the following formula:

$$S = 1300 - \frac{20L}{D}$$

maximum ratio $\frac{L}{D} = 50$

where:

L = length, unsupported, in inches
D = least dimension of timber, in inches
S = allowable stress of cross section, in pounds per square inch

22.2.4 Shoring, Sloping, Benching, Trench Box Illustrations. Figures in OSHA 1926, subpart P, tentatively illustrate the basic shoring, sloping, benching, trench box, and shield requirements contained in this subsection.

22.2.5 Trench Boxes and Shields. The designated authority may authorize portable trench boxes, sliding trench boxes, or shields instead of required sloping, benching, or supporting methods when:

a. A PE designs the boxes or shields, which provides protection equivalent to shoring and sheeting for the same condition and conform to requirements of OSHA 1926, subpart P.

b. The boxes or shields are constructed and maintained to design standards.

c. A job hazard analysis covering operation and maintenance of the boxes or shields has been developed, and affected employees have been trained and instructed on the effective use of the protective equipment.

d. Backhoes, excavators, and cranes used to move trench boxes and shields meet the applicable requirements in the section on "Hoisting Equipment, Piledrivers, and Conveyors."

22.2.6 Benching. Benching excavation procedures may be used to accommodate operations such as pipelaying (see 29 CFR 1926, Subpart P, Appendix B).

22.2.7 Placing Shoring, Trench Boxes, or Shields. Carry shoring, trench boxes, or shields along with the excavation, and do not omit them where the depth of trench or soil conditions require shoring or bracing. Where a backhoe or ditching machine is used, place the shoring box or shield as close as possible to the lower end of the boom. Excavations may extend 2 feet (0.61 meter) below the bottom of shoring, trench boxes, or trench shields, provided the protective systems are designed to resist the forces calculated for the full depth of the trench and there are no indications, while the trench is open, of a possible loss of soil from behind or below the bottom of the support system.

22.2.8 Removal of Support. Backfilling and removing trench support systems must progress together from the bottom of the trench. Release jacks and braces slowly. In unstable soil, use ropes or other safe means to remove the braces from the surface after the employees have left the trench.

22.2.9 Cross Braces and Jacks. Place cross braces and trench jacks in true horizontal position and secure them to prevent sliding, falling, or kickouts.

22.3 Requirements for Structure Footings

22.3.1 Casing Requirements. Provide a steel casing or support system of sufficient strength to support the earth walls and prevent cave-ins in small diameter footings, including bell-bottom footings over 4 feet (1.22 meters) deep, that employees must enter. Provide the casing or support system the full depth, except for the bell portion of bell footings.

22.3.2 Access Requirements. Provide fixed or portable ladders for access. Every employee entering the footing must wear a lifeline securely attached to a shoulder harness. Man the lifeline from above and separate it from any line used to raise or lower materials.

22.4 Requirements for Cofferdams

22.4.1 Controlled Flooding. Provide for controlled flooding of the work area in any design if overtopping of a cofferdam is possible. Devise an evacuation plan, including installation of warning signals and emergency exits, to safely evacuate employees and equipment from the work area.

22.4.2 Walkways and Guardrails. Where employees are permitted on cofferdams, install safe walkways protected by guardrails.

22.4.3 Exit. Provide a rapid means for employees who work on cofferdams to exit with their equipment.

Section 23

Tunnel and Shaft Construction

This section sets forth requirements for tunnel and shaft construction. It covers the following specific areas:

- General Requirements
- Emergency Provisions
- Ventilation
- Air Quality
- Dust Control
- Internal Combustion Engines
- Noise Control
- Fire Prevention and Control
- Excavation Operations
- Ground Support
- Transportation and Haulage
- Shafts
- Tunneling in Soil
- Compressed Air Work

23.1 General Requirements for Tunnel and Shaft Construction

In addition to complying with the safety requirements set forth in this section and other parts of these standards, comply with applicable provisions of the contract when excavating and constructing tunnels and shafts. Begin underground-related work only after an acceptable safety program or a detailed supplementary submittal specific to underground operations has covered all aspects of the operation.

23.1.1 Employee Identification. Entrances to all underground facilities must have a check-in and checkout system that provides the contractor with an accurate record of each person underground. The system must be able to identify each individual and general location. General locations include heading, train crew, track crew, maintenance area, storage area, survey stations, etc. Additionally, when underground, all employees must carry or wear a positive means of identification, such as a metal disk or tag.

23.1.2 Illumination. Underground lighting and illumination intensities must adhere to the current ANSI/IES RP-7, "Recommended Practice for Industrial Lighting" and UL 924, "Emergency Lighting and Power Equipment." Use nonmetallic light fixtures and support lighting conductors on insulators located on the side of the tunnel or shaft opposite the firing line. Use acceptable portable lighting equipment within 50 feet of any underground heading during explosives handling.

23.1.3 Electrical Equipment. A professional engineer (PE), knowledgeable in underground wiring practices, must design and certify the underground electrical distribution system to meet good practice and applicable standards. Install and maintain all electrical equipment, including the section on "Electrical Safety," to meet applicable requirements. Permit only dry-type transformers underground and ensure they are protected from possible damage. Separate or insulate power lines from air and waterlines, metal ducts, telephone lines, and blasting lines.

23.1.4 Bonding and Grounding. Ground and bond air and water piping, metal vent pipe, rails, and similar conductive devices at the portal or shaft head and at no more than 1,000-foot intervals.

23.1.5 Communications. Install a telephone system or an equivalent powered communication system between the tunnel heading and the portal, the shaft bottom and shaft head, and the first-aid station. Keep the powered communication systems independent of the tunnel or shaft power supply, and install the powered communication systems so that failure or disruption of any one station will not disrupt the operation of any other station. Test communication systems at the beginning of each shift and more frequently, when necessary, to ensure reliability. An employee must not work alone unless that employee is either within voice communication distance of another employee or has an appropriate powered communication system to obtain instructions and emergency assistance.

23.1.6 Blasting. Blasting and explosive-handling operations must conform to the requirements in the "Blasting" section.

23.1.7 Personal Protective Equipment. Employees entering underground workings must wear, as a minimum, hardhats, appropriate eye protection, and foot protection. Employees entering wet areas must wear rubber footwear; underground type rain gear; and eye, face, and head protection as described in the section on "Personal Protective Equipment." When applicable, provide employees with other personal protective equipment, and ensure they wear them.

23.2 Emergency Provisions

23.2.1 Evacuation Plan. Develop and post emergency evacuation plans, including provisions for rescue equipment, at the portal or shaft head. Instruct employees in the emergency procedures.

23.2.2 Self-Rescuers. Provide employees and others with self-rescuers, approved by National Institute of Occupational Safety and Health (NIOSH) and/or Mine Safety and Health Administration (MSHA), or make them available at headings, shaft bottoms, and all other underground work areas. Provide at least one readily available self-rescuer for each employee and visitor. Ensure that employees and others have satisfactorily completed certified training before going underground. Visitors instructed in operating the self-rescuer and accompanied by a trained employee are exempt from this training requirement. Maintain self-rescuers in accordance with the manufacturer's requirements.

23.2.3 Emergency Hoists. Provide an emergency personnel hoist for shafts more than 50 feet deep. Design the hoist so that, as a minimum, the load hoist drum is powered in both directions and a brake automatically applies upon power release or failure. Provide the emergency hoist in addition to the primary hoist.

23.2.4 Rescue Crews. As part of the emergency plan required in the section on "Emergency Planning," develop an emergency plan covering the possible emergencies requiring the use of a rescue crew. The plan must include the equipment, training, and organization of the rescue crews.

a. Provide at least two rescue crews of at least five men each for tunnel and shaft operations employing 25 or more employees at one time underground. One crew must be on the jobsite or within ½ hour travel time away from the portal. The other crew must be within 2 hours travel time.

b. Organize and train at least one crew of at least five employees as a rescue crew, or, for smaller jobs, arrange in advance with a locally available rescue service. Locate the rescue crew or rescue service on the jobsite or within ½ hour travel time from the portal.

c. Thoroughly instruct new crew members upon assignment to the rescue crew and conduct refresher training for the full crew at least every 6 months.

d. Instruct and train rescue team members to perform rescue operations; use and care for oxygen breathing apparatus; and use firefighting equipment. Provide oxygen-breathing apparatus unless, in the development of the emergency plan, analysis specifically indicates that the use of self-contained breathing apparatus is sufficient. Keep breathing apparatus in good repair and ready for use at all times. Maintain a sufficient supply of spare breathing apparatus, replacement parts, and regenerating material or air cylinders.

23.2.5 Emergency Lighting. Provide each employee and visitor entering underground workings with an MSHA-approved portable hand or cap lamp and make sure the employee or visitor carries it. Providing hand or cap lamps does not take the place of meeting lighting requirements.

23.2.6 Designated Person. At least one designated person must be on duty above ground when personnel are underground. The designated person must be familiar with operating features of the lighting and ventilation system and the procedures for obtaining emergency service. The designee must remain within contact range of the communication system annunciator.

23.3 Requirements for Ventilation

Mechanically ventilate all areas of tunnels, shafts, and other underground workings with clean, breathable, nonrecirculated, outside air. Place the ventilation system in operation before employees enter any underground workings and keep the system in operation until all personnel have left the area serviced by the system.

23.3.1 Ventilation System Design Requirements. Submit the system(s) design criteria, specifications, and appropriate drawings before acquiring or installing the system. Incorporate the following specific design features in all ventilation systems:

a. Mechanically induce all airflows. Do not provide required air quantities by natural ventilation methods.

b. Construct primary ducts and fans of noncombustible metallic materials. You may use short, noncritical sections of expandable-type ducting in secondary systems.

c. Use class 1, division 1 electric motors, fans, drives, and auxiliary equipment, including wiring, starters, and controls. Design, install, and maintain the system in explosion-proof condition and make sure it is capable of operating in an explosive atmosphere.

d. Ensure the noise levels of ventilation fans does not exceed 90 decibels when measured at the closest point of employee exposure.

e. Ensure system airflows, secondary systems excepted, are reversible from a surface location. Incorporate a control system in the reversing feature so it is not necessary to rewire fans or electrical circuits to accomplish the reversing sequence.

f. Design the primary ventilation systems to operate in the exhausting mode.

g. Maintain primary duct system inlets within 3 duct diameters of the tunnel face or shaft bottom when operating in exhaust and within 10 duct diameters of the tunnel face or shaft bottom when operating on blow. In conventional drill and blast tunnels, you may need to install a supplemental ventilation system to maintain minimum ventilation rate to the tunnel face or shaft bottom during all portions of the excavation cycle. "Blow Joes" or similar-type recirculating devices do not meet this requirement.

h. Heat or cool the ventilation air as necessary to ensure air temperatures at work sites are between 40 ºF and 100 ºF.

i. Design ventilation system capacities (cubic feet per minute) to be the greater of:

1. The total rate (cubic feet per minute) required for all MSHA-approved diesel engines operating underground.

2. The total rate (cubic feet per minute) required for all non MSHA-approved equipment. Non MSHA-approved diesel equipment must meet appropriate requirements in this section.

3. The total rate (cubic feet per minute) required to control airborne contaminants or toxic and flammable gas or vapor within prescribed limits or values specified or referenced in this section and in the "Occupational Health" section.

4. The rate (cubic feet per minute) required to maintain a minimum air velocity of 100 feet per minute (feet per minute) over the gross bore area of all sections of the underground workings.

23.3.2 Air Volume Measurements. Develop and implement a procedure to maintain design airflows in all sections of underground workings. The procedure, as a minimum, must require the following:

a. Determining airflows immediately after any system installation or modification that could significantly affect airflows (e.g., adding new fans, repairing fans, or changing duct arrangements).

b. Continuously monitoring airflows in primary ventilation systems with direct readout instruments containing low-air volume alarms.

c. Determining airflows in congested tunnel areas (e.g., headings and near rapid excavation machines) by pitot tube traversing of the duct system supplying or exhausting air from the area. (Refer to American Conference of Governmental Industrial Hygienists publication, "Industrial Ventilation," for acceptable equipment and methods for air volume determinations.)

d. Maintaining all data obtained by measurement, including the date, place, time, instrumentation, calculations, results, and the names of test personnel, on the surface and make it available for review.

23.4 Requirements for Air Quality

Underground air quality must meet the following specifications:

(a) Oxygen concentrations must be between 19.5 percent and 22.0 percent.

(b) Carbon monoxide concentrations must not exceed 25 parts per million (0.0025 percent).

(c) Carbon dioxide concentration must not exceed 5,000 parts per million (0.5 percent).

(d) Nitrogen dioxide concentration must not exceed 3 parts per million (0.0003 percent).

(e) Hydrogen sulfide must not exceed 10 parts per million (0.001 percent).

1. Conduct tests for hydrogen sulfide in the affected areas every 4 hours whenever hydrogen sulfide levels exceed 5 parts per million (0.0005 percent).

2. Use a continuous sampling hydrogen sulfide indicator with alarm to monitor the affected work area if hydrogen sulfide levels exceed 10 parts per million (0.001 percent).

3. Take steps to increase ventilation to reduce the concentration if the concentration of hydrogen sulfide exceeds 10 parts per million (0.001 percent) time-weighted average for an 8-hour period.

(f) Do not allow methane gas to exceed 20 percent of the lower explosive limit:

1. Whenever 5 percent or more of the lower explosive limit for methane or other flammable gases is detected, take steps to increase the ventilation rate or other steps to lower the methane concentration.

2. Whenever 10 percent of the lower explosive limit for methane or other flammable gases is detected, evacuate all employees except those necessary to eliminate the hazard, and disconnect electrical power except for explosion-proof pumps and ventilation equipment.

(g) Do not allow other flammable gases or vapors to exceed 10 percent of the lower explosive limit.

(h) Do not allow other airborne contaminants, including dust, to exceed the limits prescribed in the section on "Occupational Health."

23.4.1 Quantitative Sampling of Underground Environments. A competent person must conduct the quantitative sampling of underground environments. A competent person is one who through education, experience, and training can, using acceptable scientific instruments and methods, determine the quality of air in underground environments. Conduct quantitative sampling as follows:

a. While excavating the tunnel at least once each 4 hours and before reentry into the face area after each blast, test the environment in the face area: first for oxygen concentration and then for flammable gas or vapors, carbon monoxide, hydrogen sulfide, and nitrogen dioxide.

b. At least once during each work shift change, test all working environments for oxygen concentration, flammable gas or vapors, carbon monoxide, nitrogen dioxide, hydrogen sulfide, and other applicable gases or vapors.

c. Sample all working environments near dust-producing operations for applicable airborne particulates within 10 days after underground operations begin, and at 90-day intervals thereafter, or within 10 days following major changes in tunnel excavation methods or major modifications to ventilation systems. Within 10 days following the sampling date, furnish a full report of the sampling method and analysis and an evaluation of the environmental conditions to the affected employees.

d. Log and file environmental sampling data, including procedures, equipment, personnel, dates, and results at a surface location and make it available for review.

23.4.2 Specialized Instrumentation. In addition to quantitative sampling requirements, install specialized direct reading instruments to determine the concentration of flammable gases and vapors as follows:

a. Equip all rapid excavation machines with a multisensor continuous flammable gas and vapor detector designed to shut down excavation operations when gas or vapor concentrations reach 10 percent of the lower explosive limit. Locate one sensor at the dust shield near the conveyor belt opening. Locate another sensor at the operator's station and a third sensor in the primary duct of the exhaust mode ventilation system.

b. In conventional (drill and blast) operations, install an automatic multisensor continuous gas detector near the tunnel heading or shaft bottom. Equip the unit with visual and audio alarm components capable of alerting employees working at the heading or bottom that flammable gas or vapor concentrations have exceeded 10 percent of the lower explosive limit. Locate one sensor in the primary duct of an exhausting ventilation system and at least one more sensor in the general tunnel area within 30 feet of the face. Locate all sensors installed in the tunnel proper as near the crown as practical.

c. Machine excavation operations, other than those described in paragraph a. above, require a similar detection system, a system with one sensor effectively placed to detect flammable gas and vapor concentrations near the cutter head.

23.4.3 Suspensions of Operations. Suspend all underground operations and remove all employees from underground workings whenever flammable gas or toxic gas or vapor concentrations exceed the acceptable levels set forth in this section on "Air Quality." Prohibit reentry, except for rescue operations, until authorized in writing by the contracting officer or representative, or office head. Do not provide written authorization until the following occurs:

a. The employer has engaged the services of a PE experienced in gaseous tunneling or mining operations.

b. The PE has, after onsite investigation and testing, developed a written detailed procedure for safely reentering the underground workings and resuming operations.

c. The procedure complies with all requirements of these standards and the regulations of Federal and State entities having jurisdiction.

23.5 Requirements for Dust Control

Carry out all drilling and excavation operations in a manner that meets the requirements of this subsection and control airborne dust concentrations within limits prescribed in the section on "Occupational Health." Quantitative testing is required for underground environments and operations to ensure effectiveness of dust control methods.

23.5.1 Drilling. Equip rotary and percussion drills with water or chemical dust-control systems or other control systems.

23.5.2 Machine Excavation. Equip tunnel boring machines or other excavating machines with an effective dust-control system(s) before installation. Make sure the system can control the dust concentrations within the specified safe hygienic limits. Routinely maintain and test the system to ensure its effectiveness.

23.5.3 Muck Piles. Keep muck piles wet to reduce dust concentrations.

23.6 Requirements for Combustion Engines

Do not use internal combustion engines, other than approved diesel-powered equipment, underground. Provide written approvals or certifications before taking the equipment underground. Do not consider equipment approved until it meets one of the following provisions:

(a) The diesel-powered equipment has been approved or certified under the provisions of MSHA regulations 30 CFR Part 32 or Part 36 (formerly schedules 24 and 31). When applicable, obtain a permit from the State entity having jurisdiction.

(b) The employer certifies the diesel-powered equipment is equivalent to MSHA-approved equipment and meets the following requirements:

1. The engine's fuel injection system allows adjustments to the mechanism controlling maximum fuel injection only by breaking a seal or by altering the design.

2. At maximum fuel air adjustment under normal operating conditions and within the rated output range of the engine, make sure the undiluted exhaust gas does not contain more than 2,500 parts per million carbon monoxide and no more than 2,000 parts per million oxides of nitrogen.

3. Dilute the exhaust gas with air before discharging it into the surrounding tunnel atmosphere. Ensure that the discharged mixture of exhaust gas and air doesn't contain more than 100 parts per million carbon monoxide, 25 parts per million oxides of nitrogen, 10 parts per million aldehydes, and 2 milligrams per cubic meter of exhaust gas particulate emissions.

4. Cool engine exhaust to less than 160 ºF before releasing it into the surrounding tunnel atmosphere.

23.6.1 Ventilation Requirements. Ensure that ventilation (cubic feet per minute) incident to the use of diesel-powered equipment underground meets the requirements of this section, including the following:

a. The cumulative MSHA-approved ventilation rate for all diesel-powered equipment must be used for underground ventilation.

b. For non-MSHA-approved equipment, a ventilation rate (cubic feet per minute) adequate to dilute all gaseous exhaust contaminants to below the prescribed limits or values specified or referenced in the "Occupational Health" section and to reduce the particulate emissions to below 1 milligram per cubic meter. In no case must the required ventilation rate be less than 150 cubic feet per minute multiplied by the manufacturer's rated horsepower of all engines when operating at maximum fuel/air ratio.

23.6.2 Maintenance and Testing. Inspect and maintain diesel equipment in accordance with the manufacturer's instructions. Design, operate, and maintain diesel equipment in conformance with MSHA 30 CFR Parts 36, 75.1909, and 1914. Maintain records of inspections and maintenance.

23.7 Requirements for Noise Control

Assess and control noise associated with underground operations, using the section on "Occupational Health."

23.8 Requirements for Fire Prevention and Control

In addition to the requirements set forth in the section, "Fire Prevention and Protection," the following requirements apply to all underground operations.

23.8.1 Heating. Do not use liquified petroleum gas (LPG) and natural gas heaters underground.

23.8.2 Gasoline, Diesel, and LPG. Do not permit gasoline or liquefied petroleum gases underground. Do not permit more than 1 day's supply of diesel oil underground. Do not pipe diesel fuel or combustible liquids from the surface to below ground.

23.8.3 Welding and Cutting. Comply with the section, "Hand Tools, Power Tools, Pressure Vessels, Compressors, and Welding," as well as this paragraph when welding and cutting underground. You may use acetylene and methyl acetylene propadiene stabilized gas underground for welding, cutting, and hot work. Do not permit underground more than the amount of fuel gas and oxygen necessary for work under progress for that shift. Before and continuously during welding or cutting, a competent person must determine that the atmosphere does not exceed the flammable gas, vapor, or oxygen limits.

23.8.4 Lubricants. Keep oil, grease, and diesel fuel stored underground in tightly sealed containers in fire-resistant areas at least 300 feet (91.44 meters) from explosive magazines and 100 feet (30.48 meters) from shaft stations, inclined passageways, and major electrical installations. Install in the storage area only electrical lighting systems that are approved for class I, division 2 locations.

23.8.5 Hydraulic Fluids. Use only fire-resistant hydraulic fluids approved by a recognized authority, such as Underwriters Laboratories, Inc., or Factory Mutual, in hydraulically actuated machinery and equipment, unless the equipment is protected by a fire protection system.

23.8.6 Belt Conveyors. Provide fire extinguishers of at least 2-A:40-B:C units at the head and tail pulleys and at 300-foot intervals along the belt line. Install a device on the conveyor drive system that automatically disconnects power to the drive unit if the conveyor stalls.

23.8.7 Portal Structures. Erect fire-resistive structures within 100 feet of a tunnel portal or shaft entrance. Place flammable material storage areas at least

200 feet away from the portal or shaft entrance. Do not permit combustible or flammable material within 100 feet of the portal or shaft entrance, main fan installation, or in a location where, in case of a spill or leak, the material will flow into the portal area.

23.8.8 Fire-Suppression Systems for Diesel-Powered Equipment. Equip all diesel-powered equipment operated underground with all of the following:

a. A minimum of one 2-A:40-B:C dry chemical fire extinguisher that is accessible from ground level.

b. Factory Mutual or other nationally recognized independent testing laboratory must specifically approve a dry chemical, pre-engineered, fixed-nozzle-type fire-suppression system for the respective service and the potential hazard. The design, installation, operation, and maintenance of the system must be in accordance with the testing laboratory's recommendation. The system, where applicable, must conform to National Fire Protection Association Standard No. 17, "Dry Chemical Extinguishing System," and the requirements of the authority having jurisdiction. Manual system actuators must be accessible from ground level and within reach of the operator when seated in the operating position.

23.9 Requirements for Excavation Operations

Before the start of excavation operations, train employees in the safety requirements for the method of excavation to be used: include the equipment to be used, the ground support systems, and the material handling systems in the training program.

23.9.1 Drilling Operations.

a. Examination and Scaling. Before starting the drill cycle, examine the face and lifters for misfires. If found, remove them before drilling. Don't drill lifters through loose rock or water. Inspect the heading, including the face, for loose rock, and scale it before mucking and drilling. Protect employees engaged in these activities from dislodgements by location, ground support, or other equivalent means.

b. Equipment Inspection. Inspect drilling equipment each shift and correct defects affecting safety before using the equipment.

c. Drill Jumbos. On jumbo decks, more than 6 feet high, install removable guardrails with pipe uprights and chain handrails or equivalent protection on the open sides and back. Also provide safe access to the deck and cover the decks with solid, nonslip decking. When moving jumbos, do not permit riders on the deck unless they are assisting the operator.

1. Chock jumbos to prevent movement while employees are working on them.

2. Maintain walking working surfaces of jumbos to prevent slipping, tripping, and falling.

d. Moving Drills. Secure drill steel, tools, mast, and other equipment in a safe position when moving a drill to another area. Provide receptacles or racks for drill steel stored on drill jumbos.

e. Drill Masts. Do not permit employees on the drill mast when the drill bit is in operation.

f. Column Drills. Firmly anchor drills supported on columns before operation and retighten the drill frequently during operation.

g. Startup Warning. Before the drill cycle begins, warn the employees working below the jumbo deck.

h. Lifting Material and Equipment. Provide a mechanical means to raise heavy materials and equipment to the top decks of jumbos more than 4 feet high.

i. Airhose. Secure all airhose with an inside diameter greater than 0.5-inch at each connection and at the drill with clips and wire rope, chain lashings, or an equivalent safety device.

23.9.2 Mechanical Excavation.

a. Mechanical Hazards. Sound an audible warning before excavating or conveying machinery. Equip excavating machines with dead-man controls. Provide adequate guarding where workers are exposed to moving parts or to hydraulic lines operating at temperatures greater than 160 ºF.

b. Lockout. In addition to requirements found in the section, "Hazardous Energy Control Program," provide a means to lock out all power sources from the mechanical excavating equipment. Where employees may need to work between the face and the cutter head tunnel-boring machines, provide the employees with a positive mechanical block to prevent movement of the cutter head and a provision to lock out the power.

c. Examination. Thoroughly examine the heading before starting excavation equipment.

23.10 Requirements for Ground Support

23.10.1 Tunnel Portals. Keep rock faces above and adjacent to portal areas thoroughly scaled, and remove all loose or overhanging rock. Provide chain link fabric on rock faces that are subject to spalling or raveling. Provide a fire-resistive protective canopy at all tunnel portals. The protective canopy must project at least 15 feet from the portal face and must withstand falling earth or rock.

23.10.2 Inspection and Scaling. At least once a shift, a competent person must inspect tunnels and shafts where employees are working. Scale and support them as required. Provide scaling bars and maintain them in good condition. A competent person must inspect the entire tunnel, including roof and walls at least weekly. Maintain weekly inspection records on the surface.

23.10.3 Loose Ground. Remove or support loose rock and earth. Employees scaling or installing supports must work from supported areas or protect them with spiling, crown bars, shielding, or other equivalent protective systems.

23.10.4 Rock Bolting. A PE must design rock bolt support systems. Make torque meters and torque wrenches available where rock bolts are in use. Make sure a competent person establishes torque testing and retightening intervals, on the basis of rock conditions and existing vibration sources.

23.10.5 Damaged Tunnel Supports. Immediately repair or replace damaged or dislodged tunnel supports of any description. Whenever possible, install new supports before removing the damaged supports.

23.10.6 Anchorage. Design and install all sets, including horseshoe-shaped or arched rib steel sets, with the bottoms sufficiently anchored to prevent movement. Install lateral bracing between sets to stabilize the support.

23.10.7 Wood Supporting Structures. Do not use timber supports or wood lagging.

23.11 Requirements for Transportation and Haulage

The employer must develop a complete set of operating rules for all types of haulage equipment. Provide a copy of these rules and discuss them with all employees before they go underground. Do not implement operational changes affecting the rules until you change the rules.

23.11.1 Inspection. Maintain all haulage equipment in safe operating condition. A qualified person must inspect it at the beginning of each shift. Correct equipment defects affecting safe operation before using the equipment.

23.11.2 Rail Haulage Systems

a. Locomotives. In addition to ensuring that locomotives meet the requirements of this section, equip them with: (1) a braking system, capable of stopping and holding a loaded train on any section of track; (2) headlights, a backup light, an audible warning device, a continuous revolving flashing amber light that is visible in all directions; (3) seats for the operator and all passengers; (4) adequate platforms and handholds for the train crew; (5) rerailers and jacks; (6) dead-man controls; and (7) falling object protection in accordance with the latest revision of 29 CFR 1926, Subpart S, "Tunnels and Shafts, Caissons, Cofferdams, and Compressed Air."

b. Man-Haul Units. (1) Totally enclose man-haul units, except for doors, small windows, and ventilation openings; (2) equip man-haul units with seats for all passengers, adequate access devices, and safety chains in addition to safety coupling devices; (3) use man-haul units only to transport personnel, their personal equipment, and small secured tools. Man-haul trips must consist of an engine and man-haul car(s) only. Pull man-haul cars when occupied. Personnel who are incidentally transported between shift changes may sit on locomotive seats or in specially equipped, empty muck cars that have adequate headroom. Engines must pull muck cars carrying personnel, and muck cars must be equipped with safety chains.

c. Haulage Cars. Equip mine dump cars with automatic safety couplings. Equip cradle or bottom dump cars with a positive-locking device to prevent accidental dumping. Provide and use tiedown chains or bumper blocks to prevent overturning of cars dumped by hand.

d. Tracks. Install and maintain rails in a manner that prevents shifting or excessive settlement. Anchor rails to prevent unsafe separation, and gauge them during laying operations and regularly while in use. Provide berms, bumpers, blocks, safety hooks, or equivalent means to prevent overtravel or overturning at dumping areas.

e. Operations. Load and secure materials to be hauled to prevent sliding or dislodgement. Carry only small hand tools, lunch pails, or similar light items on top of locomotives, provided that the top of the locomotive is designed or modified to retain them while traveling. Chock, block, or set the brakes on parked equipment to prevent inadvertent movement.

23.11.3 Nonrail-Type Haulage Systems. Nonrail-type haulage systems must comply with the following applicable requirements:

a. Rubber-tired or crawler equipment and operations must comply with applicable requirements of this section and the section, "Mobile and Stationary Mechanized Equipment."

b. Conveyor systems equipment and operation must conform with applicable requirements of this section and the section, "Hoisting Equipment, Piledrivers, and Conveyors."

23.12 Requirements for Shafts

In addition to other applicable provisions of this section, the following requirements apply to the excavation of vertical and inclined shafts. Support shafts more than 5 feet deep if employees must enter. A competent person must determine the method of support.

23.12.1 Access. Provide all shafts with a protected manway designed to permit safe entrance to and exit from the shaft bottom. Hoisting systems designed, installed, operated, and maintained as set forth in this section may transport personnel.

23.12.2 Guards. Protect the shaft opening with totally enclosed perimeter guarding that is as high as a standard guardrail. Slope the ground adjacent to the top of the shaft collar away from the shaft to prevent liquids from entering and construct an effective barrier to prevent mobile equipment from accidentally entering the shaft.

23.12.3 Hoisting Systems. Do not use cranes, derricks, or similar equipment as the primary hoisting system to raise or lower personnel. Only use cranes, derricks, or similar equipment meeting the requirements of this section for an emergency hoisting system. Do not use cranes to raise or lower muck or concrete buckets or similar devices to remove excavated material or to place concrete, except in shafts less than 75 feet (22.86 meters) deep. You may use cranes to raise and lower construction materials or equipment that cannot be safely handled by the hoisting system. Cranes must conform with applicable provisions of the "Hoisting Equipment, Piledrivers, and Conveyors" section and all of the following requirements:

- Equip primary and secondary hoisting lines with planetary or worm gears, torque convertors, automatic braking systems, or other equivalent systems that prevent the loadlines from being placed in a free wheeling or neutral position controlled only by a manual brake or dogs (hooked or U-shaped device used for gripping or holding heavy devices).
- Equip hoisting lines with: (1) an anti-two-blocking device or a two-block damage prevention feature; and (2) a limit switch to prevent overtravel at the bottom of the shaft. Keep at least two full wraps of wire rope on the drum at all times.
- A competent person must inspect the crane at the beginning of each shift and each time it is set up at the work site. Give the crane a full cycle operational test lift before initial use at the shaft site and each time it is reset at the site.

a. General Requirements of the Primary Hoisting System. Install a stationary hoisting system meeting the requirements of this subsection and applicable provisions of the "Hoisting Equipment, Piledrivers, and Conveyors" section, and ANSI A10.22, "Safety Requirements for Rope-Guided and Non-Guided Workmens' Hoists," at all shaft sinking operations 75 feet (22.86 meters) or more deep. A PE must design all stationary hoisting systems. Follow the more stringent standard if there are conflicts between these and referenced standards.

b. Specific Requirements of the Primary Hoisting System. The stationary hoisting system must meet applicable ANSI standards, the requirements of the State having jurisdiction, and the following specific requirements:

1. Personnel Hoisting. You may use the primary hoisting system to hoist personnel in attached cages or manskips that meet the requirements of referenced ANSI standards or in buckets suspended beneath crossheads operating on rail or rope guides, provided: (1) the sides of the bucket are steel and at least 4 feet high, and at least 1/16 inch thick; (2) you use emergency chains, slings, or double clevis pins between the lower end of the hoisting rope and the bucket to prevent the bucket from falling in the event of ring bolt or clevis pin failure; (3) you provide a bonnet that covers the top to protect it from falling rock or other objects; (4) the bonnet is the equivalent of two steel plates 3/16 inch thick, sloping toward each side and arranged to permit safe egress from the bucket; (5) the speed of the personnel platform does not exceed 200 feet per minute; and (6) governor controls set for 200 feet per minute are installed in the control system and used during personnel hoisting.

2. Hoist Motors. Design the hoist motor so that the load powers up and down through the gears. There must be no friction gearing or clutch mechanism by which the motor or other power source can be disconnected from the hoist drum. When the control is brought to the "stop" position, or should the motor stop, the load must stop and remain in the stopped position.

3. Hoist Controls. Design the hoist control to return to the "stop" position when the operator removes his/her hand from the control lever. Whenever the control lever is in the stop position, the brakes must automatically apply and the power must cut off. All hoist controls and the emergency power cutoff must be within reach from a single operating position.

4. Guides. Equip shafts more than 75 feet (22.86 meters) deep with guide rails or guide cables to prevent the cage or bucket from swaying.

When sinking shafts more than 75 feet (22.86 meters) deep, keep the guide rails or cables as close as possible to the bottom of the shaft. Maintain rail guides within one rail length of the bottom. Provide a safe means of access from the bottom landing to the bottom of the shaft. When sinking shafts less than 75 feet (22.86 meters) deep, guide cages, skips, and buckets that may swing, bump, or snag against shaft sides or other structural protrusions by fenders, rails, ropes, or a combination of those means. Guide cages, skips, and buckets in all completed shafts by ropes or rails for the full length of their travel.

5. Broken-Rope Safety. Equip cages, skips, or buckets operating on guides or guide cables in shafts more than 75 feet (22.86 meters) deep with a broken-rope safety device, or equivalent, that will stop and hold a weight that is 150 percent of rated capacity in the event of a hoisting cable failure.

6. Limit Stops. Equip hoists with approved-type limit switches that will automatically stop the cage or bucket at the limits of travel.

7. Communications. Provide hoist operators with a closed-circuit communications system to each landing station. Locate a speaker-microphone so that the operator can communicate with individual landing stations during the hoist.

8. Performance Inspections and Tests. Following installation and before use, at 6-month intervals thereafter, and after modification or repair of the critical components, inspect each hoist and load test it under the direction of the PE or a qualified person certified by the PE to conduct such inspections and tests. Maintain a comprehensive report detailing the required inspections and test procedures and results. The PE, or his or her designee, must sign and maintain the report. Include a broken rope drop test to verify that safety clamps function properly and that the guide ropes/rails, their supports, and the bucket/cage are able to withstand the imposed load.

(Note: ANSI A10.5, "Safety Requirements for Material Hoists," under "Standards for Material Handling, Storage, and Disposal," details one method for conducting such tests.)

Further, performance test the hoist with a test load of 125 percent through all limits of travel to ensure satisfactory operation of limit switches, speed indicators, braking systems, and controls.

9. Periodic Inspection and Tests. A competent person must visually check all hoisting machinery equipment, anchorages, and hoisting rope at the beginning of each shift and during hoist use, as necessary. A competent person must check each safety device at least weekly during hoist use to ensure suitable operation and safe condition. Periodic inspections and tests must conform to the PE's recommendations.

c. Overhead Protection. Do not hoist or lower material or tools while personnel are working at the bottom of a shaft unless a barrier of adequate strength is installed to protect the personnel from falling objects or material. Do not lower any load, cage, skip, or bucket directly to the bottom of a shaft when personnel are working there. All such equipment must stop at least 15 feet above the bottom of the shaft and remain there until the signal person at the bottom of the shaft gives the signal to lower.

23.12.4 Suspended or Movable Work Platforms. Design, inspect, and test suspended or movable work platforms in accordance with applicable provisions of this section and the section, "Hoisting Equipment, Piledrivers, and Conveyors." The term "platform" in this subsection is synonymous with the terms skip or cage, in referenced subparagraphs, subsections, or standards.

23.12.5 Small-Diameter Shafts. Provide small-diameter shafts, such as manholes, wells, or test pits that employees must enter, with a steel casing, concrete pipe, timber cribbing, or other support adequate to retain surrounding earth.

23.12.6 Inspection. Following a blast, check the walls, ladders, supports, blocking, and wedges to determine if they have loosened. If they are loose or unsafe, make repairs before continuing work in the shaft.

23.13 Requirements for Tunneling in Soil

23.13.1 Support. When excavating by conventional methods, do not extend the excavation more than 2 feet in advance of the tunnel supports. When using continuous mining machines, keep the support within 4 feet of the face or shield. Do not permit employees under unsupported or unshielded sections of the tunnel.

23.13.2 Voids. Fill, block, or brace voids behind ring beams, liner plates, or other supports to prevent caving.

23.13.3 Design of Support. A PE must design support systems for tunnels excavated in soil.

23.14 Requirements for Compressed-Air Work

The employer must comply with the requirements set forth in 29 CFR 1926.803, "Compressed Air," when operations involve work in a compressed-air environment.

Section 24

Blasting Operations

This section discusses blasting operations, with specific focus on the following areas:

- General Requirements
- Radio and Electromagnetic Radiation
- Transporting Explosives
- Transporting Explosives Underground
- Storing Explosives
- Handling Explosives
- Loading Explosives and Blasting Agents
- Wiring operations
- Firing explosives
- Inspection following a blast
- Misfires
- Using safety fuses
- Using detonator cord
- Underwater blasting

24.1 General Requirements for Blasting Operations

In addition to the requirements of this section, the transportation, handling, storage, and use of explosives are subject to provisions of ANSI A10.7 - Safety Requirements for Transportation, Storage, Handling, and Use of Commercial Explosives and Blasting Agents; 29 CFR 1910.109 - Explosives and Blasting Agents; 29 CFR 1926, Subpart U - Blasting and the Use of Explosives (1926.900 to 1926.914); and 27 CFR Part 55 - Commerce in Explosives.

24.1.1 Competent Supervision. A blasting supervisor must be designated to direct and supervise all blasting operations. This includes the transportation, handling, storage, and use of explosives and blasting agents. The supervisor must provide written records of past experience to the employer as evidence of competency.

24.1.2 Qualifications.

a. Personnel. Employees who transport, store, handle, or use explosives or blasting agents must be at least 21 years of age. They must be able to give and understand written and verbal instructions.

b. Blasters. Blasters must be qualified through training, knowledge, and experience in transporting, storing, handling, and using explosives, and have a working knowledge of State and local laws and regulations which pertain to explosives. Blasters must hold a Federal, State, or local license or certificate, have proof of formal training attended within the last 5 years, or three recommendations from past employers or explosives manufacturers testifying to the blaster's knowledge and ability to perform in a safe manner the type of blasting that will be required.

24.1.3 Blasting Plan. Submit a comprehensive blasting plan before the start of blasting operations and have it approved. The blasting plan may be submitted as part of the overall site safety plan, as required by the "Contractor Requirements" section of these standards (for contract operations) or as a supplementary plan to a Job Hazard Analysis. Explosives must not be transported onto the jobsite before the plan has been approved. The plan must identify proposed methods and procedures for conforming with referenced standards and regulations, and it must include the following information:

- Method and equipment for transporting explosives and detonators
- Type and location of storage facilities
- Type and quantity of explosives and detonators
- Primer assembly procedure and location
- Employee training programs
- Provisions for protecting people, structures, and private and public property
- Provisions for developing and distributing a daily blasting plan covering hole diameter, spacing, loading, and delay patterns
- Provisions for disposal of explosives, blasting agents, and associated materials

24.1.4 Security and Inventory. Secure and protect explosives from theft. Maintain an accurate running inventory of all explosives stored at the jobsite. Such records must be available. Promptly report any loss or theft to the appropriate authorities.

24.1.5 Notifications. Notify the owners and operators of the facility and take all necessary precautions for the safe control of the blasting operations before beginning blasting operations in the immediate vicinity of buildings, public roads, overhead powerlines, utility services, or similar facilities. At least 24 hours before blasting in the vicinity of gas, electric, water, communications, or other utilities is to begin, the blasting supervisor must notify appropriate utility representatives.

24.1.6 Smoking Restrictions. Prohibit smoking, firearms, matches, open flame lamps, fire, heat-producing devices, and sparks in or near explosive storage sites or in areas where explosives are handled, transported, or used.

24.1.7 Thunderstorms. Discontinue the handling or use of explosives during the approach and progress of a thunderstorm. All employees must leave the danger areas and seek a place of safety when these conditions are present. Install an approved lightning warning device capable of detecting atmospheric conditions that could produce lightning on the jobsite. Warning devices must be acceptable to the COR or office head before installation.

24.1.8 Damage Control. Take precautions to minimize ground vibration, airblast, and flyrock. Include a damage control section in the site blasting plan that addresses these issues. Use blasting mats where flyrock damage is possible. Use modern blasting seismographs and methods to measure ground vibrations and air blast levels at designated structures or locations. Unless otherwise specified, control the blasting so that ground vibrations and airblast levels do not exceed the following:

Ground Vibration Limits[1]		
Type of Structure[2]	**Peak Particle Velocity (inches per second)**	
	At Low Frequency[3] (<40 Hertz)	**At High Frequency (>40 Hertz)**
Modern homes, drywall interiors	0.75	2.0
Older homes, plaster on wood lath construction for interior walls	0.5	2.0

Reference: Siskind, D.E., M.S. Stagg, J.W. Kopp, and C.H. Dowding, "Structure Response and Damage Produced by Ground Vibration from Surface Mine Blasting." U.S. Department of the Interior, Bureau of Mines, Report of Investigations RI 8507, 1980.

[1]The graph in Appendix B of the above reference may be used in lieu of the limits listed in this table.

[2]For precarious structures not listed in the table, use the limits for older homes; for all other structures not listed in the table, use the limits listed for modern homes.

[3]All spectral peaks within 50 percent amplitude of the predominant frequency must be analyzed.

Airblast Limits	
Instrumentation	**Air Blast (decibels)**
0.1 hertz high-pass system	134
2 hertz high-pass system	133
5 or 6 hertz high-pass system	129
C-slow (for events not exceeding 2 seconds' duration)	105

Reference: Siskind, D.E., V.J. Stachura, M.S. Stagg, and J.W. Kopp, "Structure Response and Damage Produced by Airblast from Surface Mining," U.S. Department of the Interior, Bureau of Mines, Report of Investigations RI 8485, 1980.

24.1.9 Warning Signs. Post warning signs at access points to blasting areas.

24.1.10 Destruction of Explosives. Deteriorated or damaged explosives, blasting agents, blasting supplies are prohibited. Destroy and remove these and all excess explosives from the site in accordance with the specific written instructions of the manufacturer.

24.1.11 Empty Explosive Containers. Destroy empty boxes and combustible packing materials which have contained explosives in accordance with the manufacturer’s disposal procedures. If disposal is through burning, all personnel must remain at least 100 feet from the burning site once the material has been ignited and until no visible flames or smoke have been detected for 1 hour.

24.1.12 Fire. If a fire begins that involves explosives, or where the danger of the fire contacting explosives is imminent, do not fight the fire. All personnel must seek safe shelter; guard the fire area to prevent intruders.

24.2 Radio and Electromagnetic Radiation

Take adequate precautions to prevent accidental discharge of electric blasting caps from current induced by radar, radio transmitters, powerlines, and similar sources of electromagnetic radiation.

24.2.1 Mobile Radio Transmitters. Mobile radio transmitters or cellular telephones within 100 feet of electric blasting caps or delays not in their original containers are prohibited unless de-energized and effectively locked.

Post warning signs at least 36 by 42 inches in size, stating BLASTING ZONE—TURN OFF 2-WAY RADIOS AND CELLULAR TELEPHONES, on all public roads within 1,000 feet of blasting operations, using electronic detonators.

24.2.2 Non-electric Firing Systems. If it is not possible to observe the safe clearance distances from radio frequency (RF) transmitter stations, as set forth in Institute of Makers of Explosives (IME) publication 20, "Safety Guide for the Prevention of Radio Frequency Radiation Hazards in the Use Of Electric Blasting Caps," use nonelectric firing systems to blast. Electrical detonators must not be stored or used within the IME-specified distances of a transmitter station.

24.3 Requirements for Transporting Explosives

Transporting explosives by air, water, or on public highways must comply with the provisions of US Department of Transportation Regulations contained in 46 CFR 146-149 - Water Carriers; 49 CFR 171-177 Subchapter C - Hazardous Materials Transportation; and 49 CFR 390-397, "Motor Carriers."

24.3.1 Vehicles. Vehicles used to transport explosives must conform to the following requirements:

a. They must be in good repair, with all electrical wiring completely protected and securely fastened to prevent short circuits.

b. They must have tight floors. Cover any exposed spark-producing metal with wood or other nonsparking material to prevent contact with containers of explosives.

c. Do not load them beyond rated capacity, and secure the explosives to prevent shifting or dislodgment.

d. Transport explosive materials in open-bodied motor vehicles only if they have been loaded into a portable magazine that is securely fastened to the truck bed. Never transport explosive materials in open-bodied motor vehicles that depend on a fire-resistant tarpaulin cover for protection.

e. Mark vehicles transporting explosives with reflectorized signs on both sides and the front and rear with "EXPLOSIVES" in red letters. Make letters at least 4 inches high on a white background or placarded in accordance with 49 CFR Part 172, Subpart F - "Placarding."

f. Equip them with two or more fire extinguishers with a rating of at least 2-A:40-B:C.

g. Inspect them daily before use to ensure that the vehicle is in proper condition for safe transportation. The inspection must determine that fire extinguishers are charged and ready; electric wiring is protected and fastened to prevent short circuiting; chassis, motor, pan, and underbody are reasonably clean and free of oil and grease; fuel tanks and lines are secure and have no leaks; tires are in serviceable condition with proper inflation; and lights, brakes, horns, wipers, etc., are functioning properly.

24.3.2 Vehicle Operators. Motor vehicle operators transporting explosives must be at least 21 years old and be properly licensed drivers. Drivers must be physically fit, careful, capable, and reliable. Drivers must not be unlawful users of, or addicted to, alcohol, narcotics, or dangerous drugs. Drivers must be familiar with applicable local, State, and Federal laws and regulations governing the transportation of explosive materials. Transportation on Federal highways or other public roads requires a commercial driver's license.

24.3.3 Caps and Detonators. Do not transport blasting caps and detonators with other explosives unless the blasting caps or detonators are in a closed metal storage container that has at least a 2-inch wood lining. Such containers must be at least 2 feet away from other explosives.

24.3.4 Flammable Materials. Do not transport spark-producing tools, carbides, oil, matches, firearms, acids, storage batteries, oxidizing or corrosive compounds, or flammable materials with explosives.

24.3.5 Parking. Attend vehicles containing explosives at all times. Do not park loaded vehicles, even if attended, near any bridge, tunnel, or other structure that may be occupied or locations where people may congregate or assemble.

24.3.6 Fueling. Do not refuel vehicles while they are carrying explosives.

24.3.7 Smoking Restrictions. Employees who transport, handle, or use explosives must not smoke or carry on their persons or in the vehicle matches, lighters, firearms, ammunition, or flame-producing devices of any description.

24.3.8 Riders. Permit only the authorized driver and helper to ride on trucks transporting explosives or detonators.

24.4 Requirements for Transporting Explosives Underground

In addition to the requirements set forth in the previous subsection, "Requirements for Transporting Explosives," the provisions of this subsection apply to underground transportation of explosives.

24.4.1 Hoists. Notify the hoist operator before transporting explosives or blasting agents in a shaft conveyance. Do not permit any person to ride a hoist or shaft conveyance transporting explosives or blasting agents. Do not transport detonators while transporting explosives.

24.4.2 Powder Cars and Trucks. Convey explosives and blasting agents only in specifically built or equipped insulated powder cars or truck-mounted containers approved by the State entity having jurisdiction. Mark powder cars with reflectorized signs on both ends and sides with "EXPLOSIVES" in letters at least 4 inches high against a sharply contrasting background at all times that there are explosives in the car. Cover or remove the signs when no explosives are present. Do not transport explosives or blasting agents on a locomotive; at least two car lengths must separate the locomotive from the powder car. Pull (do not push) powder cars.

24.4.3 Common Transport of Detonators and Explosive Materials. Physically separate compartments for transporting both detonators and explosive materials in the same conveyance or car by at least 24 inches or by a solid partition at least 6 inches thick. Do not transport detonators and other explosive materials together in any shaft-conveyance.

24.4.4 Transportation of Personnel and Explosives. No personnel, other than the transport operator, helper, and the individuals handling the explosives may ride transports carrying explosives.

24.4.5 Truck Transportation. Trucks transporting explosives underground must meet other applicable provisions of these standards and have their electrical systems checked weekly to detect possible electrical hazards. A written record of such inspections must be maintained. Auxiliary lights on truck beds powered by the truck's electrical system are prohibited. Do not store explosives in trucks.

24.4.6 Transporting Explosives to the Face or the Loading Area. Take only the quantity of explosives or blasting agents estimated necessary for the blast to the face or loading area. Take explosives or blasting agents to the loading area only after the drilling has been completed and the holes are ready to be loaded. Remove surplus explosives and blasting agents from the area before wiring up the blast.

24.4.7 Makeups. Make up primers and delays at the face or loading area, unless a primer-makeup plan is submitted and approved.

24.5 Explosives Storage

24.5.1 Requirement. Store explosives and related materials in approved magazines and in accordance with the applicable provisions of the Bureau of Alcohol, Tobacco, and Firearms as set forth in 27 CFR 55, "Commerce in Explosives." Magazines must be bulletproof, rodent-resistant, weather-resistant, ventilated, and constructed to the standards of the Bureau of Alcohol, Tobacco, and Firearms, or the Institute of Makers of Explosives.

24.5.2 Magazine Location. Locate explosives magazines in accordance with the State and local laws. The COR or office head must approve the proposed sites before location or construction. Consider contractor and Government offices, shops, etc., to be inhabited buildings when determining magazine locations, quantities, and safe distances.

24.5.3 Notifications. Notify local authorities, such as law enforcement agencies and fire departments, of the type, planned quantity, and storage location on the site before bringing explosives onto a site for storage.

24.5.4 Detonators. Do not store blasting caps, electric blasting caps, detonating primers, and primed cartridges in the same magazine as other explosives or blasting agents. Locate detonator magazines at least 100 feet from magazines containing other explosives or blasting agents, if unbarricaded, and at least 50 feet away, if barricaded.

24.5.5 Combustible Materials. Do not permit smoking or open flame within 100 feet of storage magazines. Remove vegetation and combustible material within 25 feet of all magazines.

24.5.6 Security. Securely lock magazines at all times except to inspect or move explosives. Maintain an inventory of all storage and withdrawal of explosives. Inspect magazines storing explosives at least every 7 days to ensure that there has been no unauthorized entry or removal of explosives.

24.5.7 Posting. Post areas around magazines with "EXPLOSIVES" signs. Place the signs so that a bullet passing through the sign will not strike a magazine.

24.5.8 Storage. Store explosives in their original containers. Store containers of explosives with the top side up as designated on the container. Use the oldest stock of explosives first.

24.5.9 Maintenance. Promptly remove debris and combustible material from magazines. When magazine floors become stained with explosives, clean them in accordance with the explosive manufacturer's instructions.

24.5.10 Transfer In and Out. Provide for the safe transfer of explosives in and out of magazines, including providing ramps or walkways, as necessary.

24.5.11 Storage Underground. Do not permanently store explosives underground. Temporary storage must comply with the following requirements:

> **a. Powder Cars.** Restrict temporary storage to limited supplies stored in specially designed powder cars located at least 1,000 feet from the face or blasting area. Do not permit transformers, storage of flammable materials, welding, open flame, smoking, and other ignition sources within 100 feet of the powder car.
>
> **b. Posting and Lighting.** Designate the storage area or siding by a red light visible in all directions, and post both ends of the powder car with a luminous sign, stating "EXPLOSIVES - NO SMOKING, FLAME, OR WELDING WITHIN 100 FEET."
>
> **c. Protection.** Locate or barricade the powder car to protect it from damage. Design siding or car-passes, when used for temporary storage, to protect the powder car from accidental entry by other cars and to prevent accidental entry of the powder car to the main line. The protective devices installed are subject to approval of both the employer and the State entity having jurisdiction.

24.6 Requirements for Handling Explosives

24.6.1 Handling Explosives. Handle explosives carefully. Do not drop, throw, or slide them. Carry detonators, primers, and other explosives in separate containers when transporting them manually. When they are not in their original containers, place them in a suitable nonmetallic container for manual transportation.

24.6.2 Removal from Containers. Remove explosives from their original containers only as needed for immediate use. Use only nonsparking tools or devices to open such containers. Dispose of empty containers and packing in accordance with the manufacturer's recommendations, or promptly burn them in an approved location.

24.7 Loading Explosives and Blasting Agents

24.7.1 Planning. Plan and schedule excavation so that drilling and loading operations will not conflict. Do not permit loading within 50 feet of drilling operations. Do not permit any activity, other than that which is required for loading holes, within 50 feet of loaded holes or holes that have the explosives in place, ready to load. A qualified blaster must supervise loading operations.

24.7.2 Drilling. Do not drill in an area already blasted until examining remaining "bootlegs" (holes that do not detonate full depth) for unexploded charges, as well as the total area, to make sure no unexploded charges remain. Do not insert drills, picks, or bars into bootlegs, even if examination fails to disclose explosives.

24.7.3 Loading Areas. Make boreholes ready for loading, and remove equipment and tools not used for loading from the area before delivering the explosives to the site. Isolate the loading areas with appropriate signs or temporary barricades to prohibit access by unauthorized people. While the bare holes are being loaded with explosives, exclude all personnel, other than those involved in the loading of boreholes, from the blast site.

24.7.4 Boreholes. Make boreholes large enough to permit loading of cartridges and explosives without forcing. Prime, load, tamp, and fire as promptly as possible with a minimum of exposure to personnel.

24.7.5 Tamping. Tamp only with wooden or plastic tamping poles without exposed metal parts. Nonsparking metal connectors on jointed poles are permissible. Seat cartridges by even, steady pressure, and do not tamp primers.

24.7.6 Priming. Follow the manufacturer's recommendations in priming cartridges. Make primers up only at the loading area and in quantities limited to the number required for a single round of blasting.

24.7.7 Stemming. Stem all blastholes in open work with noncombustible material to the collar or to a point that will confine the charge.

24.7.8 Extraneous Electricity. Prohibit electric conductors, electric equipment, and all sources of ignition in or adjacent to the loading area. Remove lights 50 feet from the face before starting to load in tunnels and shafts. If stray currents are suspected, thoroughly check out the area with suitable instruments. If stray currents cannot be eliminated, use nonelectrical detonators, delays, and caps.

24.7.9 Shunts. Do not remove the manufacturer's shunt from the cap leg wires until you complete loading and connect the cap into the blasting circuit.

24.7.10 Sprung Holes. Do not chamber (spring) boreholes.

24.7.11 Blasting Mats. Where blasting may expose personnel or property to injury or damage from flying material, cover the charges with blasting mats. Carefully protect the blasting circuits, and do not permit the circuits to contact steel mats.

24.7.12 Loading and Shooting. Do not leave loaded holes unattended or unprotected. If possible, fire all holes loaded on a shift during that same shift. If it is necessary to delay firing because of an emergency, isolate the area and post watchpersons to prevent entry to the area. Conduct aboveground blasting operations between sunup and sundown.

24.7.13 Pneumatic Loading Systems. Conduct the hazards from static electricity and stray currents associated with pneumatically loading boreholes with blasting agents, take the following precautions:

a. Use only approved pneumatic loaders.

b. Effectively ground and bond the entire system, including placers, valves, and loading hose. Ground at the face in tunnels and shafts. Do not use piping and rails to ground the system.

c. Following installation of the ground, check the ground with an approved meter to ensure that the resistance is within safe limits.

d. Use loading hoses of an approved, nonsparking, semiconductive material designed to maintain static electricity within safe limits.

24.7.14 Underground Use of Blasting Agents. Before using blasting agents underground, a powder technician representing the explosive manufacturer or supplier must inspect the proposed method of loading and the loading equipment. Submit written evidence of such inspection and approval of the systems.

24.8 Wiring Operations

24.8.1 Firing Devices. Use an electric blasting machine to fire blasts using electronic detonators. Do not fire blasts by connection to any other electrical system. Fire blasts using nonelectric detonators with a blasting machine or starting device prescribed by the detonator manufacturer. Do not use cap and fuse firing underground or in the excavation of shafts. Do not use electric blasting caps within 500 feet of energized high-voltage lines or facilities.

24.8.2 Wiring Procedure. Do not remove the manufacturer's shunt from the cap leg wires until the cap has been connected to the leadlines or to another cap in preparation for the assembly of two or more caps into a single series. When firing two or more series of caps as a series-parallel system, make sure that the caps in each series are the same in number (quantity, not delay periods), and test each series separately with an approved blasting galvanometer to: (1) ensure that the series is complete, and (2) ensure that each series has the same resistance and that the resistance is close to the calculated resistance for the series. If the first reading indicates an incomplete circuit, locate the fault and correct it. If the second reading indicates a higher or lower resistance than calculated, correct the situation before final hookup and firing.

24.8.3 Electric Caps and Delays. All caps and delays in a shot must be made by the same manufacturer, and the number in a circuit must not exceed the capacity of the blasting machine or power source.

24.8.4 Galvanometer Testing. Make the following tests with an approved blasting galvanometer during all wiring operations:

(1) Test the circuit, including all caps, before connecting it to the firing line.

(2) Check the firing line before connecting it to the blasting machine or power source.

24.8.5 Firing Lines. Firing lines must be of sufficient current-carrying capacity but not smaller than No. 14 gauge solid copper wire or equivalent. Do not connect the firing line to the blasting machine or power source until you have completed and tested the wiring and cleared the blast area. Do not ground a power circuit used for firing electric blasting caps.

24.8.6 Connecting and Lead Wires. Connecting and lead wires must be insulated single solid wires of sufficient current-carrying capacity.

24.8.7 Power Circuit. When using a power circuit for firing, lock the firing switch in the "OFF" (open) position at all times, except when firing. Design the power circuit so that the firing lines to the cap circuit are automatically short-circuited when the switch is in the "OFF" position. Entrust the keys to the firing switch only to the blaster. In underground operations, the firing circuit must have a "lightning" gap of at least 5 feet, located between the firing switch and the source of power. Bridge the gap with a flexible jumper cord just before firing the blast.

24.9 Firing

24.9.1 Preparation. Before connecting the firing line to the power source, notify all personnel in the danger area of the blast and remove them to a safe area. Make satisfactory arrangements for evacuating the danger area and ensuring that no one enters the area before the blast.

24.9.2 Responsibility. The blaster must be in charge of the blasting machine or firing switch, and must connect the firing line to the firing device. The blaster must make all connections from the cap circuit back to the firing device, and the firing line must remain shorted until connected to the firing device immediately before firing.

24.9.3 Blasting Signal. Sound the following blasting signal on a clearly audible whistle, horn, or siren before each surface or underground blast:

- Blasting warning: A 1-minute series of long blasts 5 minutes before the blast signal
- Blast signal: A series of short blasts 1-minute before the shot
- All clear: A prolonged blast following inspection of the blast area

24.9.4 Posting Blasting Signals. Post blasting signals at all access points, and before each shot, post competent flagpersons at all access points to the danger area.

24.9.5 Disconnecting. Immediately following the blast, disconnect the firing line from the firing power source or blasting machine and shunt it. Lock firing switches open.

24.10 Inspections Following a Blast

24.10.1 All Blasts. Before the all-clear signal, the blaster must thoroughly inspect to determine if all charges have fired. The blaster must carefully check wires and search for unexploded charges.

24.10.2 Underground. In addition to the previously listed requirements, check and test the heading for adequate ventilation and safe concentrations of dusts, toxic vapors, and gases. Also, before permitting personnel in the heading, scale the face and make it safe.

24.10.3 All-Clear Signal. Sound the all-clear signal only after satisfactorily completing the inspection.

24.11 Requirements Regarding Misfires

If you suspect or find a misfire, keep all personnel, except the blaster and employees necessary to handle the misfire, out of the danger area. Prohibit all work in the danger area except that necessary to remove the misfire hazard. If a misfire occurs while using cap and fuse, all personnel must remain at a safe distance from the charge for at least 1 hour. If other electric or nonelectric initiating methods are used, the blasting supervisor may reduce the waiting period to 30 minutes.

24.11.1 Refiring. Refiring is the desired method of clearing misfires. The following actions are mandatory:

a. For electrically fired blasts in which broken wires or faulty connections caused the misfire, make repairs, reconnect the firing line, and attempt to fire the charge.

b. For misfires originally initiated by detonating cord or nonelectrical detonators, the blaster must inspect lines coming out of the holes, and if they appear to be intact, the blaster can reconnect them and attempt to detonate the misfired holes.

c. In blastholes where leg wires are discontinuous or leads or detonating cord cut off, there may still be explosives in the hole that can be reprimed and fired. Remove any stemming in the hole. Float stemming out with water. Place a new primer in the hole and attempt to fire the charge.

24.11.2 Removal of Explosives. This procedure must be the last resort. Perform it only when refiring has failed or when refiring would present a hazard. Remove explosives by washing them out with water, or, if the misfire is underwater, blow them out with air.

24.11.3 Work Restrictions. Do not permit drilling, digging, or picking until: (1) you have detonated all missed holes or removed the explosive, and (2) the blaster has approved the resumption of work.

24.12 Requirements for Using Safety Fuses

Use safety fuses only where sources of extraneous electricity make the use of electric caps dangerous. Do not use damaged fuse or fuse with sharp kinks.

24.12.1 Capping. Before capping a safety fuse, cut a short length from the end to ensure a fresh-cut end in each blasting cap.

24.12.3 Crimper. Use cap crimpers of approved design for attaching blasting caps to safety fuse.

24.12.4 Length of Fuse. The minimum length of safety fuse must be as required by State law, but it must not be less than 30 inches. Provide the blaster sufficient time to permit the blaster to reach a place of safety.

24.12.5 Multiple Cap and Fuse Use. At least two blasters must be present when multiple cap fuse blasting is done by hand lighting methods. Each blaster must light no more than 12 fuses when using hand-lighting devices.

24.12.6 Mudcapping. Do not use cap and fuse to fire mudcap charges unless you separate the charges sufficiently to prevent one charge from dislodging other shots in the blast.

24.13 Use of Detonating Cord

24.13.1 Care in Use. Use only detonating cord consistent with the type and physical condition of the borehole, stemming, and the type of explosive. Consider and handle detonating cord in the same manner as other explosives.

24.13.2 Installation. Cut the line of detonating cord extending out of a borehole or from a charge from the supply spool before loading the remainder of the hole or placing additional charges. All runs must be free of loops, sharp kinks, or angles that take the cord back toward the oncoming line of detonation.

24.13.3 Connections. Detonating cord connections must be competent and positive and in accordance with approved and recommended methods. Make knot-type or other cord-to-cord connections only with detonating cord in which the explosive core is dry. Inspect connections before firing.

24.13.4 Use of Delays. When using detonating cord millisecond-delay connectors or short-interval-delay electric blasting caps with detonating cord, follow the manufacturer's recommendations.

24.13.5 Connecting Blasting Caps. When connecting blasting caps to detonating cord, tape or otherwise attach the cap securely along the side or the end of the cord, with the end of the cap containing the explosive pointed in the direction in which the detonation is to proceed.

24.13.6 Detonators. Do not bring detonators for firing the trunkline to the loading area, and do not attach the detonating cord until everything else is in readiness for the blast.

24.14 Underwater Blasting

24.14.1 Supervision. A competent blaster must conduct all blasting operations. Do not fire any blast without that person’s approval.

24.14.2 Loading Tubes. Do not use loading tubes and casings of dissimilar metals for electric or other stray-current-affected detonators or explosives. When tubes are necessary, load these electrically affected devices through nonsparking loading tubes.

24.14.3 Detonators. For underwater blasting operations, use only water-resistant blasting caps and detonating cord or other detonators and/or firing systems and methods approved by the manufacturer.

24.14.4 Marking Charges. When placing more than one charge underwater, attach a float device to an element of each charge so that it will be released by the firing. Handle misfires using precautions and procedures in this section.

24.14.5 Blast Warning. In addition to the standard audible blast warning, display blasting flags.

24.14.6 Boats in Area. Do not fire blasts while any vessel underway is within 1,500 feet of the blasting area. Notify those onboard vessels moored or anchored within 1,500 feet before the blast is fired.

24.14.7 Swimming and Diving. Do not fire blasts when swimmers or divers are in the vicinity and exposed to injury from the blast.

Section 25

Concrete, Masonry Construction, and Formwork

This section sets forth the requirements for concrete, masonry construction, and formwork. It specifically addresses plant and equipment, concrete conveyance systems, reinforcing steel, surface preparation, formwork and falsework, vertical shoring, tubular welded frame shoring, tube and coupler shoring, single-post shores, vertical slip forms, releasing and moving forms, precast concrete, lift-slab, and masonry construction.

25.1 Plant and Equipment

25.1.1 General. Design, operate, and maintain all equipment, facilities, and formwork for concrete and masonry construction according to the requirements of this section, other applicable parts of these standards, the subsection, "Other Mechanized Construction Equipment," and the current edition of ANSI A10.9, "Construction and Demolition Operations—Concrete and Masonry Work."

25.1.2 Batching and Screening Plants. Design and construct concrete batching and screening plants, aggregate production plants, hoppers, bins, silos, and related equipment with an adequate safety factor to prevent structural failure or collapse. Refer to the subsection, "Other Mechanized Construction Equipment" for certification requirements. Design and equip batching plants, aggregate plants, and conveyor systems with mechanical dust control systems and water spray systems (or other acceptable means) to keep airborne dust concentrations within acceptable exposure limits. Comply with permit-required confined space and hazardous energy control procedures when entering silos, storage bins, tunnels, shafts, or similar enclosed areas.

25.1.3 Bulk Storage Bins. Bulk storage bins, containers, and silos must have conical or tapered bottoms and be able to start material flow mechanically or pneumatically.

25.1.4 Loading Skips. Install protective guardrails on each side of loading skips if loading skips are one cubic yard or larger. Equip loading skips with a mechanical device to clear the skip of material.

25.1.5 Bull Floats. Where bull float handles may contact energized electrical conductors, establish a hazardous energy control clearance and lock out the power to those conductors.

25.1.6 Powered Concrete Trowels. Equip manually guided powered and rotating concrete troweling machines with a control switch or positive mechanical release device that automatically stops trowel rotation when the operator releases the equipment handle.

25.1.7 Concrete Buggies. Handles of concrete buggies must not extend beyond the wheels on either side of the buggy.

25.1.8 Concrete Buckets. Concrete buckets equipped with hydraulic or pneumatically operated gates must have positive safety latches or similar safety devices to prevent premature or accidental dumping. Design the buckets so aggregate does not accumulate on the bucket's top and sides. Do not ride concrete buckets or permit personnel under buckets that are being raised or lowered into position by cranes or cableways. Do not route elevated concrete buckets over employees. Concrete buckets with manually operated gates must be self-closing. Maintain all buckets in structurally sound condition. A professional engineer (PE) must approve any alterations that affect structural competency.

25.1.9 Transmix Trucks. Transmix trucks and concrete pumping trucks, including operating procedures, must conform with requirements in this subsection and the subsection "On-Highway Equipment."

25.1.10 Personal Protective Equipment. Employees placing or finishing concrete must wear applicable protective equipment, but never less than long-sleeved shirts, long pants, rubber safety boots, gloves, hardhat, and eye glasses with side shields. Make eyewash facilities available at each placement or finishing operation.

25.1.11 Lockout/Tagout. Lock out and tag equipment, such as compressors, mixers, screens, and concrete pumps, before performing maintenance or repair work.

25.2 Concrete Conveyance Systems

25.2.1 General. "Concrete Conveyance Systems" are defined as mechanical devices used to move concrete from the receiving hopper of the system to the point of use (i.e., pumps, tremies, conveyor belts, flexible hoses, pipelines, and the structures or mobile equipment on which the system is installed). They do not include concrete buckets hoisted by cranes, cableways, or specialized hoisting systems, or transmix trucks used to convey concrete from the batch plant to the placement site. These types of mechanical devices are covered elsewhere in these standards.

25.2.2 Requirements. The manufacturer or a PE must design and certify all concrete conveyance systems as safe for intended use. The contractor or owner/operator must operate, maintain, inspect, and test the systems in accordance with the more stringent requirements set forth in the manufacturer's instructions, PE's specifications or these standards.

25.2.3 Concrete Pumping Systems

a. General. Concrete pumping systems consist of a concrete pump, pipeline (slickline) including short or long beds, couplings, intermediate and end hoses, and all supporting structures and equipment. Pipe accessories may include shutoff valves, direction change valves, articulating pipe connections, telescoping pipes, cleaning heads, trap baskets, and taper (transition) pieces. Concrete pumping systems may be stationary or mobile, or a combination of both types.

Design, install, test, and operate all systems and supporting equipment according to the more stringent requirements contained or referenced in these standards or in the manufacturer's or PE's specifications.

b. Concrete Pumping Line (slickline, intermediate or end hoses, bends, couplings, transitions, etc.).

1. General. The manufacturer must certify that all materials, pipes, and accessories are safe to use in concrete pumping systems and are within the calculated design pressures. Remove piping and accessories from service whenever rupture safety factors (bursting pressure divided by maximum obtainable pump pressure) are less than two (and, preferably, four). All hoses must be approved for concrete pumping operations and maximum anticipated operating pressures. Affix maximum approved operating pressures to the hose. Install hoses according to manufacturer's approved methods and procedures. Provide safety lashings that can support a fully loaded hose at all hose connections. The manufacturer must approve, in writing, any field repairs to hoses, pipes, or couplings.

2. Couplings. Couplings may be bolt, snap, toggle, or cup-tension type. Secure snap or toggle couplings against accidental opening using safety pins or equivalent devices (see figure 25-1). Clearly mark couplings with shoulder diameter and pressure rating. Couplings must have a pressure rating two times greater than the pump's maximum manufacturer's rating. Adjustable coupling eyebolts must have stops on adjustment threads to prevent overadjusting.

3. Assembly

(a) A competent person, trained and experienced in the type of systems being installed, must directly supervise their assembly. Do not assemble or use a concrete pumping system on the construction site unless the system supervisor has a manufacturer-approved piping wall thickness monitoring and replacement procedure (ultrasonic, weepholes, etc.). Test all piping system components in accordance with the procedure before onsite use, unless written evidence proves that a satisfactory testing procedure is in place and functioning.

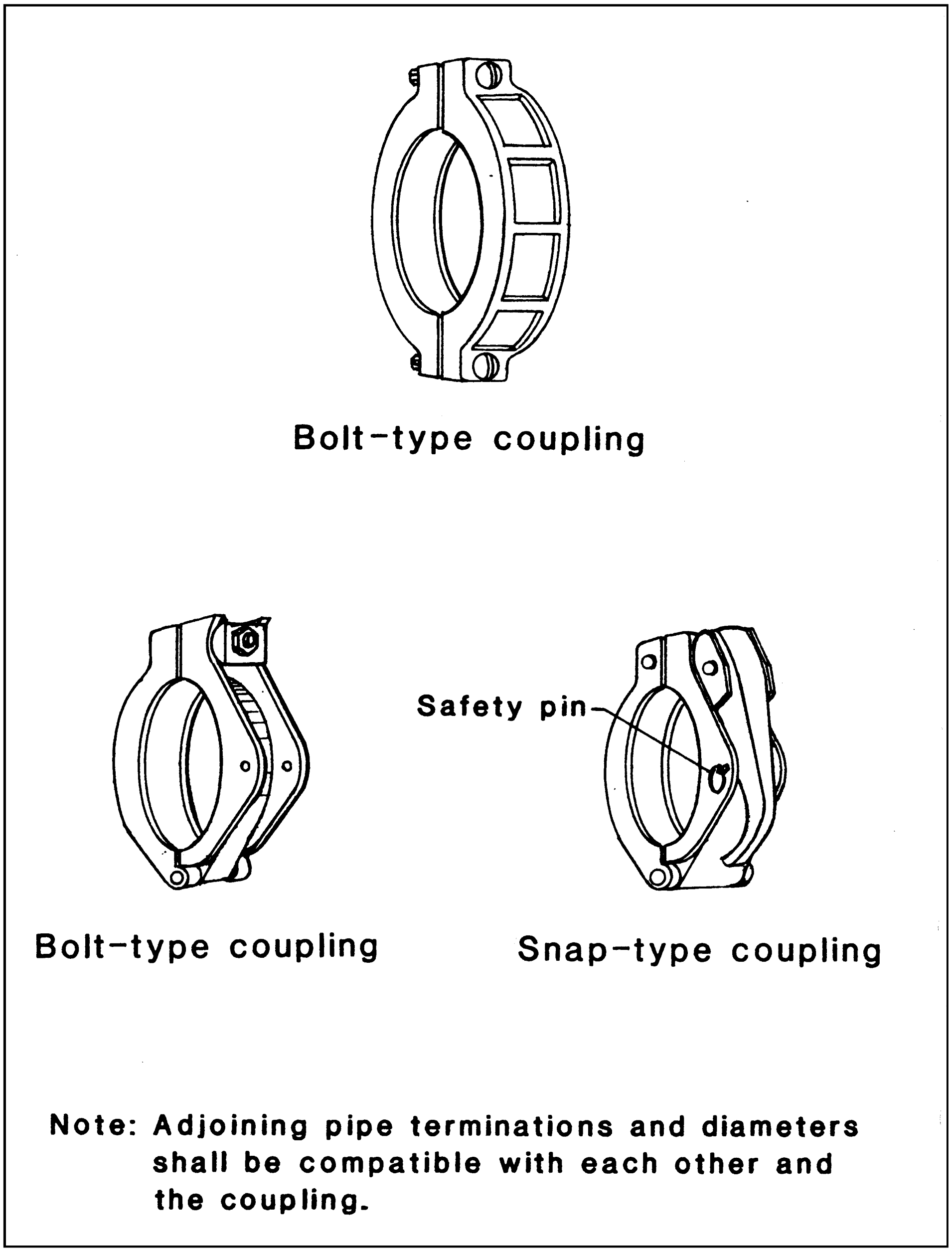


Figure 25-1.—Pipe couplings.

(b) Adjoining pipe terminations must be compatible with each other and the coupling. Mating pipe terminations must be the same diameter as marked on the coupling. It is not acceptable to construct the flange shoulder by welding, screwing, or otherwise attaching an external ring to the pipe or grooved-type flanges the same diameter as the pipe.

(c) Securely brace and anchor all piping to minimize movement and to ensure that line parts will be restrained if failure occurs. A PE or the manufacturer must approve any piping attached to or supported from structural members or formwork, as well as piping installed on equipment that may impose loadings beyond design criteria.

c. Placing Booms

1. General. The manufacturer or a PE must design and certify placing booms and all supporting structures or equipment. Delivery piping, intermediate or end hoses, couplings, and accessories supported by or used with placing booms must conform with this section. Anchor each section of rigid pipeline or hose to the boom, so no section can fall from the boom in the event of coupling or adapter failure. Metal pipe swivels are the preferred method for accommodating boom folding actions.

Equip all hydraulic cylinders with hydraulic pressure relief valves that automatically prevent boom or cylinder damage. Use placing booms only for hoisting system piping, accessories, and the concrete being conveyed.

2. Mountings. Design and operate trailers and trucks with mounted placing booms (see figure 25-2) according to the requirements in the section, "Mobile and Stationary Mechanized Equipment" and Department of Transportation regulations. Inspect and brake test them in accordance with the references above. The manufacturer or a PE must design stationary boom mountings. Visibly display the weight of booms, attachments, and accessories on the boom. Clearly display on the boom or in the operating instructions all outriggers, jacks, or other stabilizing features required by the manufacturer or PE. Visibly mark outriggers with maximum load imposed on supporting surface. Locate outrigger controls so the operator can continuously observe the outrigger whenever it is being extended or retracted.

3. Controls and Gauges

(a) Mount permanently installed controls so the boom or other moving parts cannot strike the operator and so the operator has a clear view of the receiving hopper. Adequately light control panels and operator platforms during night operations. Access to elevated control stations must be in accordance with these standards. Fall protection systems meeting requirements in the section, "Mobile and Mechanized Stationary Equipment," must be in place on the platform. Protect all operating platforms with adequate guardrails.

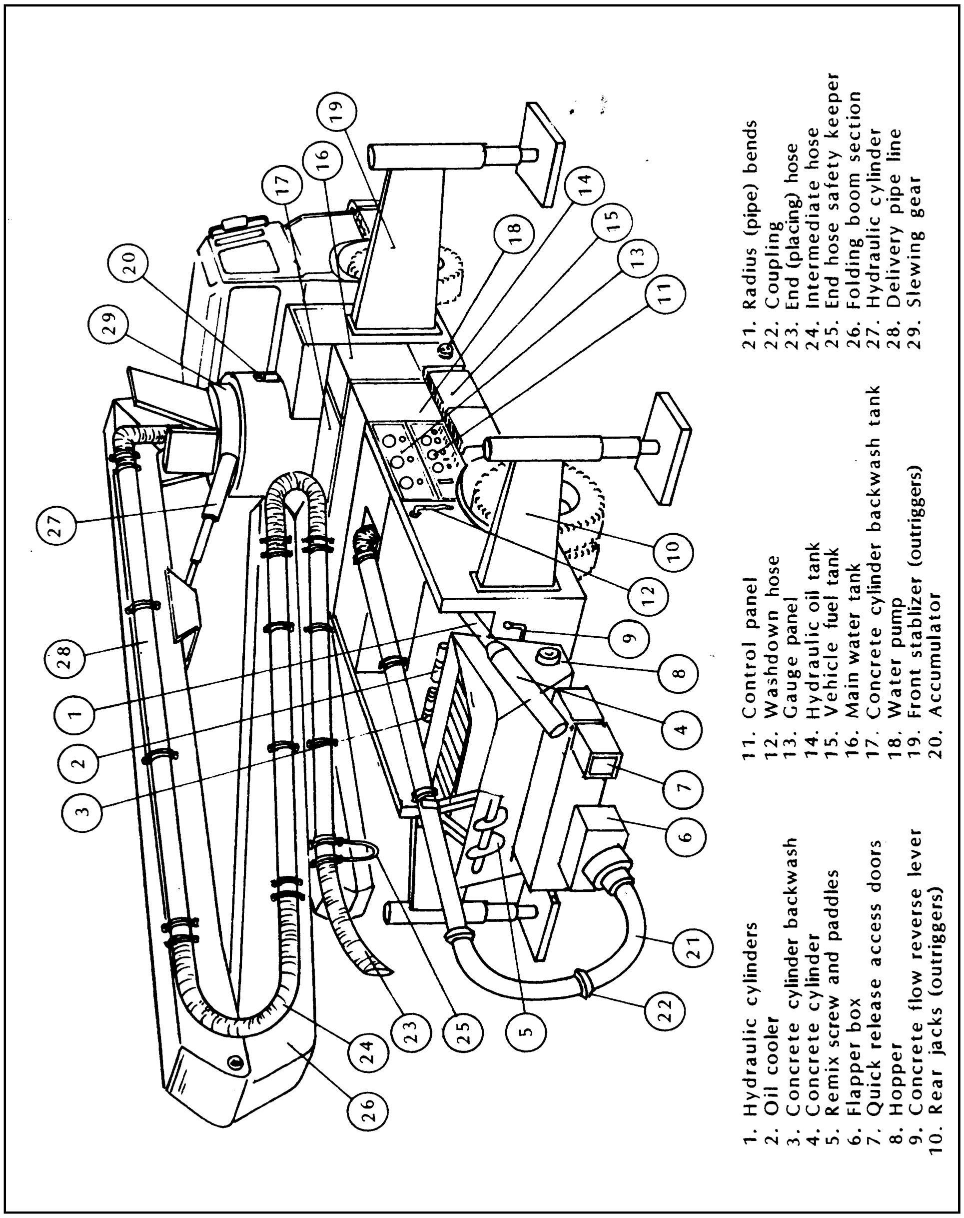


Figure 25-2.—Crane boom mounted concrete conveyor system.

(b) Mark all controls with symbols or wording that clearly shows their function. When possible, ensure that the direction of control movement corresponds with direction of motion. Arrange the controls to prevent unintentional motion by the operator. All controls must be deadman type.

(c) Ensure that combination stationary and remote control systems for booms can only be operated from one location at a time. All control panels (stationary or remote) must lock in the "off" position when unattended.

(d) When the operator cannot see gauges that detect critical temperatures and pressures, equip the pumping system with automatic shutoff or control devices that limit temperatures or pressures to within predetermined safe limits.

(e) Provide an emergency, all function, stop button on all control panels. The button must be easily identifiable by size and color and be accessible from the normal working surface.

(f) Radio remote controls must be Federal Communications Commission (FCC) certified for two-way communication and have shielding, filtering, and discrete coding to prevent accidental stimulation of the receiver.

4. Performance Inspection and Testing

(a) Stationary Mounting. After making major repairs or alterations to critical structural members, or when directed by the Contracting Officer's Representative (COR) or office head, performance inspect and load test stationary-type placing booms in accordance with the manufacturer's or PE's instructions.

Initially mounting a placement boom on a new stationary supporting structure, or at a new location, is considered a major alteration. Performance and load testing must be completed before use at the new location. When moving the boom between tested structures or locations, additional load tests are not necessary, unless required by the COR or office head. However, operationally test the placement boom before conveying concrete. This test must include: (1) fully extending all boom sections to a horizontal position with end hose attached; (2) rotating the boom through 360 degrees or maximum degrees of operation; (3) raising extended boom to vertical position and rotating through 360 degrees or maximum degrees possible; and (4) testing relief valve settings by folding boom sections against each other.

(b) Mobile Mountings. Performance inspect and load test placement booms mounted on truck chassis or trailers after repair or alterations to critical components and when directed by the COR or office head. Further, when relocating them to any load tested location, subject them to the more stringent operational test described in the previous subparagraph or in the manufacturer or PE's instructions. The load testing requirement for supplier-owned and operated truck- and trailer-mounted units may be waived when: (1) the equipment is used onsite sporadically or for short intervals; (2) no critical defects are found after visual inspection and conducting operational tests; (3) the owner/operator has written confirmation that the boom and supporting equipment have satisfactorily passed a performance inspection and load test following the repairs or alterations.

(c) Performance Inspection and Load Test Procedures. Conduct performance inspections of all critical components to ensure they meet the minimum recommended levels specified in the manufacturer's or PE's operating or inspection manuals. If the information is unavailable, the manufacturer or PE must develop it for use in making the inspection. Conduct load tests with test weights spaced along the boom as specified by the manufacturer or PE. Load test data supplied by the manufacturer or PE is unacceptable unless it adequately tests all critical structural components and tipping moments to 100 percent of manufacturer's maximum rated conditions, and load-limiting devices are tested to activating limits.

d. Concrete Pumps

1. General. A manufacturer or PE must design and certify concrete pumps for intended use and pressures. Truck chassis, trailers, skids, or railcars that have mounted pumps must conform with applicable requirements of these standards, including the sections on "Mobile and Mechanized Stationary Equipment" and "Tunnel and Shaft Construction," and this section. Skid-mounted pumps must have sufficient eyes for attaching slings or special hoisting devices. Affix a permanent notice to the pump, stating overall weight of pump and supporting structures.

Support, anchor, and stabilize pumps in accordance with manufacturer's or PE's requirements. All docks, outriggers, or axle locks specified by the manufacturer or PE must accompany the unit and be placed in recommended operating position before starting pumping operations.

2. Controls and Gauges. Mount permanently installed controls so the operator can observe all critical pump components. Adequately light control panels and operating platforms during night operation. Mark controls with symbols or wording that clearly shows their functions. Ensure that combination stationary and remote control panels for pumps can only be operated from one location at a time.

All control panels must lock in the "off" position when unattended. If the operator cannot directly view gauges for detecting critical temperatures and pressures, equip them with an automatic shutoff or control devices that limit temperature and pressure to within predetermined safe limits. Provide an emergency shutoff button on all control panels. The buttons must be easily identifiable by size and color and be accessible from normal work surfaces. Radio remote controls must be FCC certified for two-way communication and have shielding, filtering, and discrete coding to prevent accidental stimulation of the receiver.

3. Specific Requirements. Guard all dangerous moving parts. Position the receiving hopper so concrete can readily flow from transmix trucks or other concrete conveyance equipment discharge chute into the hopper. Provide a hinged grill to prevent access to dangerous moving parts. Securely mount the grill on the hopper with an interlocking arrangement that prevents access until feed, agitator, and valve mechanisms are rendered inoperative. Grill parallel bar spacings must be no more than 3/4 inches apart and be able to support a 250-pound load.

Construct inlet and outlet valves and chambers to restrict personnel access until all energy sources are locked out and stored energy is dissipated.

e. General Operating Requirements

1. Competent personnel must install and operate concrete pumping systems and equipment.

2. Personnel may work on piping systems or supporting structures only after all inline pressures have been relieved by running the pump in reverse or opening air or water relief valves.

3. Position pumps so trucks can avoid backing. If backing is necessary because of site conditions that you cannot modify, a signal person must stand to the side of the truck and direct it. Prevent pedestrians and vehicle traffic from entering the pump area during backing operations.

4. Trucks with installed pumps and placing booms that use truck engine power to operate the equipment must conform fully with the "Mobile and Mechanized Stationary Equipment" section and all other applicable provisions of these standards.

5. End hoses must not exceed lengths specified by the manufacturer or PE. Do not allow placing booms to drag end hoses laterally. Manually relocate hose using pulling slings.

6. When operating or transporting placing booms close to high-voltage power lines, comply with these and other applicable standards.

7. When relocating placing booms and end hose outside the operator's visible range, a signal person must give full attention to directing the operation.

8. Do not externally brace placing booms or lay them on any supporting structure during pumping operations unless approved by the manufacturer or PE.

9. All outriggers, jacks, or other stabilizing features required by the manufacturer or PE must accompany the boom or pump and be in recommended operating position before conveying concrete.

10. Do not relocate mobile-mounted placing booms or withdraw outriggers unless the boom is in defined transport position.

25.3 Reinforcing Steel

25.3.1 Lateral Supports. Laterally support reinforcing steel for walls, piers, columns, and similar structures to prevent overturning or collapse. The lateral supports for reinforcing steel must be able to withstand the forces applied during construction.

25.3.2 Rigging. Securely tie together bundles of reinforcing steel before moving by crane or cableway to prevent slipping. Use two-part slings to handle steel more than 20 feet long.

25.3.3 Impalement. Cover exposed rebar onto or into which employees could fall to eliminate the hazard of impalement. Do not use plastic cap coverings for impalement protection, but you may use them to cover the ends of horizontal rebar. Cover vertically protruding rebar with wood troughs or other substantial material.

25.3.4 Positioning Device Systems. Employees must use a positioning device (see the section on "Fall Protection") when working in a stationary location 6 feet or higher above any adjacent work surfaces or when placing and tying reinforcing steel in walls, piers, columns, etc. Employees must use a personal fall arrest system meeting the requirements of the section on "Fall Protection" when moving on reinforcing steel higher than 24 feet above adjacent surfaces.

25.3.5 Walkways. Reinforcing mats used as walkways must have planking to ensure safe footing.

25.3.6 Prohibited Uses. Do not use reinforcing steel as guy attachments at deadmen or other anchorage points for scaffolding hooks, for stirrups, or as a load-bearing member of any lifting device.

25.3.7 Wire Mesh Mats. Secure wire mesh reinforcing mats at each end to prevent recoiling. Secure unrolled wire mesh on each side of a proposed cut before cutting the mesh.

25.3.8 Post-Tensioning Operations. Do not permit employees, except those essential to post-tensioning operations, to be behind the jack during tensioning operations. Erect signs and barricades to limit employee access to the post-tensioning area during tensioning operations.

25.4 Surface Preparation

25.4.1 Green Cutting or Abrasive Blasting. Employees engaged in green cutting must wear eye and face protection. Employees engaged in wet or dry abrasive blasting using silica sand must wear an approved abrasive blasting air-line respirator, heavy-duty footwear, and hardhat. (See the section, "Personal Protective Equipment," for specific requirements.)

25.5 Formwork and Falsework

25.5.1 Design and Erection. In addition to the specific requirements set forth in this section, the design and erection of formwork or falsework shall be in accordance with specifications, pertinent provisions of the latest edition of ACI 347, “Guide to Formwork for Concrete,” and ACI 318, “Building Code Requirements for Reinforced Concrete,” and current edition of ANSI A10.9, “Safety Requirements for Masonry and Concrete Work.”

25.5.2 Safety Factor. Design, erect, brace, and maintain formwork, falsework, structural shoring, and bracing to safely support all vertical and lateral loads that might be applied until the structure can support such loads. Incorporate the minimum safety factors (as specified in ANSI A10.9, "Construction and Demolition Operations - Concrete and Masonry Work") in the design and erection of all framework, shoring, falsework, and formwork accessories.

25.5.3 Construction Loads. Do not impose any construction loads on the partially completed structures unless such loading has been considered in the design and is shown on the formwork design drawings or specifications.

25.5.4 Drawings and Plans

a. A PE must approve and sign detailed design calculations and working drawings for all formwork or vertical shoring installations when any of the following conditions exist:

- The height, as measured from the top of the sills to the soffit of the superstructure, exceeds 14 feet
- Individual horizon span lengths exceed 16 feet
- Provisions are made for vehicular or railroad traffic through the falsework or vertical shoring.

b. For all formwork and vertical shoring installations not discussed in subparagraph a. above, one of the following must approve and sign the formwork plan or shoring layout:

- A PE
- A manufacturer's authorized representative
- A contractor's representative, qualified in using and erecting formwork and vertical shoring.

c. Make drawings or plans showing the jack layout, formwork, shoring, working decks, and scaffolding available at the jobsite.

25.5.5 Form Anchors. Design form anchors that support forms and scaffolding with a minimum safety factor of three. Impose no load on form anchors or concrete anchorages until the concrete has set the minimum period of time set forth in the subsection, "Releasing and Moving Forms." Form sections supported by form anchors must be no more than 50 feet long and must be designed and installed so that no forces, incurred by form or anchorage failure, can transfer to an adjacent section.

25.5.6 Housekeeping. In all areas where persons must work or pass, remove and stockpile all stripped forms and shoring promptly after stripping. Pull or cut protruding nails, wire ties, and other unneeded accessories to avoid hazards.

25.5.7 Fall Protection. Employees, when working 6 feet or more above any adjacent work surface (and not protected by fixed scaffolding, guardrails, or safety net) must use a personal fall protection system. Employees working in a stationary position may use a positioning system, but only until they need to relocate to a new position.

25.6 Vertical Shoring

25.6.1 Additional Loading. Temporarily store reinforcing rods, materials, or equipment on top of formwork only if structures have been designed or strengthened to support the additional loading. Do not load eccentric loads on shore heads or similar members, unless these members are designed for intended loading.

25.6.2 Sills. Sills used in shoring must be sound, rigid, and able to carry the maximum intended load.

25.6.3 Shoring Equipment. Inspect all shoring equipment before erection to make sure it conforms to the shoring layout. Do not use damaged equipment for shoring.

25.6.4 Inspection. Inspect erected shoring equipment immediately before, during, and after placing concrete to make sure shoring equipment meets the requirements specified on the formwork drawings. Immediately reinforce or reshore any damaged or weakened shoring equipment.

25.6.5 Reshoring. Provide reshoring when necessary to safely support slabs and beams after stripping or where such structures are subject to superimposed loads.

25.6.6 Removal of Shoring. Remove shoring equipment only after concrete has reached the minimum strength required in the formwork and shoring design and a PE or supervisor has inspected and approved the placement. Plan removal so you do not overload in-place shoring equipment.

25.7 Tubular Welded Frame Shoring

25.7.1 Safe Loading. Do not load metal tubular frames used for shoring beyond the safe working load recommended by the manufacturer. Design metal tubular frame shoring with a minimum safety factor of 2.5.

25.7.2 Condition. Locking devices on frames and braces must be in good working order; coupling pins must align the frame or panel legs; pivoted cross braces must have their center pivot in place; and all components must be in good serviceable condition. Promptly repair or replace faulty or damaged parts and components.

25.7.3 Inspection. Make a thorough inspection after erection to ensure that: (1) spacing between towers and cross brace spacing does not exceed that shown on the layout and that all locking devices are in the closed position; (2) the devices for attaching the external lateral stability bracing are securely fastened to the legs of the shoring frames; (3) baseplates, shoreheads, extension devices, or adjustment screws are in firm contact with the footing sill and the form.

25.8 Tube and Coupler Shoring

25.8.1 Design. Design the tube and coupler shoring for the maximum intended loading with a minimum safety factor of 2.5.

25.8.2 Couplers. Couplers (clamps) must be of structural-type metal, such as drop-forged steel, malleable iron, or structural grade aluminum. Do not use gray cast iron or couplers that are deformed, broken, or have defective or missing threads or bolts.

25.8.3 Inspection. Make a thorough inspection after erection to ensure that:

a. The shoring has been erected as shown on the layout drawings.

b. The spacing between posts does not exceed that shown on the layout.

c. All interlocking tubular members and couplings are properly installed and tightened.

d. All baseplates, shore heads, extension devices, or adjustment screws are in firm contact with the footing still and the form material and snug against the legs of the frames.

25.9 Single-Post Shores

25.9.1 Design. Single-post shoring layouts must provide for the maximum intended loading with a minimum safety factor of 3. When using single-post shores in more than one tier, a PE with structural experience must design and inspect them.

25.9.2 Bracing. Horizontally brace single-post shores longitudinally, transversely, and diagonally. Install the bracing while erecting shores.

25.9.3 Inspection. Inspect single-post shores and adjusting devices before use. Do not use fabricated shores and adjusting devices that are heavily rusted, bent, dented, rewelded, damaged, or defective. Do not use timber shores and timber components of fabricated shores if split, knotted, broken, or otherwise structurally defective.

25.9.4 Baseplates and Shore Heads. Baseplates and shore heads of single-post shores must be in firm contact with the footing sill and the form materials.

25.9.5 Angled Formwork. When formwork is at an angle or sloping, or when the shored surface is sloping, specially design the shoring for such loading.

25.9.6 Adjustment. Do not adjust single-post shores after concrete is in place.

25.10 Vertical Slip-Forms

25.10.1 Design and Supervision. A PE, experienced in slip-form design, must design all vertical slip-forms. Drawings prepared by the PE, showing the jack layout, anchorages, formwork, scaffolding, etc., together with installation, jacking, and leveling instructions, must be available at the jobsite and followed. A person experienced in slip-form operations must supervise form installation, movement, and leveling.

25.10.2 Jack Supports. Design steel rods or pipe on which the jacks climb (or by which forms are lifted) for that intended purpose. Encase supports in concrete or anchor them. Supports anchored or secured by form anchors must use two or more independent form anchors, separated a minimum of 5 feet vertically.

25.10.3 Vertical Loading. Position jacks and vertical supports so the vertical loads are distributed equally. Do not exceed the capacity of the jacks.

25.10.4 Line and Plumb. Keep the form structure in line and plumb during jacking operations.

25.10.5 Lifting. When lifting, proceed steadily and evenly. Do not exceed the predetermined safe rate of lift.

25.10.6 Bracing. Provide lateral and diagonal form bracing to prevent excessive distortion of the structure during jacking.

25.10.7 Holding Devices. Provide the jacks or other lifting devices with mechanical dogs and other automatic holding devices to provide protection in case the power supply or the lifting mechanism fails.

25.10.8 Scaffolding and Platforms. Vertical lift forms must have scaffolding or work platforms that completely encircle the area of placement.

25.10.9 Supervision. An experienced supervisor must oversee vertical slip-form operations. The supervisor must be present on the deck during slipping.

25.11 Releasing and Moving Forms

25.11.1 Lifting. When raising or moving forms by crane, cableway, A-frame, or similar mechanical lifting device, securely attach the forms to wire rope slings that have a minimum safety factor of eight. Equip the panels and form sections with hoisting brackets to attach slings. Remove loose tools and materials before moving forms. Use taglines for controlling forms whenever necessary to protect personnel or structures.

25.11.2 Riding Forms. Employees must not ride forms or form scaffolding as it is raised or moved, with the exception of vertical slip-forms.

25.11.3 Releasing. Adequately brace or secure vertical and overhead forms before releasing them. Before releasing and moving forms, relocate employees at lower levels who may be exposed to falling materials.

25.11.4 Form Removal. Do not remove forms until the concrete being supported is sufficiently strong to support its weight with all loads placed on it, to ensure safe removal of the forms, shoring, and bracing.

25.12 Precast Concrete

25.12.1 Requirement. Brace precast concrete walls, structural framing, or tilt-up wall panels until after permanent connections are made. A PE must design temporary bracing that provides at least 15 pounds per square foot on projected surfaces.

25.12.2 Temporary Bracing. A PE must design temporary bracing for precast concrete walls, structural framing, or tilt-up wall panels. Such bracing must provide at least 15 pounds per square foot on projected surfaces.

25.12.3 Suspended Loads. Do not allow employees under precast concrete members being lifted or tilted into position.

25.12.4 Lifting Inserts. The lifting inserts for tilt-up concrete members must be able to support at least two times the maximum intended load. Other types of lifting inserts for precast concrete members must be able to support at least four times the maximum intended load. Lifting hardware must be able to supporting at least five times the maximum intended load.

25.13 Lift-Slab

25.13.1 Lift-Slab Operations. A PE, experienced in lift-slab construction, must design and plan lift-slab operations. Such plans must include detailed instructions and sketches that show the prescribed method of erection and ensure lateral stability of the building/structure during construction.

25.13.2 Jacks/Lifting Units. Mark jacks/lifting units to show the rated capacity established by the manufacturer. Design jacks/lifting units with a minimum safety factor of 2.5. Do not load jacks/lifting units beyond their rated capacity.

a. Jacking equipment includes any load-bearing component used to carry out the lifting operation, such as threaded rods, lifting attachments, lifting nuts, hook-up collars, t-caps shear heads, columns, and footings.

b. Design and install jacks/lifting units so they will neither lift, nor continue to lift, when loaded beyond their rated capacity.

c. Install a safety device for jacks/lifting units to ensure that loads will remain supported in any position if jacks malfunction.

25.13.3 Jacking Operations. Synchronize jacking operations so the slab will remain level at all support points to within a ½-inch tolerance at all times.

a. If leveling is automatically controlled, install a device that will stop the operation when the tolerance is exceeded or when the jacking system malfunctions.

b. If manual controls maintain leveling, locate these controls in a central location; an experienced, competent person must attend the controls during lifting. Limit the maximum number of manually controlled jacks/lifting units on one slab so the operator can maintain the slab level. The maximum number must not exceed 14.

c. Only employees who are not essential to the jacking operation may remain beneath a slab during lifting. During jacking operations, only employees who are essential to the jacking operation may remain in the building/structure.

d. When making temporary connections to support slabs, secure wedges with tack welding, or an equivalent method, to prevent them from falling out of position. Release lifting rods only after securing column wedges.

e. A certified welder, familiar with the welding requirements specified in the plans and specifications for the lift-slab operation, must perform all welding on temporary and permanent connections. Do not execute load transfer from jack/lifting units to building columns until the welds on the column shear plates cool to air temperature.

f. Make sure jacks/lifting units are secured to building columns so they do not dislodge or dislocate. Design and install equipment so the lifting rods cannot slip out of position.

25.14 Masonry Construction

25.14.1 Requirements. Establish a limited access zone when erecting a masonry wall. The limited access zone must equal the height of the wall to be constructed, plus 4 feet, and must run the length of the wall. Establish the limited access zone before starting construction and locate it on the side of the wall that will not be scaffolded. Only employees directly involved in the construction of the wall may enter the limited access zone. The limited access zone must remain in place until the wall is adequately supported to prevent collapse. The supports must be able to withstand a load of at least 15 pounds per square inch. Walls over 8 feet high must have supports in place until permanent supporting elements of the structure are in place.

25.14.2 Equipment. Guard masonry saws with (a) a semicircular enclosure over-blade and (b) a slotted horizontal hinged bar mounted underneath the guard enclosure to retain fragments of shattered blades. Equip saws with dust-control systems or make provisions for wet sawing that control airborne dust concentrations.

25.14.3 Scaffolding. Design masonry scaffolding for a minimum loading of 50 pounds per square foot. In all other respects, design, install, inspect, and maintain masonry scaffolding in accordance with applicable provisions in the section, "Walking and Working Surfaces."

Section 26

Steel Erection

This section sets forth Reclamation's requirements for erecting steel structures. It covers the following specific areas:

- General Requirements
- Permanent Flooring
- Temporary Flooring
- Other Flooring
- Structural Steel Erection
- Plumbing-Up
- Bolting
- Riveting
- Fire Protection

26.1 General Requirements for Erecting Steel Structures

Storage, handling, and erecting of steel structures, buildings, or structural components or members must conform to the applicable requirements of these standards and the current edition of American National Standards Institute (ANSI) A10.13, "Safety Requirements for Steel Erection."

26.1.1 Fall Protection. Develop a fall protection program before starting steel erection. Include all phases of the steel erection in the program and eliminate, to the extent possible, employee exposure to falls.

a. Detail the steps to be taken to provide protection for employees exposed to potential falls.

b. Provide a training program that enables all involved employees to recognize the fall hazards and the procedures to follow to minimize the hazard.

26.2 Requirements for Installing Permanent Flooring

26.2.1 Installation. Install permanent floors as the erection of structural members progresses. Install no more than eight stories between the erection floor and the uppermost permanent floor, except where the design maintains the structural integrity.

26.2.2 Bolting and Welding. Erect no more than four floors or 48 feet of unfinished bolting or welding above the foundation or the uppermost permanently secured floor.

26.3 Requirements for Installing Temporary Flooring

26.3.1 Planking. Solidly plank or deck the derrick or erection floor over its entire surface except for access openings. Planking or decking must be sufficiently thick and strong to supporting the working load. Never use planking less than 2 inches thick, full dimension undressed. Lay planking flush and secure it to prevent movement.

26.3.2 Skeleton Steel Erection. Where erecting skeleton steel, maintain a tightly planked and substantial floor within two stories or 30 feet, whichever is less, below and directly under that portion of each tier of beams on which employees are performing any work. If installing a tightly planked and substantial floor is not practicable, install safety nets.

26.3.3 Safety Nets. On buildings or structures not adaptable to temporary floors, and where scaffolds are not used, install and maintain safety nets whenever the potential fall distance exceeds two stories or 25 feet. The nets must clear the surface of structures below.

26.3.4 Temporary Planking Removal. Remove temporary planking successively, working toward the last panel of temporary floor, so that employees work from the planked floor. Protect employees removing planks from the last panel by safety harness with safety lines attached to a catenary line or other substantial anchorage.

26.4 Requirements for Installing Other Flooring

26.4.1 Double-Wood Floors. In erecting buildings with double-wood floor construction, complete the rough flooring, including the tier below the one on which floor joists are being installed, as the construction progresses.

26.4.2 Single-Wood Floor. For single-wood floors or other flooring systems, keep the floor immediately below the story where the floor joists are being installed planked or decked over.

26.5 Requirements for Structural Steel Erections

26.5.1 Solid-Web Structural Members. In placing solid-web structural members, do not release the hoisting line until the member is secured with at least two bolts or the equivalent at each connection. Draw the bolts up wrench tight.

26.5.2 Open-Web Joists. Place open-web steel joists on structural steel framework only after such framework is permanently bolted, riveted, or welded.

26.5.3 Bar Joists. In steel framing, where bar joists are used and the columns are not framed in at least two directions with structural steel members, field bolt a bar joist at the columns to provide lateral stability during construction.

26.5.4 Long-Span Joists. Where long-span joists or trusses 40 feet or longer are used, provide lateral stability by installing a center row of bolted bridging before slacking the hoisting line.

26.5.5 Securing Structural Members. Securely bolt or fasten into position each structural steel member before releasing the loadline. When setting steel trusses, temporarily cross brace them until permanent bracing is installed.

26.5.6 Taglines. Use a tagline or guide rope on all hoisted loads that expose employees to the swing of the load.

26.5.7 Temporary Support. Before lifting falls are unhitched, either draw the anchor bolts down tightly when columns are being set on base plates or shims, or guy and support them to prevent collapse.

26.5.8 Connectors. Whenever possible, "connectors" must straddle the beam instead of walking along the top flange.

26.6 Requirements for Plumbing-Up

26.6.1 Connections. Secure connections of the equipment used in plumbing-up. Properly secure turnbuckles to prevent unwinding when under stress.

26.6.2 Guys. Position plumbing-up guys and related equipment so that employees can work on the connection points. Remove the plumbing-up guys only under the supervision of a competent person.

26.7 Requirements for Bolting

26.7.1 Drift Pins. When knocking out bolts or drift pins, provide a means to keep them from falling.

26.7.2 Impact Wrenches. Equip impact wrenches with a locking device to retain the socket.

26.7.3 Containers. Provide containers for storing and carrying bolts, drift pins, and rivets. Secure the containers against accidental displacement when aloft.

26.7.4 Drilling and Reaming. Two employees must operate drilling and reaming machines unless the handle is firmly secured to resist the torque reaction of the machine if the reaming or drilling bit should bind.

26.8 Requirements for Riveting

26.8.1 Riveting Hammers. Properly install a safety wire on the snap and on the handle of the pneumatic riveting hammer and use it at all times. The wire must be at least No. 9 (B&S gauge) leaving the handle, and the wire on the snap must be at least annealed No. 14, or equivalent.

26.8.2 Removing Rivets. When knocking off or backing out rivet heads, provide a means to keep them from falling.

26.9 Requirements for Fire Protection

26.9.1 Fire Protection. In accordance with the section, "Fire Prevention and Protection," develop a fire protection and prevention plan before erecting any major structure.

26.9.2 Welding and Cutting. Take precautions to prevent sparks or fires in accordance with the section, "Hand Tools, Power Tools, Pressure Vessels, Compressors, and Welding."

26.9.3 Riveting. Only rivet in the vicinity of combustible material when fire extinguishers or hoselines are readily available to extinguish fires.

Section 27

Reclamation Drilling Standards

This section establishes specific safety standards and safe work practices for earth and rock drilling operations. The standards do not apply to drilling powder holes for excavation.

27.1 Standards for Site Selection and Working Platforms

27.1.1 Preparation of the Work Site. Clear the work site to provide adequate room for the drill platform and supplies. In preparing a work site located on adverse topography, guard against flooding, caving, slides, and loose boulders. Stabilize the drill platform with outriggers or adequate timbering.

27.1.2 Underground Utilities and Overhead Lines. Survey the work site to determine the presence of underground or overhead utilities before setting up the drill rig. Locate and mark the underground utilities. Maintain a minimum of 15 feet of clearance from buried utilities unless the location of the utilities is positively determined by exposing them. Meet the requirements of the "Electrical Safety" section for equipment operation adjacent to high voltage lines, except maintain a minimum 30-foot clearance between any part of the drill or mast and the powerline, regardless of voltage.

27.1.3 Drainage. Provide a drain for the drill water to flow from the work site. Extend the drain far enough to prevent undercutting of the foundation.

27.1.4 Drill Platform Design. Ensure drill platforms provide an adequate working space for the drilling operation and have a firm stable foundation. A professional engineer must design unusual drill platforms.

27.1.5 Mud Pits and Drainage Excavations. Ensure mud pits and drainage excavations are safely sloped and located to provide minimum interference with work. Where necessary, provide suitable barricades, catwalks, etc. to reduce the possibility of injury. Use ladders in pits or excavations 4 feet deep or more.

27.1.6 Lighting. Illuminate all working surfaces with a minimum of 10-foot candles.

a. Ensure all electrical wiring for illumination purposes meets National Electrical Code. Qualified personnel must install all wiring.

b. Use heavy duty, outdoor, nonshattering light bulbs, unless the bulbs are enclosed by the fixture.

c. Maintain the lighting circuits in good repair. Remove defective wiring or fixtures from service.

27.1.7 Flammable Liquids. Store, handle, and dispense flammable liquids in accordance with the section, "Standards for Material Handling, Storage, and Disposal."

27.2 General Requirements for Drill Rigs

Drilling rigs must meet the following requirements regarding how they are equipped, labeled, operated, and maintained.

27.2.1 Control Levers. Post labels clearly indicating the function and direction of the control levers on the power unit controls of all drills. Where practicable, design operating unit controls to return to neutral when the control levers are released.

27.2.2 Safety Shutoff. Install at least two emergency safety power shutoff devices on all units. Locate one switch within easy reach of the operator and one within easy reach of the helpers at ground level near the drill or auger head. You may connect a safety line to an emergency stop switch instead of using the two emergency stop switches. Clearly label emergency stop devices or make them readily identifiable in some other way. Check daily to ensure that they work.

27.2.3 Operator. Only qualified personnel instructed in the operation of the particular equipment may operate the power unit.

27.2.4 Lubrication and Repair. Lubricate all drilling equipment routinely. Shut down equipment during manual lubrication and during repairs or adjustments.

27.2.5 Preventive Maintenance. Provide an effective preventive maintenance program for periodic inspections at such intervals as are necessary to ensure safe operation and adequate maintenance.

27.2.6 Refueling. Do NOT refuel internal combustion engines while they are running. Where practicable, position or shield the fuel tank to avoid accidentally spilling fuel on the engine or exhaust manifold during refueling.

27.2.7 Inspection. A competent person must inspect drilling equipment before each shift to determine if it is in safe operating condition. Correct any damage or deficiencies before using the equipment. Maintain written records of all deficiencies and repairs.

a. Develop an inspection checklist based on the manufacturer's recommendations and the requirements of this section for each piece of drilling equipment. Inspect drilling equipment at least monthly and maintain a written record. Use the inspection checklist to document the monthly inspection.

b. Give hoisting units on the drill an annual performance test to the maximum rated load.

c. Inspect truck-mounted drill rigs annually for compliance with the applicable Department of Transportation regulations.

27.2.8 Gears and Moving Parts. Isolate or guard belts, gears, shafts, pulleys, sprockets, spindles, drums, and other type moving drives as set forth in the current edition of American National Standards Institute (ANSI) B15.1, "Safety Code for Mechanical Power Transmission Apparatus."

27.2.9 Fire Extinguishers. Carry a 2-A:40-B:C dry chemical fire extinguisher on the unit and remove it to a position within 25 feet of the work site during drilling operations. Inspect extinguishers at least once every month. A qualified inspector must conduct annual maintenance inspections and tagging.

27.2.10 Exhaust Systems. Equip engine exhaust systems with spark arresters when operated where sparks constitute a fire hazard.

27.2.11 Raising Mast. Clear personnel from the immediate area before raising the mast, except for the operator and a helper if necessary. Check to ensure safe clearance from energized power lines or equipment. Remove unsecured equipment from the mast before raising the mast. Adequately secure cables, mud lines, and cat lines to the mast before raising the mast.

27.2.12 Securing Mast to Rig. Secure the mast to the rig in an upright position using the original pins or bolts or equivalent pins and bolts, after it is raised.

27.3 Truck-Mounted Drills

27.3.1 General. Provide platforms, steps, handholds, and guardrails on the equipment to ensure safe access and footing. Coat the platform and decks with a nonskid surface.

27.3.2 Truck Movement. Do NOT move trucks backwards unless the driver has personally inspected the area behind the truck. Use a spotter in restricted or congested areas or in areas where workers are located. Equip trucks with serviceable automatic backup alarms.

27.3.3 Transporting Drill Equipment. Thoroughly inspect drill equipment before moving it to ensure that the mast, drill rods, tools, and other supplies and equipment are secure to prevent displacement while in transit. Observe applicable traffic laws when moving drill equipment over public roads. Check steering mechanism, brakes, lights, load limits, and proper flagging or lighting of load extensions. Do not move trucks until the mast is secured in the transport position.

27.4 Skid-Mounted Units

27.4.1 Towing Equipment. Equipment used to skid drill units must have adequate power to safely control the intended loads. Provide an adequate means for braking the skid unit when moving a skid mounted drill down a slope. Skidding operations must meet the requirements in the section on "Mechanized and Stationary Equipment," specifically "Unusual Equipment Configurations."

27.4.2 Access. Provide employees with a safe means of access to the skid-mounted drill unit.

27.4.3 Tie Downs/Anchors. Secure the drill while raising the mast or during drilling operations with either a deadman or by weighting or bolting it down to prevent the drill from tipping over.

27.5 Drilling Operations

27.5.1 General. Before starting the power unit, disengage all gears, set the cable drum brake, and make sure no rope is in contact with the cathead.

27.5.2 Safety Chains. Use a safety chain and cable arrangement to prevent water swivel and mud line whip.

27.5.3 Water Swivels and Hoisting Plugs. Check all water swivels and hoisting plugs daily for possible frozen bearings and lubricate properly before using. A frozen bearing could cause mud line whip and injure employees.

27.5.4 Breaking Operation. The operator must have eye contact with the employee placing the tongs, forks, or wrenches when breaking drilling tools, rods or casing with the use of the drill's power.

27.5.5 Chuck Jaws. Periodically, check the chuck jaws and replace them as necessary.

27.5.6 String of Drill Rods. Do not tighten the chuck jaws against a moving drill string. Use a cat line or hoisting cable and plug for braking before tightening the chuck.

27.5.7 Supporting Drill Rods. Use mechanical means to raise or lower drill rods.

27.5.8 Drilling with Air. When drilling with air, direct the exhaust into a dust collection system, divert it through a long discharge hose away from drilling personnel, or dampen it with water or a wetting agent to control the dust. Direct the cuttings to the side away from employees.

27.5.9 Cleaning Drill Rods. When using drilling fluids, use a rubber or other suitable wiper to remove material from the drill rods when removing them from the drill hole.

27.5.10 Pipe Wrench Jaws. Check pipe wrench jaws periodically and replace them as they become worn.

27.5.11 Draining of Drill Rod. Allow drill rods to drain completely following breaking and before removing them from the working area.

27.5.12 Hoisting of Drill Rod. The operator must exercise care to avoid a sudden release of the drill rod while the rod is being carried from the hole.

27.5.13 Hoist Capacity. Determine the hoist capacity and weight of the drill rod to prevent collapse of the mast during drill string removal. Do NOT exceed the operating capacity of the mast and hoist.

27.5.14 Cleaning of Auger Flights. Do NOT clean auger flights while the auger is rotating.

27.5.15 Auger Sections. Avoid mismatching auger sections. Do NOT use different brands and different weights in the same auger string.

27.5.16 Fitting Pins. Use only tight-fitting pins designed for the auger. Inspect all connectors daily, and do not use any defective connectors.

27.5.17 Drill Hole Protection. Adequately cover or protect unattended drill holes to prevent animals or people from accidently falling into them.

27.5.18 Warning Signs. On all equipment, install a durable warning sign containing the following wording in full view of the operator:

- All personnel must be clear before starting machine
- Stop the auger to clean it
- Stop engine when repairing, lubricating, or refueling
- Do not wear loose fitting clothing or gauntlet-type gloves

27.6 Underground Drilling Operations

27.6.1 General Requirements. All drilling activities conducted underground must comply with the section, "Tunnel and Shaft Construction" of this standard and 29 CFR 1926, Subpart S, "Tunnels and Shafts, Caissons, Cofferdams, and Compressed Air," of the Safety and Health Regulations for Construction.

27.6.2 Access. Provide and maintain a safe means of access to all underground working places.

27.6.3 Lowering and Hoisting Equipment in Shafts. Do not carry heavy equipment down ladders into a shaft. Provide mechanical hoisting devices to lower and hoist equipment in shafts more than 10 feet deep.

27.6.4 Unattended Shafts. Use barricades equipped with gates or doors to restrict access to unattended shaft openings. Fence and post subsidence areas that present hazards.

27.6.5 Evacuation Plan. Develop evacuation plans and procedures before startup and make them known to all employees.

27.6.6 Underground Ventilation. Mechanically ventilate underground work areas in accordance with the section, "Tunnel and Shaft Construction." Provide a minimum air velocity of 100 feet per minute (FPM) over the gross bore area of the underground workings.

27.6.7 Scaling Work Areas. Thoroughly scale work areas before any drilling operations and periodically during all underground work.

27.6.8 Walkway. Maintain a clear walkway and do not allow equipment or materials to obstruct the passageway.

27.6.9 Drainage. Provide and maintain drainage away from the work site.

27.6 .10 Lighting. Install and maintain sufficient lighting in work areas and access ways. Illuminate all work areas with a minimum of 10-foot candles.

27.6.11 Electric Service Lines. All work areas must have electrical service lines that are insulated, strung on insulators, and separated from water, air, or telephone lines.

27.6.12 Hardhats. Employees must wear hardhats conforming with ANSI Z89.1, type I, class E.

27.6.13 Miner's Lamps. Provide miner's lamps to all employees who work underground and ensure all employees wear them while working underground. Install a lighting system to provide illumination.

27.6.14 Rain Clothing. Wear rain suits if conditions warrant.

27.6.15 Anchors. Install rock bolts or anchors in accordance with the manufacturer's instructions. Rock bolts or anchors used for lifting and pulling must have a safety factor of 5. Adequately torque all rock bolts in accordance with manufactures' recommendations.

27.6.16 Column Mounted Drill Units. Securely stabilize all column mount drills with necessary timbers and wedges adjacent to column foot plates. Drive wedges into place and nail them to adjacent timbers to prevent vibration movement.

27.6.17 Flammable Liquids or Gases. Do not allow flammable liquids or gases underground, except as needed for welding and cutting.

Section 28

Watercraft and Dredging

This section sets forth the requirements for watercraft and dredging. The requirements for actual watercraft and dredging equipment are discussed, as well as the requirements for personnel performing such watercraft and dredging operations. Inspection, training, certification, and various operating activities are discussed in detail.

28.1 General Requirements for Watercraft Operations

28.1.1 Requirement. Construct all watercraft and perform all watercraft operations according to the requirements of these standards, as well as applicable U.S. Coast Guard (USCG), Department of the Interior, State, and local requirements.

28.1.2 Inspection and Certification. Inspect, certify, license, and number all watercraft and equipment according to applicable regulations of USCG and other jurisdictional entities before placing them in service.

28.1.3 Capacity Plates. Plainly mark on all watercraft the maximum occupancy and carrying capacity allowed onboard for safe passage (i.e., USCG maximum capacities). Do not exceed this maximum occupancy or carrying capacity.

28.1.4 Loading. Make sure each boat has enough room, freeboard, and stability to safely carry the maximum cargo and passengers under various weather and water conditions.

28.1.5 Flame Arresters. Equip gasoline engines, except for outboard types, with a USCG-approved backfire flame arrestor. Make sure the arrestor is attached to the air intake with a flame-tight connection. It must be kept clean and in serviceable condition.

28.1.6 Fire Extinguishers. For watercraft less than 65 feet in length, at least one USCG-approved fire extinguisher, rated 2-A:40-B:C or greater, must be carried onboard. Watercraft 65 feet or larger must carry sufficient fire extinguishers to meet USCG requirements. Watercraft with gasoline or liquid petroleum gas powerplants located in a compartment or confined location must have a fixed automatic carbon dioxide (or equivalent) fire-extinguishing system.

28.1.7 Ventilation. Watercraft with permanently installed gasoline engines must have powered ventilation systems to remove gasoline vapors from the vessel.

28.1.8 Fuel. Store fuel in approved containers suitable for marine use. Fuel lines must be equipped with a valve to cut off fuel flow. In addition, if the watercraft will not be in use for a period of 8 hours or longer, then the valve must be closed.

28.1.9 Navigation Lights. Watercraft must be able to display navigation lights required by USCG. Display navigation lights between sunset and sunrise and any other time visibility is reduced (fog, haze, rain, etc.).

28.1.10 Operator Training and Qualification. Reclamation employees and others who operate a Reclamation-owned watercraft must first be certified or licensed to operate watercraft in accordance with DOI 485 DM 22. Non-Reclamation employees who operate watercraft owned by others must be qualified in accordance with USCG, State, and local regulations.

28.1.11 Float Plans. If the operator expects watercraft activities to take longer than 4 hours from time of departure until time of return, a float plan must be prepared. The float plan must include the following information:

- Watercraft information (vessel make/model or local identifier)
- Personnel onboard
- Activity to be performed
- Expected time of departure, route, and time of return
- Means of communication (if any)

28.1.12 Personal Flotation Devices (PFD) Equip watercraft with one USCG-approved PFD for each occupant, and once USCG-approved throwable device onboard the watercraft. Wear a PFD whenever you are onboard a watercraft or working around bodies of water where a drowning hazard exists. Refer to the section on "Personal Protective Equipment."

28.1.13 Safety Equipment. Equip all watercraft with adequate safety equipment to meet USCG requirements and any hazards that may be encountered during normal operations.

28.1.14 Swimming. You must not swim from watercraft or any floating equipment unless you are a certified diver whose duties require such swimming.

28.2 Dredging Operations

28.2.1 Inspections. A qualified person must inspect dredges and related equipment before they are entered into service, and at least yearly thereafter, to make sure they are in safe operating condition. The inspector must have a recognized degree, certificate, or license, or professional standing, as well as extensive knowledge, training, and experience in solving problems related to the work. Inspections must be documented and accessible to personnel.

28.2.2 Maintenance and Repair. Before performing repair or maintenance work on the pump, suction, or discharge lines below the water line, or within the hull, in addition to the normal process of securing hoisting machinery, you must raise the ladder (or drag arm) above the water line and positively secure it. Set blank or block plates in suction or discharge lines as appropriate. Also see the section on "Control of Hazardous Energy (Lockout/Tagout)."

28.2.3 Pipeline Marking. Dredge pipelines that float or are supported on trestles must display appropriate lights at night and when visibility is restricted, in accordance with USCG regulations and 33 CFR 88.15.

28.2.4 Public Notification. Issue public notices where dredging activity may pose hazards to navigation or to the public.

28.2.5 Safety Plans. Prepare a comprehensive safety plan for each dredging operation. Make the plan location specific and include provisions for communications and emergency response.

28.2.6 Submerged Dredge Pipeline

a. Where a pipeline crosses a navigation channel or other area subject to boat traffic, submerged pipeline must rest on the channel bottom. The top of the pipeline and any anchor securing the pipe must be no higher than the maximum draft of traffic expected in the area where pipe is placed.

b. When buoyant or semibuoyant pipeline is used, the dredge operator must make sure the pipeline remains fully submerged and on the bottom. When raising the pipeline, warn boat traffic of the pipeline hazard. Adequately mark the entire length of the pipeline as required by the USCG.

c. Mark the entire location of the submerged pipeline with signs, buoys, lights, or flags as required by USCG and as approved by the authority having jurisdiction.

d. Conduct routine inspections of the submerged pipe to ensure anchorage.

e. Remove all anchors and related materials when removing the submerged pipe.

28.2.7 Floating Pipeline. Floating pipeline is any pipeline not anchored on the channel bottom. Clearly mark floating pipeline, including rubber discharge hoses. Do not allow pipelines to fluctuate between the water surface and the channel bottom or to lie partially submerged.

a. If floating pipelines are used as accessways, equip them with a walkway and handrail on one side. Personnel using the walkway or working on the pipeline must wear an approved PFD.

28.2.8 Dredge Design. Design dredges so that a failure or rupture of any of the dredge pump components (including dredge pipe) will not cause the dredge to sink.

a. Dredge Pumps. Any dredge with a dredge pump below the water line must have a bilge alarm or automatically shut down in the event of a pump leak.

b. Fall Protection. Provide guardrails, bulwarks, or taut cable guard lines for deck openings, elevated surfaces, or other locations where a person may slip or fall from them. Guardrails and taut cable guard lines must comply with the requirements for standard guardrails.

c. Walking and Working Surfaces

1. Provide anti-slip surfaces on all working decks, stair treads, vessel ladders, and other walking or working surfaces that may become wet during operations.

2. Remove obstructions in walking and working surfaces if possible. Where obstructions cannot be removed, post appropriate warning signs or distinctively mark them in accordance with section 9 and ANSI Z535.1.

3. Where the distance between the vessel and docks or landings exceeds 18 inches horizontal or 12 inches vertical, provide gangways. Gangways must be at least 22 inches wide, with standard railings, and be able to support 250 pounds (with a safety factor of 4:1) at its midpoint.

28.2.9 Relocation. A qualified person must directly supervise any mobilization, demobilization, or relocation of dredges, support barges, or other support equipment.

Section 29

Marine and Diving Operations

This section establishes the requirements for marine and diving operations, oversight of contractor diving operations and Reclamation diving operations. Issues discussed include dive team requirements, diver qualifications, predive planning, hazard control measures, supervision, equipment, recordkeeping, accident reporting and first aid, recompression, surface-supplied air diving, scuba diving, and communication systems.

29.1 Requirements for Contractor Diving Operations

29.1.1 General Requirements. Conventional hardhat and lightweight surface supplied and scuba diving operations must conform to the more stringent requirements of this subsection or 29 CFR 1910, Subpart T, "Commercial Diving Operations." Use regulations contained in the U.S. Navy Diving Manual, volumes I through V, to resolve issues not covered by these or referenced standards.

29.1.2 Hazard Control Measures. Bring diving equipment to the worksite only after a Safe Practices Manual, diving plan, and dive hazard analysis have been developed and the Contracting Officer's Representative (COR) or Dive Master has approved it. The dive hazard analysis and diving plan must specifically address safety procedures for each separate diving location or mode and include policies to ensure compliance with these and referenced standards. If conditions change, cease diving operations until you reevaluate conditions and implement appropriate controls.

29.1.3 Diver Qualifications. Divers, including those on standby, must have a certificate of training from a recognized diving school or certified record of past diving experience. Prior to commencing diving operations, submit divers' names and qualifications to the COR or Dive Master. Divers must be at least 18 years old and be fully familiar with the equipment, diving system, and emergency procedures to be used. Divers must have undergone a medical examination within the past year that certifies them as physically fit for diving. In addition, a diver may dive to depths greater than 100 feet seawater equivalent only if they have previous experience diving to the maximum depth required in the planned dive. Divers must not take part in diving operations if they have severe colds, sinus or ear infections, alcohol intoxication or its aftereffects, drug addiction, fatigue, acute illness, or vertigo. All dive team members must be trained in cardiopulmonary resuscitation, first aid (American Red Cross standard course, or equivalent), and oxygen first aid.

29.1.4 Supervision. A designated, experienced, onsite Dive Master must personally supervise all diving operations, including use of personnel and decompression.

29.1.5 Equipment. Use a tagging or logging system to record equipment modification, repair, test, calibration, or maintenance services. Include the date and type of work performed and the name or initials of the person who did the work.

a. Air Compressor System. Compressors that supply air to the surface-supplied air (SSA) diver must have a volume cylinder with a check valve on the inlet side, a pressure gauge, a relief valve, a drain valve, and a carbon monoxide filter and alarm system. Compressors must have the capacity to overcome any line loss or other losses and deliver a minimum of 4.5 cubic feet per minute to each diver at the maximum working depth. Locate air compressor intakes away from areas containing exhaust or other contaminants. Respirable air supplied to a diver, or to air tanks, must not contain:

1. Carbon monoxide (CO) greater than 10 parts per million (ppm).
2. Carbon dioxide (CO2) greater than 1,000 ppm.
3. Oil mist greater than 5 milligrams per cubic meter.
4. A noxious or strong odor.

Test the air compressor system output for air purity at least every 6 months, by taking samples at the connection to the distribution system.

b. Compressed Gas Cylinders. Compressed gas cylinders must:

1. Be designed and maintained according to the applicable provisions of 29 CFR 1910.101(a).
2. Be stored in a ventilated area and protected from excessive heat.
3. Be secured against falling.
4. Have shutoff valves recessed into the cylinder or protected by a cap, except when in use, when manifolded, or when used for diving.

29.1.6 Surface-Supplied Air Diving

a. Auxiliary Air Supply. Provide an auxiliary air supply during all dives. The auxiliary air supply must have a standby compressor or air flasks with a capacity of 72 cubic feet or more. Compressors that are used for diving operations must not be used for any other purpose. Auxiliary air supply must meet the requirements in the subsection, "Air Compressor System."

b. Decompression. A recognized decompression specialist must prepare decompression tables. Post decompression times inside and outside decompression chambers.

c. Decompression Chamber. The following circumstances require an onsite, dual-lock, multiplace decompression chamber (capable of recompressing the diver to a minimum of 165 feet seawater equivalent) and trained operating personnel:

- Diving operations that are outside the no-decompression limits or to depths greater than 100 feet seawater
- When surface recompressing capabilities are recommended by the decompression specialists, Dive Master, or where necessitated by onsite conditions

Decompression chambers must accommodate at least two persons.

d. Decompression Dives. Divers engaged in dives outside no-decompression limits or engaged in mixed-gas diving must remain awake and close to an attended decompression chamber for at least 1 hour following the dive. The diver must be able to contact a decompression chamber facility during the 4-hour period immediately following treatment or after leaving the water.

e. Communications. Equip divers and standby divers with communication systems that permit simultaneous, two-way conversations between the diver, his tender, other divers and tenders, and the Dive Master. Communication systems must be operable from the time the diver puts on his helmet or mask until it is removed.

f. Minimum Crew Size. Two divers must be available on any one diving operation. The standby diver must be available, suited up, and ready to dive in an emergency. The standby diver must not serve as a tender. The minimum crew must consist of at least four persons: the Dive Master, a diver, a standby diver, and a tender. For each diver added to the crew, one tender must also be added.

g. Reserve Breathing Gas Supply. Each diver using lightweight SSA must carry a reserve breathing gas tank. When heavy, deep-sea diving gear are used, when diving to depths exceeding 100 feet of seawater, or when diving outside the no-decompression limits, the standby diver must have an extra breathing gas hose for the working diver.

29.1.7 Scuba Diving

a. Requirement. Scuba diving is permitted only when sanctioned by the contract specifications and authorized in writing by the contracting officer.

b. Maximum Depths. Limit scuba diving to depths and times that will not require decompression staging as set forth in the U.S. Navy Standard Air Decompression Tables. Scuba dives depths must not exceed 100 feet of seawater after altitude adjustment.

c. Compressed Air. Oxygen or mixed gases are prohibited, except for up to 40 percent nitrox, when used in accordance with the National Oceanic and Atmospheric Administration (NOAA) Diving Manual: Diving for Science and Technology, Chapter 15, "Nitrox Diving" and Appendix VII, "Nitrox Dive Tables." Use only open circuit scuba systems.

d. Diving Equipment. A recognized approving agency must approve scuba diving equipment. Use and maintain scuba diving equipment in accordance with the manufacturer's recommendations.

e. Buddy System. A dive may be made singly if the dive is less than 20 feet deep, there is little current, and visibility is good (at the discretion of the Dive Master). All other dives with scuba gear must use a buddy system.

f. Standby Diver. Provide a standby diver for each diver or buddy pair. The standby diver must be a qualified, fully equipped scuba diver and remain on the surface, close to the diver.

g. Standard Equipment. Scuba divers must wear buoyancy compensators and have a depth indicating device, timing device, cutting tool, compass, submersible pressure gauge (or integrated dive computer) to monitor cylinder/system air pressure, and an alternate second stage air source, such as an octopus or safe second.

29.2 Requirements for Reclamation Diving Operations

29.2.1 Regulations and Policy. Reclamation diving operations must comply with the requirements of 29 CFR 1910, Subpart T, "Commercial Diving Operations." The policies and guidelines for Dive Team establishment, review, training, certification, and diver qualifications are contained in Department of the Interior Manual 485 (Safety and Health Handbook), Chapter 27, "Underwater Diving Safety." Use the U.S. Navy Diving Manual, Volumes I, II, and V, to resolve issues not covered by these or referenced standards.

29.2.2 Reclamation Oversight. A Bureau Diving Safety Board and a Regional Diving Advisory Committee (RDAC) must oversee Reclamation diving operations. These organizations must provide guidance for the safety of all diving operations. They are responsible for:

a. Establishing a Bureau of Reclamation Safe Practices Manual for Underwater Inspection Program.

b. Reviewing diving activities.

c. Establishing qualifications for divers.

d. Providing periodic diver training opportunities.

e. Approving dive teams and Dive Masters.

f. Reviewing all diving operations and accidents.

29.2.3 Diving Operations.

a. General. Sufficiently train and equip Reclamation dive team members with resources to safely perform diving operations.

b. Restrictions on Specialized Diving. Reclamation teams must not undertake specialized operations, such as underwater welding, gas or electric arc cutting and burning, or explosive demolition. Permitted activities include minor maintenance (such as removing rocks and debris from stilling basins; operating small, hand-held, nonelectric power tools; inspections; and assisting surface maintenance crews with installation or cleaning operations).

c. Recordkeeping.

1. Each diver must maintain a dive log that contains, at a minimum, the following information:

- Names of dive team members (including Dive Master)
- Location
- Date
- Time
- Diving mode
- General nature of the work performed
- Appropriate surface and underwater conditions
- Maximum depth and bottom times
- Any accidents or unusual conditions encountered

RDAC will ensure that accurate dive logs are maintained and tabulated on an annual basis.

2. Maintain a log of all equipment modifications, repairs, tests, calibrations, and maintenance.

3. Maintain the underwater diving safety records identified above and other dive team records in accordance with table 29-1.

Table 29-1.—Dive team recordkeeping

Record	Instructions	Retention period[1]	Responsibility
Injury or illness requiring hospitalization of 24 hours	Notify RDAC, report using SMIS system within 6 days; CA-1 within 2 days	5 years (SMIS) Permanent (CA-1)	Team leader
Minor diving injuries	Report using SMIS system within 6 days; (CA-1) within 2 days	5 years (SMIS) Permanent (CA-1)	Team leader
Safe practices manual	Retain copy at dive site	Current document	Dive Master
Depth-time profiles	Individual records	Until transferred to the dive log	Diver
Recording of dives (dive log)	Individual records (tabulated annually)	1 year, unless an accident; in case of accident, 5 years	Dive Master
Dive hazard analysis and briefing notes	Review and discuss dive hazard analysis prior to each dive.	1 year	Dive Master
Dive team medical records and medical clearance	Keep with medical records. Retain copy of medical clearance at dive site.	5 years; most recent clearance (1 year)	Team leader
Equipment inspections, repairs, maintenance, and calibration	Keep current record until equipment is withdrawn from service.	Most current tag or entry	Team leader
Dive training and dive training summary	Individual diver must maintain it as a continuous record; annual summary at dive site.	Continuous running record; summaries every 5 years	Team leader
Compressor air quality	Check every 180 days.	Most current record	Team leader

[1] Records required to be retained 5 years (with the exception of minor injuries report) must be forwarded by Reclamation to the National Institute for Occupational Safety and Health (NIOSH), Department of Health and Human Services.

d. Dive Plan and Hazard Analysis. Prepare a dive plan and hazard analysis before each diving activity. All personnel involved must review the dive plan and hazard analysis before suiting up. As a minimum, the plan must contain the following:

1. Names and duties of dive team members, including diving supervisor.

2. Date, time, and location of the dive operation.

3. Diving mode to be used (scuba, surface-supplied air, etc.), including a description of the backup air supply.

4. A description of the work divers will perform, and inspection requirements.

5. Surface and underwater conditions, including visibility, temperature, thermal protection, and currents.

6. Activity hazard analysis for each phase of work, including the hazards of flying after diving.

7. Maximum depth and bottom time (make altitude adjustments to dive tables for dives at altitudes of 1000 feet or more above sea level).

8. Emergency management plan, including emergency procedures, means of notification, telephone numbers (for ambulance, doctors, and Divers Alert Network), locations of evacuation route, and emergency assistance.

9. Lockout/tagout procedures, including how to deal with differential water pressures due to unequal water elevations.

10. Equipment servicing records, procedures, and checklists and requirements for special tools and equipment.

29.2.4 Accident and Incidents. Report all accidents that occur in connection with a diving activity, following standard accident reporting procedures (see table 29-1). In addition, the team leader must submit to the RDAC a comprehensive analysis of each accident or incident involving a diver. The purpose of the accident and incident analyses is to identify hazardous situations and constructively prevent their recurrence.

29.2.5 Diving Supervision. The Dive Master must attend each diving operation. The Dive Master is responsible for predive planning, the dive hazard analysis, and the conduct and safety of the dive. The Dive Master's decisions are final. However, a diver who considers a diving operation unsafe is not required to participate in the dive.

29.2.6 Required Divers. At least three divers must be present during all Reclamation dives. In addition to the diver, there must be a standby safety diver and the Dive Master. Top side personnel are responsible for tending the diver, recordkeeping, and controlling any surface-supplied breathing air equipment. This requirement may be varied only with the approval of the Dive Master and RDAC.

29.2.7 Predive Briefing. Before beginning work on a dive operation, the dive team, facility representatives, and/or others involved in, or affected by, the operation must meet to review the dive plan and dive hazard analysis and to coordinate the diving operation. Maintain a record of the briefing notes.

29.2.8 Safe Practices Manual. Make the Safe Practices Manual available at each dive location.

29.2.9 Maximum Depth. Limit diving operations to depths and times that will not require decompression staging, in accordance with the U.S. Navy standard air decompression tables and the altitude conversion tables developed by R.L. Bell and R.E. Borgwardt (1975). When diving, do not exceed 100 feet of seawater (after altitude conversion).

29.2.10 Clearance and Lockout Procedures in Areas of Hazardous Energy Sources. Use clearance and lockout procedures where hazardous energy sources exist. When diving near dams, powerplants, pumping plants, or diversion structures with mechanical or electrical features that could pose a hazard to divers, a technical representative from the project at which the dive is being made must be present or in direct communication to assist the divers. All divers must review the clearance before beginning diving operations. Clearance procedures and lockouts must conform with the section, "Control of Hazardous Energy (Lockout/Tagout)" of this standard.

29.2.11 Pressure Differentials. Review diving operations for potential hazards to divers before beginning to dive on the upstream or high-pressure side of open or badly leaking gates, valves, diversion structures, or other features where a combination of flow and pressure differential could immobilize a diver.

29.2.12 Equipment. Equip each diver to ensure personal safety. No diver is required to dive with a type or brand of equipment they consider unsafe. Divers must not dive with equipment known to be damaged or improperly maintained.

a. Basic Auxiliary Requirement. The basic auxiliary requirement for each scuba diver includes, but is not limited to:

1. Buoyancy compensating device.
2. Depth indicating device.
3. Timing device.
4. Cutting tool.
5. Compass.
6. Submersible pressure gauge (or integrated dive computer) to monitor cylinder/system air pressure.
7. Alternate second stage air source, such as an octopus or safe second.

b. Equipment Inspection. Before diving operations begin, and every day during dive operations, dive team personnel must inspect the equipment to make sure it is in proper operating condition. Record inspection results in a dive log or as required by the Safe Practices Manual.

c. Air Cylinders. Every year, have all air cylinders visually inspected by a certified cylinder inspector, attach an inspection sticker to the cylinder and issue a certificate. Hydrostatically test the cylinders every 5 years in accordance with U.S. Department of Transportation regulations. Permanently mark the cylinder with the most recent test date.

d. Regulators. A diver's first and second stage regulators must be professionally inspected at least once a year, or more frequently if recommended by the manufacturer. Retain the inspection certificate until the next inspection or maintenance.

29.2.13 Diving Flag. Fly a red flag with white diagonal stripe (see figure 29-1) at all times when divers are working near motor boats or other dangerous watercraft, or where mandated by State or national Coast Guard regulations.

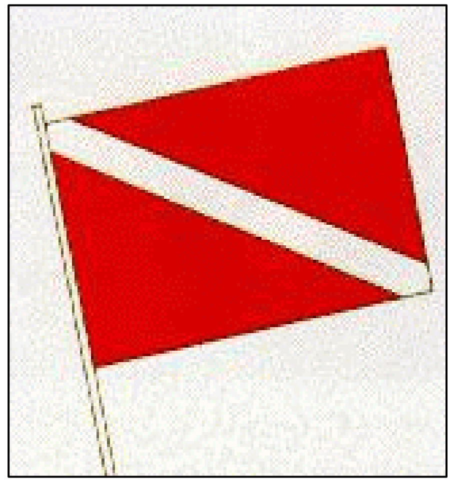


Figure 29-1.—Diving flag.

29.2.14 Surfacing. Divers must surface when the cylinder pressure reaches 500 pounds per square inch or at the first signs of equipment malfunction.

29.2.15 Recompression Chamber Location. Include in the dive hazard analysis all emergency telephone numbers, including the Divers Alert Network (DAN) and the local hospital. DAN maintains a listing of the closest recompression chambers for each day. The dive hazard analysis must also specify the most effective mode of transportation to the hospital, as determined by the Dive Master.

29.2.16 Repetitive Dive Tables. Keep repetitive dive tables at the dive site as part of the dive plan and dive hazard analysis.

29.2.17 Emergency First Aid Equipment. Make emergency first aid equipment immediately available to the dive team. Include in the dive plan and dive hazard analysis the location and telephone number of an ambulance service and hospital near the dive area. Emergency first aid equipment must include a first aid kit, spine board, and a demand-type oxygen unit able to deliver at least 15 liters of oxygen per minute. When traveling to remote sites where professional medical assistance is more than 1-1/2 hours away, have Remote Emergency Medical Oxygen available at all times.

29.2.18 Post-Dive Restrictions

a. Commercial Flying. Wait a minimum of 12 hours after completing a single no- compression dive, or 24 hours after multiple days of diving or decompression dives.

b. Driving to Altitude. Divers shall correct for altitude prior to diving by assuming the highest point to be reached after the dive is the altitude of the dive. Refer to the Travel Delay Table and Altitude Modifications discussion in Bureau of Reclamation Safe Practices Manual for Underwater Inspection Program.

29.2.19 Individual Safety. Divers are ultimately responsible for their own safety. It is the diver's responsibility and privilege to refuse to dive if, in the diver's judgment, conditions are unsafe, unfavorable, or the dive would violate the dictates of their training, judgment, or these regulations.

29.2.20 Transporting Cylinders. Transport all dive cylinders in racks designed for this purpose or secure them safely. Shade dive cylinders and maintain the temperature at less than 100 °F if possible. If the temperature, elevation, or other conditions cannot be controlled, reduce the pressure to avoid exceeding the cylinder's working pressure.

29.2.21 Scuba Diving

a. Compressed Air. Use only open-circuit type scuba equipment using compressed air. Obtain compressed air from a reliable source, meeting the specifications of Compressed Gas Association (CGA) Standard G7.1, Commodity Specification for Air.

b. Penetration Drive. You must not dive with scuba, under overhead obstructions, or when vertical access to the surface is restricted if you can become disoriented as to the egress direction. Limit penetration to less than 50 feet.

c. Standby Diver. Provide a standby diver for each working unit or pair of divers. The standby diver must be suited up and have all diving gear available for immediate use. Position the standby diver to respond quickly to the needs of the divers.

d. Buddy System. Conduct all scuba diving activities using a buddy system, unless the Dive Master determines that two divers working in close proximity will increase the hazards. A single diver may work alone, subject to the following conditions:

1. The working depth does not exceed 20 feet, or 30 feet with approval by the Dive Master and Safety Manager.

2. A standby diver is provided for the single diver.

3. The Dive Master, standby diver, and diver clearly understand that the diver will be working alone.

4. The Dive Master, standby diver, and diver agree, in advance, on the exact operation. The diver must not alter the agreed-upon operation or stray from the prescribed locality.

29.2.22 Surface-Supplied Air Diving. SSA diving is permitted only if divers, standby divers, and console operators have successfully completed SSA training by an RDAC-approved instructor from an accredited or nationally recognized organization.

a. Air Supply. Each diving operation must have a primary breathing air supply sufficient to support divers for the duration of the planned dive. Air supply to SSA must be a manifold control system of scuba cylinders that meet the criteria of this section or a volume tank specifically designed for use in a breathing air system. A manifold system must be at least a two-cylinder system and allow cylinders to be changed without shutting down the air supply.

b. Air Quality. Respirable air that will be supplied to divers through cylinders must be obtained from suppliers whose air is tested every 6 months by an independent tester. Respirable air must not contain:

1. Carbon monoxide greater than 10 ppm.
2. Carbon dioxide greater than 1,000 ppm.
3. Oil mist greater than 5 milligrams per cubic meter.
4. A noxious or pronounced odor.

c. Reserve Breathing Air. Equip each diver with a reserve breathing supply that the diver can immediately turn on if the primary air source is lost.

d. Umbilicals. Mark umbilicals in 10-foot increments to 100 feet, beginning at the diver's end, and in 50-foot increments thereafter. Umbilicals must be made of kink-resistant materials. Include a safety line as an integral part of each umbilical. Umbilicals must have a nominal breaking strength of at least 1,000 pounds.

e. Helmets. SSA helmets and masks must have a check valve at the attachment between the helmet or mask and hose. They must also have an exhaust valve. Helmets and masks must have a minimum ventilation rate capacity of 4.5 cubic feet per minute at the depth in which they are operated.

f. Weight System. Equip divers with a weight belt that can release quickly.

g. Safety Harness. Divers must wear a safety harness. The safety harness must have a positive buckling device and an attachment point for the umbilical and safety line.

h. Equipment Records. Record each equipment modification, repair, test, calibration, or maintenance service in the equipment log.

i. Minimum Crew Size. At least two divers must be available on any one diving operation. The standby diver must be suited up and ready to dive in an emergency. The standby diver must not serve as a tender. The crew must consist of at least four persons: the Dive Master, a diver, a standby diver, and a tender. For each diver added to the crew, one tender must also be added.

j. Dive Tender. While in the water, each diver must be continuously tended by one tender.

k. Penetration Dive. Station an SSA diver at the underwater point of entry when diving takes place in enclosed or physically confining area. Limit penetration to 300 feet total distance.

l. Standby Diver. While a diver is in the water, the SSA standby diver must be suited up and ready to dive in an emergency.

m. Communication System. All SSA diving operations require electronic communication systems. The communication system must provide diver-to-diver and diver-to-surface communication. If voice communications are lost, terminate all diving.

Section 30

Tower Climbing Safety

This section establishes the requirements for protecting employees during tower activities. This section covers the following topics:

- General Requirements
- Responsibilities
- Hazard Identification and Assessment
- Personal Protective Equipment
- Personal Conduct
- Anchorages, Aerial, and Fixed-Climbing Devices
- Fall Protection Requirements for Elevated Work
- Non-ionizing Radiation
- Preclimb and Rescue Procedures
- Training and Qualifications
- Recertification
- Recordkeeping

Refer to RSHS Section 16 for additional fall protection and rope supported work requirements.

30.1 General Requirements

30.1.1 Qualifications. In accordance with 29 CFR 1910, 29 CFR 1926, and Departmental Manual 485, all employees and contractors who perform tower or elevated work must be medically qualified to perform those jobs (in accordance with subsection 30.10.5, "Medical Qualification"), must be certified as a qualified climber (in accordance with subsections 30.7.2, "Qualified Climber Classification," and 30.10, "Training and Qualifications") to perform those jobs, must have the appropriate equipment to do the job, must work on structures that are safe, and must perform those jobs in accordance with this section and relevant CFRs.

30.1.2 Design. Every effort must be made to design towers to minimize or eliminate the need for climbing.

30.1.3 Program Coordinator. Each region must designate a Regional Program Coordinator (RPC) for tower climbing activities. In addition, each area office may designate a local program specialist who will work with the RPC.

30.1.4 Tower Standards. Tower climbers must only climb towers certified by the manufacturer to meet Telecommunications Industry Association/Electronic Industries Association (TIA/EIA) 222 for tower construction and 29 CFR 1910.66, Appendix C, “Personal Fall Arrest Systems,” for anchorages. Towers that do not meet these standards must be red tagged with the words, “Do Not Climb” until the towers are retrofitted or replaced with towers that do meet these standards. Until then, work activities must be accomplished by other methods (e.g., aerial devices).

30.1.5 Minimum Crew Size. A minimum of two employees are required for tower climbing activities.

30.1.6 Emergency Work. Emergency situations may exist that pose an imminent threat to human life due to the lack of telecommunications services; these emergency situations may require expedient performance of tower or elevated work. In these situations, every effort must be made to perform a risk assessment of such work. Any emergency work performed that does not comply with this section or the CFR must be clearly documented and reported to the Regional Safety Manager (RSM) and the designated RPC.

30.2 Responsibilities

30.2.1 Designated Agency Safety and Health Official. The Designated Agency Safety and Health Official is responsible for developing, implementing, and reviewing Reclamation’s tower climbing program. This includes: maintaining policies, developing training courses, and program review.

30.2.2 Reclamation Safety and Occupational Health Office. The Reclamation Safety and Occupational Health Office is responsible for providing safety assistance to tower climbing program coordinators. Reclamation’s Security, Safety, and Law Enforcement office must ensure that standards comply with the U.S. Department of the Interior (DOI) policy and provide direction to regions when implementing the DOI DM 485 - Occupational Medicine Program Handbook for tower climbers.

30.2.3 Regional Director. Each Regional Director must establish and maintain a tower climbing program in accordance with OSHA and the requirements given in this section. Each Regional Director must appoint a RPC to ensure that the requirements contained in this section are adopted for all tower climbing and elevated work activities.

30.2.4 Program Coordinators. Program Coordinators are responsible for:

- Ensuring that the established tower climbing program is carried out in an effective manner.

- Ensuring that employees receive the proper training required in the use, care, and inspection of fall protection equipment, as well as ensuring that the proficiency requirements, which allow workers to perform climbing activities, are met. Minimum training requirements are outlined in subsection 30.10.3, “Training.”

- Participating in the refinement and implementation of a regional tower climbing program.

- Determining that tower climbers are designated as “qualified” after successfully completing all requirements to become qualified climbers.

- Maintaining an inventory of qualified climbers, performing an annual inspection of personal protective equipment (PPE), and reporting to the RSM.

30.2.5 First-Line Supervisors. Supervisors are responsible for the following:

- Ensuring that employees who perform tower climbing activities adhere to all program requirements and follow good safety practices.

- Ensuring that employees who perform tower climbing activities are provided with tower climbing and fall protection courses that meet the training requirements contained in this section.

- Maintaining position descriptions that accurately relate to tower climbing physical requirements and abilities.

- Ensuring that employees who perform tower climbing activities have current medical clearances.

- Ensuring that they are aware of any health issues employees have who perform tower climbing activities.

- Ensuring that a minimum of two employees perform each tower climbing activity.

30.2.6 Onsite Job Leads. In coordination with the crew, onsite job leads are responsible for:

- Specifying the fall protection system to be used before engaging in the work activity.
- Ensuring that a Job Hazard Analysis (JHA) is completed and that pertinent work procedures are clearly defined and well understood by the work crew.
- Evaluating the physical condition of the climbers before allowing them to climb.
- Stopping work when safety concerns are identified until the issue is resolved.
- Being aware of changes in conditions and events as the job progresses that may require review and modifications of the fall protection system in use or work procedure plan.
- Requiring that all climbing and fall protection equipment is inspected prior to each use.
- Ensuring that contractors use only qualified climbers and follow all state, local, and Federal laws for tower climbing and fall protection.
- Ensuring that climbing plans are in place prior to the beginning of each job.

30.2.7 Crew Members. Each member of a work crew has the following responsibilities:

- Adhering to fall protection rules and procedures.
- Identifying unsafe and unhealthful conditions that exist or are anticipated at a jobsite.
- Participating in the development of a JHA to obtain an understanding of the safety and health requirements and work procedures of the job.
- Inspecting personal fall protection equipment prior to each use.

- Making the onsite job lead aware of any physical conditions that may impact their ability to perform the work.

30.2.8 Regional Safety Manager. The RSM must assist in the development and establishment of the tower climbing program. The RSM, in cooperation with the RPC, must perform periodic spot checks to ensure compliance with this program. The RSM must assist supervisors in arranging for training and purchasing approved fall protection equipment.

30.3 Hazard Identification and Assessment

30.3.1 Hazard Assessment. Reclamation must conduct a hazard assessment to identify, assess, and control employee exposure to hazards as required by the RSHS and any other applicable rules or regulations. Results of the hazard assessment may be documented on the JHA.

30.3.2 Prior to Climbing. Reclamation must perform and document the hazard assessments initially and daily for each site prior to permitting employees to climb the structure and when safety and health information or changes in workplace conditions indicate that a new or increased hazard may be present.

30.3.3 Hazard Assessment Details. The hazard assessments must:

- Be performed by a knowledgeable person.
- Evaluate new equipment, materials, and processes for hazards before they are introduced into the workplace.
- Identify meteorological conditions that could affect work at heights above 6 feet on a tower (e.g., wind, rain, snow, ice).
- Identify any non-ionizing radiation hazards and mitigation.
- Identify the need for personal exposure assessments.

30.3.4 Hazard Control. If hazards are identified, Reclamation must assess the severity of identified hazards and implement means to control such hazards, including providing employees with PPE designed to control the identified hazards and ensuring that employees use the proper PPE.

30.4 Personal Protective Equipment

30.4.1 General

a. Application. This section identifies the application of PPE used by employees while climbing, resting, and performing work at elevated locations. The equipment described is used to help place the worker in a desirable working position and to reduce the probability of potential fall accident injuries.

b. Storage. PPE is to be stored in a dry, dark, secure area and protected from cuts, abrasions, chemicals, and temperature extremes when not in use.

c. Inspection. Mandatory inspection of equipment before each use by the user must serve to minimize accidents resulting from deterioration of equipment. Inspections must be documented. All fall protection equipment must be inspected by the program coordinator on an annual basis, and a record of the inspection must be maintained in the office or site files.

d. Defective Equipment. Manufacturer's instructions and recommendations must be incorporated into inspection, replacement, and preventive maintenance programs. Defective equipment must be immediately removed from service and tagged “Do Not Use” until it is repaired. If defective equipment is determined to be nonrepairable, it must be disposed of immediately.

30.4.2 Fall Prevention/Positioning System

a. Full Body Harness. A full body harness, as defined in 29 CFR 1926.500, “Fall Protection – Scope, Applications, and Definitions,” and RSHS subsection 16.1.3, “Full Body Harness,” must be worn as an integral part of the fall prevention system. It must be provided with a means for attaching to other components of a personal fall arrest system. The use of a body belt (safety belt) for fall arrest is prohibited.

Full body harnesses must be inspected before each use by the wearer and annually by the Program Coordinator for the following:

- Cuts, tears, and chafing
- Electrical burns

- Physical deterioration
- Ultraviolet deterioration
- Wear on connection devices
- Evidence of shock loading
- Chemical damage and/or deterioration
- Suspect body harnesses must be destroyed.

b. Positioning Strap/Rope Lanyard. Positioning straps or rope lanyards must have each end snapped into a separate D-ring of full body harness when in a rest or work position. Rope lanyards must be spliced by the manufacturer or his qualified representative to connect fittings, other ropes, extensions, and attachments with a minimum four-tuck splice. Tools, handlines, or other objects that may interfere with the snaphook and cause rollout must not be attached to or hung from the positioning strap.

Positioning straps and rope lanyards must be inspected for the following:

- Snaphook keeper spring tension
- Exposure of colored wear-warning inner layer
- Elongation of holes in positioning strap material
- Cuts, burns, extra holes, or fraying of material
- Loose or worn rivets
- Cracks, burns, or corrosion in the snaphook
- Excessive side movement of the snaphook keeper
- Chemical damage and/or deterioration

c. Pole Climbers/Gaffs. Pole climbers cannot be used if the gaffs are less than 1-1/4 inches (32 millimeters) long as measured on the underside of the gaff. The gaffs of pole climbers must be covered with gaff protectors when not in use.

Pole climbers must be inspected before each use for the following conditions:

- Fractured or cracked gaffs or leg irons
- Wear on stirrup and leg irons
- Loose or dull gaffs
- Proper sharpening of gaffs
- Broken straps or buckles

If any of these conditions exist, the defect must be corrected before the pole climbers are used.

Pole climbers cannot be worn when working on ladders unless the wood structure is used to access a work position on a ladder. In addition, pole climbers cannot be worn when working from an aerial device. Pole climbers must be worn on ladders, in aerial devices, or when walking if used as part of an access system incidental to work activity. American Society for Testing and Materials (ASTM) F887, “Standard Specifications for Personal Climbing Equipment,” provides detailed information for care of pole climbers.

30.4.3 Fall Arrest Equipment

a. Equipment Requirements. All fall arrest equipment must have locking-type snaphooks or approved carabiners that meet or exceed applicable OSHA and American National Standards Institute (ANSI) requirements. This equipment minimizes physical trauma to the worker, comfortably supports the worker after a fall until a rescue can be made, and suspends the worker in a more easily retrievable position for rescuers.

b. Attachment. Fall arrest equipment must be attached to an anchorage as described in 29 CFR 1926.502, subpart M (Fall Protection Systems Criteria and Practices). Regardless of the attachment height, the length of the body attachment must ensure that the free fall distance does not exceed 6 feet (1.9 meters).

c. Equipment Removal. Fall arrest equipment receiving an impact or shock load from a fall must be removed from service and tagged “Do Not Use.” This type of incident must be investigated by the supervisor, reported to the appropriate Regional Safety Office, and entered into DOI’s Safety Management Information System (SMIS). The equipment must be returned to the manufacturer for inspection and repair. It must be repaired only by a qualified person at an authorized facility or must be destroyed.

d. Maintenance and Inspection. The preventive maintenance and inspection program for PPE must include determination of shelf and service lifetimes and the load limitations for the system to be used according to manufacturer’s recommendations.

30.4.4 Lanyards with Energy Absorber. Lanyards and their associated energy absorbers must be used in accordance with the following:

a. Maximum Fall. Possible falls into a personal fall arrest system must not exceed 6 feet (1.9 meters) free fall, 9.5 feet (2.9 meters) total fall distance, and 1,800 pounds (8 kiloNewtons [kN]) of maximum force.

b. System Design. Manufacturer's shock force data or test data must be incorporated into the total arrest system design (including anchorage).

c. Shock Force Indicators. Energy absorbers that have shock force indicators must be used.

d. Self-Locking Connectors. Lanyards must be equipped with self-locking snaphooks or carabiners.

e. Lanyards. Lanyards must not be knotted.

f. Compatibility. Lanyards must not be attached back onto themselves unless they are designed by the manufacturer to function in that capacity.

g. Inspection. Lanyards and energy absorbers must be inspected for the following:

- Partial activation of the energy absorbing device
- Cuts, tears, and chafing
- Electrical burns
- Physical and ultraviolet light deterioration
- Wear on snaphooks
- Operation of snaphooks
- Chemical damage and/or deterioration

h. Equipment Suspected to be Damaged. Suspect lanyards and/or energy absorbing equipment must be tagged “Do Not Use” before they are destroyed.

30.4.5 Self-Retracting Lanyard/Lifeline. Self-retracting lanyards and lifelines are attached to an automatic rewinding reel that quickly arrests a fall and limits the shock load to the worker. Self-retracting lanyards and lifelines limit the freedom of movement up to the length of the lanyard or webbing.

Self-retracting lanyards and lifelines must be used in accordance with the following:

a. System Design. Manufacturer's energy absorbing data or test data must be incorporated into the total arrest system design (including anchorage).

b. Shock Force Indicators. Self-retracting lanyards that have shock force indicators must be used (when available).

c. Self-Locking. Self-retractable lanyards must be equipped with self-locking snaphooks or carabiners.

d. Marking. Self-retracting lifelines must be permanently marked with the manufacturer's name, model number, rating, and date of manufacture.

e. Inspection. Self-retracting lanyards and lifelines must be inspected for the following:

- Partial activation of the energy absorbing device
- Snaphook keeper spring tension
- Cuts, burns, extra holes, or fraying of material
- Excessive side movement of the snaphook keeper
- Chemical damage and/or deterioration

f. Inspection and Removal. Suspect or shock activated self-retracting lanyards and lifelines must be tagged "Do Not Use" and returned to the manufacturer or other authorized repair service for repair. Periodic inspections must be in accordance with the manufacturer's recommendations.

30.4.6 Safe Climb Devices. Safe climb devices, which usually consist of a fixed rail, tube, or tensioned cable with slider, must be designed and installed in accordance with RSHS subsection 16.1.8 (Positioning Device System).

a. Preclimb Inspection. The climber must ensure that the structure, system, and PPE are inspected prior to use to ensure proper operation and good working order. If a climbing system is found to be defective, the climber must use an approved alternative climbing and fall arrest method or elect not to climb.

30.4.7 Rescue Equipment

a. Controlled Descent Devices. Controlled descent devices are used to make emergency descents from aerial devices or elevated positions on structures. Controlled descent devices must be sized to include the maximum elevated position obtainable from the bucket, platform, or elevated position. The rate of descent must be controlled by the worker (or rescuer) or by a friction type brake.

- These devices must be attached to the full body harness such that the worker (or rescuer) must have control of the descent and be able to attach and detach him or herself. Supervisors must ensure that any necessary components that affect the attachment between the descent device and the climber's full body harness are stored with the descent device.

- Controlled descent devices must be stored in a clean, dry, protected environment. They must be cleaned and carefully inspected prior to and after each use.

b. System Compatibility. The rescue equipment must be designed to work with the type of structure(s) or aerial devices where workers (or rescuer) may be required to use the equipment.

30.4.8 JHA. A JHA must be completed and maintained current at each jobsite. Prior to the start of any work at the jobsite or work area, the JHA must be reviewed to determine what PPE and safety equipment are necessary, and if there are any new hazards at the site. PPE must be worn as required in the JHA.

30.4.9 Equipment Choice. Tower climbers may consolidate the issues of safety and personal preference in selecting their choice of personal safety equipment best suited for the job, provided that personal safety equipment is adequate to protect the climber from the hazards associated with the job.

30.4.10 Visitor Control. Observers/visitors must not enter the work area or drop zone unless authorized by the supervisor and must be equipped with PPE that suits the hazards that are present. Barricade tape or an equivalent method must be used to identify and warn others of the drop zone.

30.4.11 Safety Equipment. The following list specifies safety equipment that is either required or recommended for use while on the jobsite and for climbing towers:

a. Head Protection. All personnel must wear hardhats or approved safety helmets on the jobsite, whether they are on the ground or climbing the tower. Anyone within the drop zone (radius) of a communications tower construction project must wear a hardhat and exercise caution. The drop zone is an area with a radius of one-half the height of the tower, centered on the tower's axis. When using hardhat liners, it is important the hard hat fits over the additional headgear. Hardhats or safety helmets must also be equipped with chinstraps, and the chinstraps must be used.

b. Foot Protection. Steel toe (or aluminum toe, or composite toe), reinforced-sole tower climbing boots or shoes are recommended for tower climbers. The specific climbing conditions, such as tower structure and weather conditions, must dictate the type of foot protection that will best suit the climber. Personal preference in selecting the most appropriate safety footwear must prevail, as long as the footwear selected is appropriate for the climbing activity being performed. Tennis shoes or other soft-soled shoes must not be worn for tower climbing.

c. Hand Protection. Leather work gloves are recommended when climbing towers.

d. Eye Protection. Safety goggles or safety glasses must be used whenever eye safety is at risk.

e. Ear Protection. Ear plugs must be used whenever ear safety is at risk.

f. Clothing. Suitable work clothes must be worn when climbing towers to offer protection from cuts and abrasions, weather conditions, and other tower structure hazards. Adequate work clothing consists of coveralls, pants, and shirts made of material suitable for outdoor working conditions. Clothing must not be too loose, frayed, or have loops, belts, or any other items that could present a snag hazard.

g. Communications Devices. Employer-provided, two-way, hands-free, voice actuated radio headsets must be worn by the tower climber and ground safety person to provide reliable communications during the work, negating the need for hand signals. Reclamation must provide headsets for Reclamation climbers, and the contractor must provide headsets for contractor climbers.

h. Radio Frequency Personal Monitor. Climbers must be trained on the use of a calibrated radio frequency (RF) level monitoring device, and must use it, when working around or on a tower that may have active transmitters at or above 500 watts or where the status of transmitters is unknown.

30.5 Personal Conduct

30.5.1 Safe Practices. When tower climbing, always follow safe climbing practices and watch for any unsafe climbing practices by others at the jobsite. Unsafe climbing practices must be eliminated or corrected before accidents occur.

30.5.2 Prohibited Practices. The following unsafe climbing practices are prohibited while working on towers:

- Climber shows fatigue
- Climbing through or past unprotected electrical conductors
- Failure to perform a visual tower or PPE inspection
- Attaching to a tower at an inadequate anchorage
- Not maintaining 100-percnet attachment
- Throwing any material up or down while on the tower
- Failure to maintain a 3-point contact with the tower
- Holding or attaching onto antenna lines, coax, conduits, etc., for support
- Climbing while under the influence of alcohol or drugs
- Climbing when ill or on medication that may negatively impact or impair good judgment or performance
- Working alone

30.6 Anchorages, Aerial, and Fixed-Climbing Devices

30.6.1 Anchorage

a. Anchors. Anchors must be welded (closed) (i.e., eyebolts, rigging points, slings, ropes, or other attachments designed into the structure).

b. Engineered Anchorages. Anchorages must meet the minimum requirements of an engineered system for each worker attached. An engineered system must be in compliance with the mandatory personal fall arrest system in 29 CFR-1910.66, appendix C, and must meet the following basic criteria:

- An anchorage of sufficient design to withstand a static load of 5,000 pounds or (22.2 kN) the maximum anticipated impact load times an Overload Capacity Factor (OCF) of at least 2.0 for each worker.
- An additional OCF multiplier of 0.2 for each additional worker attached to the anchorage.

Energy absorbing properties of the personal fall protection system, when incorporated into the anchorage design, will usually reduce the maximum forces imposed onto the anchorage.

c. Anchorage Considerations

1. Anchorage Loading. Additional static and dynamic loads must not be attached to the same anchorage point that is used for the personal fall arrest system.

2. Anchorage Approvals. The job supervisor, in concurrence with the qualified climber, must determine if the anchorage is to be used.

3. Inspection. Anchorages must be visually inspected at the time of attachment for loose or missing bolts, cracks, and bends. Damaged anchorages must not be used, and the tower must be red tagged as "Damaged. Do Not Climb!" All damages must be documented and reported immediately to the tower owner.

4. Shock Loading. Anchorages that have received a shock load must be immediately inspected for damage.

5. Reporting. Damage to anchorages must be reported to the supervisor and the program coordinator. The program coordinators must report all damages to the DOI SMIS.

30.7 Fall Protection Requirements for Elevated Work

30.7.1 General. This section defines the fall protection requirements for working at elevated levels (6 feet or higher) on communications towers and related structures. The design and type of structure determines the method of climbing, PPE to be used, and fall protection device required for climbing, transferring, resting, working, and rescuing.

30.7.2 Qualified Climber Classification

a. Certification. An employee may become certified as a "qualified climber" only after successfully completing Reclamation-sponsored or endorsed training courses, satisfying medical requirements, and demonstrating proficiency in climbing.

All qualified climbers must be trained in accordance with RSHS Subsection 30.10, "Training and Qualifications."

All qualified climbers must have passed a physical examination, per Department Manual 485, "Occupational Medicine Program Handbook," table 12 – Attachment D10, to ensure they are physically fit for the stresses of tower climbing and rescue.

All qualified climbers must provide documentation of required tower climbing training and climbing experience to the Program Coordinator.

b. Annual Review. A qualified climber's record must be reviewed annually for recertification in accordance with RSHS Subsection 30.11, "Recertification."

c. Non-Reclamation Employees. Non-Reclamation Government employees and contractors must also be qualified climbers in accordance with this section.

d. Government Furnished Equipment. Reclamation must provide Reclamation qualified climbers with OSHA-required equipment and PPE for the performance of their duties. Contractors are responsible for providing equipment and PPE to qualified contract climbers.

30.7.3 JHA. Prior to any tower climbing work, a JHA must be completed for each jobsite. The JHA must include a preclimb tower checklist and inspection report to accurately determine the overall tower condition, electrical or RF hazards, and what PPE is required.

a. Live Transmitters. Tower climbers must not service radio antenna systems connected to live radio transmitter equipment per 29 CFR 1910.147, "Control of Hazardous Energy (Lockout/Tagout)," as well as Facilities Instructions, Standards, and Techniques (FIST) 1.1, "Hazardous Energy Control Program." All other transmitters must be deactivated per 29 CFR 1910.97, "Nonionizing Radiation," and 29 CFR 1910.268, "Telecommunications," to prevent injuries to tower climbers while climbing in the vicinity of other antenna systems. If this is not feasible, ensure that transmitters are far enough away to not pose a RF hazard.

30.7.4 Personnel Requirements. During all climbing activities, at least two qualified climbers must be present on the jobsite. One of them must have been a qualified climber for at least 2 years, as well as a certified rescuer.

30.7.5 Attachment. Tower climbers must be attached to an anchorage point at all times when working or resting at elevated locations (6 feet and above). Moving, relocating, transitioning, and transferring activities performed on the tower require 100-percent attachment to an anchorage point.

30.7.6 Climber Fall Zone. Tower climbers must check for a safe "Climber Fall Zone" area on the tower when positioning themselves at the work position.

30.7.7 Personal RF Monitor. A personal RF monitor must be worn when climbing structures that may have active transmitters in the area.

30.7.8 Climbing Surfaces. Climbing and walking surfaces on equipment, ladder rungs, etc., will be furnished with nonskid surfaces where possible. Ladders with deteriorated nonskid surfaces must be removed from service until repaired. The walking surfaces must be kept free of clutter. Climbing and walking on cross arms (crossed tower members and diagonal bracing) in lieu of a ladder is prohibited. Climbing pathways must be clear of any obstructions.

30.7.9 Platforms. Prior to operation of the bucket or platform, workers must be attached to an engineered anchorage on the aerial device by a full body harness in conjunction with a shock absorbing or retractable lanyard. Snaphooks must be of the self-locking type. Working or standing on any rail of an aerial device must not be permitted (all work must be performed from the floor of the platform).

30.7.10 Transfer. Transfers between an aerial device and a structure are only permitted when there is no other way of completing the transfer. When transfers between a single or multiple occupancy aerial device and an aerial ladder, cable cart, or other equipment are required, they must be in accordance with the following procedure:

- Buckets and platforms must be positioned to remain stable during a transfer. The platform or bucket must have a fixed-pin or a locking mechanism to provide stability during transfer.

- The transfer must be made from the aerial device by a door, step, or secured ladder designed solely for the purpose of assisting the worker over the rim of the bucket or platform.

- Portable ladders must not extend beyond the rim of the bucket. Portable ladders must be removed from the bucket after the worker returns to the bucket. Platform guardrail systems must meet the design requirements specified in 29 CFR 1910.27, “Fixed Ladders.”

- The aerial device must be attended at all times when employees are transferring from or to the aerial device. The aerial device must be considered attended as long as a qualified operator remains at the controls, either in the bucket or at ground level. The climber and the operator must remain within voice and/or visual contact at all times when a climber is aloft. While a climber is working aloft and not transitioning to another area, the operator is allowed to work on other jobs at the site provided the operator is available when needed at the controls.

- A climber transitioning between an aerial device and a structure must be attached to the structure with both feet on the floor of the bucket or platform prior to making the transfer. The employee must not be connected to the aerial device while attaching to the structure. The unattached time must be kept to a minimum.

- There must be a second qualified climber present at the location when a transition is performed. At least one of the qualified climbers must have been a qualified climber for at least 2 years and a certified rescuer.

30.7.11 Communications Structure Requirements

a. Inspections. The Program Coordinator and RSM must ensure that all structures subject to climbing are formally inspected. This inspection must be completed by a competent person (i.e., tower technologist, professional engineer, safety engineer, licensed structural engineer, or an industry certified tower inspector). Structures inspections must consist of a detailed structural analysis per 29 CFR 1910.269, Appendix D, "Methods of Inspecting and Testing Wood Poles." This must include an inspection of fall protection system on all types of structures to ensure compliance with 29 CFR 1926, Subpart M, "Fall Protection." All communications structures owned by Reclamation must be inspected every 5 years. This formal inspection does not replace the mandatory inspection before each climb.

b. Towers

1. Fixed Ladders. When provided, fixed ladders must be used for ascending and descending communications structures, except where work assignments or conditions dictate otherwise. When safe climb devices are available and operational, they must be used to ascend and descend a communications structure.

2. Transfer. Transitioning to the work position must be accomplished while maintaining 100-percent attachment using a full body harness and lanyard or lifeline in conjunction with an energy absorbing or self-retracting lanyard or lifeline.

3. Climbing While Anchored. In situations where a safe climb device is not available or not operational, and climbing has been determined necessary, qualified climbers must be allowed to climb while maintaining 100-percent attachment to a suitable anchorage point.

4. Work Platforms. One-hundred percent attachment is not required while using approved work platforms that have guardrails and kickboards in accordance with 29 CFR 1910.23, "Guarding Floor and Wall Openings and Holes" and 1910.24, "Fixed Industrial Stairs."

5. Ladders. Portable straight or extension ladders must be placed at an angle that must not permit slippage (minimum standard is the 4:1 ratio) of the ladder base when climbing. Unsecured ladders must be supported by a ground worker until the climber has secured (tied) the ladder and transferred to the structure. (Reference 29 CFR 1910. 25, "Portable Wood Ladders," and/or 29 CFR 1910.26, "Portable Metal Ladders.")

c. Pole Structures. All Reclamation-owned pole communication structures that will be climbed must be equipped with a safe climb device. If a safe climb device is not available, then a personal fall arrest system must be used. When climbing on step bolts, fixed ladders, or moving between work or rest positions, climbers must maintain 100-percent attachment.

- Wood pole structures are not authorized for use as radio communications structures and must not be climbed. Where pole structures are still in use, an aerial device must be used to perform all work on the antenna system.

- Concrete, fiberglass, and steel poles meeting the TIA/EIA-222-F are acceptable.

d. Roofs and Miscellaneous Structures. Any telecommunications work performed by an employee positioned on a horizontal or vertical surface with an unprotected side or edge that is 4 feet or more above a lower level must be protected from falling by use of guardrail systems, safety net systems, or personal fall arrest system. Roofs are considered elevated working surfaces and require the employee to be tied off to an anchorage point that must withstand 5,000 pounds per person or the maximum anticipated impact load times an OCF of at least 2.0 for one worker. (Reference 29 CFR 1926, Subpart M.)

30.8 Non-ionizing Radiation

30.8.1 Radio Frequency Standards. Reclamation must ensure that employees performing work on communication towers are not exposed to RF electromagnetic fields in excess of the Federal Communications

Commission maximum permissible exposure limits as prescribed in 47 CFR 1.1310, "Radiofrequency Radiation Exposure Limits."

30.8.2 RF Exposures. Employees must not enter areas where RF exposure levels are above the general population/uncontrolled maximum permissible exposures described in 49 CFR 1.1310 without exercising controls as described throughout this section.

30.8.3 RF Control. Prior to employees performing work in areas on a communication tower where RF exposure levels exceed the occupational/controlled maximum permissible exposure values stated in 47 CFR 1.1310, Reclamation must enact and enforce written control procedures that provide for the reduction, elimination, avoidance, or protection from such RF levels. These written control procedures must include the following:

a. Minimizing the Exposure. Reducing the transmitter power to a level that ensures RF exposure levels in areas where employees are working do not exceed the occupational/controlled values stated in 47 CFR 1.1310, and that the transmitter power level is not increased until all employees have ceased working in those areas. If this method is chosen, the transmitter power must be locked out and tagged out at the reduced level by a competent person in accordance with 29 CFR 1910.147 and FIST 1-1. Prior to remove lock out/tag out devices and restoring the original transmitter power level, all employees must be notified and the work area must be checked to ensure that all employees have been safely positioned and removed

b. Lock Out of Hazard. If the transmitter power level in areas where employees are working cannot be reduced and maintained at a level that ensures RF exposure levels do not exceed values stated in 47 CFR 1.1310, the transmitter power must be locked out and tagged out by a competent person in accordance with 29 CFR 1910.147 and FIST 1-1. Prior to removing lock out/tag out devices and restoring the transmitter power level, all employees must be notified and the work area must be checked to ensure that all employees have been safely positioned and removed

c. Engineering and Administrative Controls. If the transmitter power level cannot be reduced or eliminated, employees must be permitted to access areas where the values stated in 47 CFR 1.1310 are exceeded if it implements engineering or administrative controls that comply with the Federal Communications Commission's regulations concerning such exposure, including limiting the duration of the exposure and utilizing monitoring equipment, RF protective clothing, and other related PPE.

d. Prohibit Access. If Reclamation cannot ensure that the conditions in RSHS subsections 30.8.3.a, 30.8.3.b, or 30.8.c are met, employees must not be permitted to access areas where RF exposure levels exceed the values stated in 47 CFR 1.1310.

30.8.4 Use of Controls. Prior to commencing work on a communication tower, a competent person must assess potential RF hazards of areas that may be accessed by employees in the course of their work, and post temporary signage to indicate areas where the RF hazard exceeds the general population/uncontrolled maximum permissible exposure limits for exposure set forth in 47 CFR 1.1310. Temporary signage must remain in place while work is performed and the hazard exists.

30.8.5 RF Safety Program. When employees are exposed to RF fields in excess of the general population/uncontrolled maximum permissible exposure limits established in 47 CFR 1.1310 as a consequence of their employment, the employer must develop, implement, and maintain a written safety and health program with site-specific procedures and elements based on the electromagnetic radiation hazards present.

30.9 Preclimb and Rescue Procedures

30.9.1 JHA. An initial JHA must be completed on each structure. The JHA must be reviewed and updated by the work crew and signed by the onsite job supervisor prior to each structure climbing job assignment. If a JHA does not exist, one must be completed prior to work commencing. Written approval of the JHA must be given by the job supervisor prior to climbing a structure in coordination with the RSM. A vital portion of the JHA pertains to rescue procedures and equipment to be used in the event of an injury. This procedure must be documented on the JHA for that structure.

30.9.2 Rescue Procedure. The rescue procedure must provide prompt rescue of employees or a means of self-rescue (e.g., providing controlled descent device, radio, etc.). A site safety briefing must be held at the beginning of each day, job, or change in work procedure to review the potential hazards involved in the work to be performed and potential rescue methods available. These discussions must help to ensure the availability of proper rescue equipment and facilitate quick rescue of the worker. Prior to job commencement, notify local emergency response regarding location of tower and activities to be completed in the event that emergency response is needed.

30.9.3 Rescue Training. Rescue of fall victims must be included in all training and job planning. Aerial devices, cranes, handlines (lifelines), or other device capable of lifting the climber must be readily available.

30.9.4 Inspection and Maintenance. Manufacturer's recommendations and Reclamation requirements must be followed for the inspection, use, and maintenance of all PPE and safety equipment.

30.9.5 PPE. Only PPE certified by the manufacturer to meet all OSHA standards and regulations is authorized for use. No personally owned, homemade, or agency-built equipment is authorized.

30.9.6 Safety and Health Precautions. Employees must not be assigned to work in hazardous areas/activities, except in pairs, and always with established communications.

30.9.7 Climbing Plan. Maintain a record containing the itinerary, name of employees, work area, estimated time of return, and miscellaneous information such as other crew members, etc. In the event that employees do not return or contact the office at the prearranged time, search and rescue procedures must be initiated. This must be the procedure for all tower climbers and telecommunications technicians.

30.9.8 Nonionizing Radiation. Per 29 CFR 1910.97, “Nonionizing Radiation,” climbers must not be permitted to work on antenna systems connected to live radio transmitters, nor be exposed to hazardous levels of electromagnetic radiation (RF energy). Maintenance procedures require notification and coordination with the affected radio system dispatchers. Coordination with dispatchers must include an estimated time for radio system reactivation on the structure being serviced. When it is necessary to accomplish work near active transmitters, a personal RF monitor must be worn to identify any hazardous levels of electromagnetic radiation.

30.9.9 First Aid Training. All employees whose work assignment in the field places them beyond reasonable access to a medical facility in terms of time and distance (approximately 15 minutes and/or 10 miles) must be adequately trained to render first aid. All climbers must have a current certificate in first aid and cardiopulmonary resuscitation (CPR) before accepting field assignments.

30.9.10 Physical Condition. A climber who is ill and/or on medication that may inhibit actions or cause overstimulation, dizziness, drowsiness, etc., must not climb. Any observed adverse physical conditions of any team member must be reported to the onsite job supervisor. Any climber that exhibits an adverse physical condition that prevents them from functioning as a climber must not function as a ground safety person. This adverse physical condition must prevent them from performing a rescue.

30.9.11 Work Near Power Lines. Reclamation climbers who must work 20 feet or closer to electrical power lines or service drop must inform the local utility company. They must request the utility company to deenergize, move, cover, or barricade the exposed energized source. Additionally, employees who perform tower climbing activities near power lines or other energized areas must complete electrical safety training as required.

30.10 Training and Qualifications

30.10.1 Climber Qualification. The training and qualification of employees for tower climbing consist of completing a 40-hour "Tower Climber and Rescue Competent Person" course (Gravitec course or equivalent; the RPC must determine if equivalent course meets the training and qualification requirements for this section). Employees must be trained in accordance with this section before they are designated as qualified climbers.

30.10.2 Testing. Climbers must be tested for knowledge and understanding of Reclamation's tower climbing policy and competency with the tower climbing program. In addition, each student must be provided with a copy of this section.

30.10.3 Training. Climbers must be trained in the principles of:

- Fall protection
- Use and care of a full body harness
- Safety climbing devices
- Tower climbing
- Transferring between equipment and structures
- Rescue techniques

In addition, climbers must be trained to recognize emergencies and know how to select and use the appropriate rescue equipment, as well as the proper technique for the situation.

a. Additional Training Content. Workers must be trained in the selection and use of PPE, fall protection and rescue equipment and their application limits, proper anchoring, tie-off techniques, proper rigging practices, determination of elongation and deceleration distance, methods of use, and inspection and storage of the system. Training must also include methods to identify energized power lines, apparatus, other auxiliary equipment on the tower. In addition, works must be knowledgeable of the rules applicable to work on and around the structure near energized power lines. Workers must become familiar with the manufacturer's recommendations, reduction in strength caused by certain tie-offs, and the maximum allowed free fall distance and total fall distance.

b. Subject Mastery. Due to the variety of required climbing techniques and associated hazards in tower work, it is essential that each respective climber receive sufficient training to master the required skills. The worker must possess the basic physical fitness required to perform the work. The worker must demonstrate, to a trainer, proficiency in climbing functions and must understand the hazards associated with each function.

c. Presentation of Training. Climbing instruction must be given in a way that equips the worker to recognize and avoid dangerous conditions, while at the same time mastering the rigors of climbing, resting, and positioning for work on various structures.

d. Equipment Proficiency. Climbers must be able to demonstrate proficiency with use and maintenance of each piece of equipment used in tower climbing activities. While climbing or working aloft, workers must be aware of how the equipment and materials they use can potentially affect safety margins.

e. Classroom and Field Training. Required training must include both classroom instruction and actual field demonstration of the topics discussed in the classroom. An industry qualified instructor must conduct all classroom instruction, field demonstration, and testing for Reclamation-sponsored courses.

f. Course Approval. Tower and fall protection courses must be approved by the RPC and performed under the supervision of a Reclamation qualified climber or Reclamation approved training facilitator.

30.10.4 First Aid and CPR Certification. Qualified climbers must have a current first aid and CPR certificate. This certificate must be obtained prior to any Reclamation-sponsored training. Reclamation must provide annual first aid and CPR training to meet this qualification.

30.10.5 Medical Qualification. Prior to attending training, climbers must pass the medical standards examination outlined and described in DM 485, table 12, Attachment D 10 of the Departmental Occupational Medicine Program Handbook. This examination describes the physical requirements needed to fulfill the qualified climber classification. The completed examination must be retained in the employee's official medical folder.

30.10.6 Documentation. Documentation must consist of a certificate indicating that the individual has successfully completed the course of instruction and has the skills required to be proficient in the tower climbing program requirements in this section. Demonstrated proficiency must be included in the documentation. The documentation must be retained in DOI Learn, and a courtesy copy must be forwarded to the Program Coordinator. Training records must be maintained for the duration of the worker's employment.

30.11 Recertification

30.11.1 Recertification. A qualified climber must maintain proficiency in climbing by demonstration and must receive periodic training as new first aid/CPR, safety equipment, climbing procedures and techniques, etc., are continuously developed. The recertification involves an annual review, by the Program Coordinator, of the climber's record to determine when a climb was last performed, when the climber had last attended a Reclamation-approved tower climbing class, when the last medical qualification was completed, and when the last first aid/CPR class was attended.

30.11.2 Proficiency Qualification. If the qualified climber has climbed at least twice in the past year, has a current medical qualification, per DM 485 and the Departmental Occupational Medicine Program Handbook, and has been to a Reclamation-sponsored tower climbing course within the past

3 years, the climber may be recertified by having the RPC make an entry into the worker's climbing record verifying that the climber is eligible for recertification.

30.11.3 Lack of Proficiency. Those qualified climbers that have not climbed at least twice in the past year, have not met the current medical qualification, have not attended a Reclamation-sponsored training course in the past 3 years, or do not have a current CPR/first aid certificate are not qualified to climb until the deficiencies are corrected.

a. Medical Exemption. If a climber does not meet the medical qualification, but does meet all other requirements, he or she can be recertified after completing a medical examination by a medical officer and an entry is made in their climbing record.

b. Practice Deficiency. If a climber has not made the required number of climbs in the past year or has not attended an approved Reclamation climbing course in the past 3 years, the climber must attend an approved Reclamation climbing course in order to be recertified, and an entry must be made in their climbing record.

30.11.4 Recordkeeping. All climbing training certificates and recertification statements pertaining to a climber must be maintained for the duration of the worker's employment. The records must be kept in DOI Learn,[1] along with a courtesy copy sent to the RPC

30.12 Recordkeeping

Upon request, the employer must give the Deputy Commissioner of Labor for Occupational Safety and Health (or designee) access to the following:

- **Training Records.** All material related to the employer's training and education record
- **Medical Records and Non-ionizing Radiation Exposure Records.** All medical records (in accordance with 29 CFR 1910.1020(d)(1)(i)) and material related to each analysis using exposure or medical records (in accordance with 29 CFR 1910.1020(d)(1)(iii))

[1] DOI Learn is DOI's training Web site: https://gm2.geolearning.com/geonext/doi/login.geo.

- **Equipment Inspections and Testing Records.** All material related to the modification, repair, test, calibration, or maintenance service of all equipment.

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Appendix A

Job Hazard Analysis

Job Hazard Analysis #___		
Project:	Job:	Location:
Job description:		
Analysis by: Date:	Reviewed by: Date:	Participants:
Points of contact : Phone number:	Requirements, including training, certifications, aurhorizations, permits, and licenses:	
Equipment:	Applicable regulatory considerations:	
Sequence of Steps	**Potential Accidents or Hazards**	**Preventive Measures** (including personal protective quipment)
1. 2. 3.	1. 2. 3.	1. 2. 3.

Tasks with Potential Exposure to Hazardous Materials, Physical Agents, or Hazardous Conditions			
Analysis by: Date:	Reviewed by: Date:	Points of contact:	
Tasks	**Name of Material or Physical Agent**	**Location**	**Control**
1. 2. 3.	1. 2. 3.	1. 2. 3.	1. 2. 3.

Job Inventory of Hazardous Chemicals		
Analysis by: Date:	Reviewed by: Date:	Points of contact:
Name of chemical	Route of entry and physical state	Controls
1. 2. 3.	1. 2. 3.	1. 2. 3.

Appendix B

Contractor Safety Program

Unless waived by the Contracting Officer's Representative (COR), prime and supplementary safety program submittals must, as a minimum, address all appropriate contractual requirements shown under the program outline. Program items will be so detailed that reviewers can ascertain adequacy. The original program submittal can cover all work phases, or only address the initial work phase with timely supplementary submittals as major work phases occur. Contractors desiring to follow this latter course of action will, in the initial submission, clearly define the original work covered and the work phases to be covered by supplements.

In no case will any phase of work commence until a program for that portion of the work has been accepted by the COR. Original and supplemental submissions covering hazardous operations and/or activities will include a standing operating procedure (SOP) and hazard analysis. The SOP will break down the operation or activity into specific basic steps. The hazard analysis will define the hazards associated with each basic step and proposed method(s) for eliminating or minimizing the hazard. Such methods will outline, as a minimum, employee training requirements, personal protective equipment requirements, procedural changes, methods for evaluating program effectiveness, etc.

All activities involving use of hazardous and/or toxic materials, work in confined spaces, work at heights over 6 feet, or underwater require an SOP and hazard analysis. Material Safety Data Sheets will be attached to all SOPs governing work that involves use of hazardous or toxic materials.

Program Outline

I. General Requirements

A. Statement of Policy
B. Statement of Safety and Health Responsibilities
C. Statement of Compliance with Regulations, Standards, and Codes
D. Statement of Subcontractor Compliance
E. Safety Inspection Procedures
F. Accident Investigation and Reporting Procedures
G. Applicable Emergency Plans
H. Confined Space Procedures
I. Lockout/Tagout Procedures
J. Fire Protection Plans
   1. Type and location of suppression equipment or systems
   2. Offsite assistance agreement
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II. Medical

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B. Training
C. Certifications
D. Physician
E. Ambulance (Name, location, and telephone number)
F. Physical Qualification of Employees
G. Records

III. Communications

A. Employee Training
B. Safety Meetings
C. Onsite Training
D. Supervisor Training

IV. Occupational Health

A. Procedures and Equipment to Minimize Hazards
B. Testing program for employees and work environments
C. Qualified personnel
D. Personal protective equipment
E. Ventilation plans

V. Machinery and Mechanical Equipment

A. Procedures and Equipment to Minimize Hazards
   1. Testing program for employees and work environments
   2. Mobile and stationary equipment
B. Inspection Procedures
C. Maintenance Procedures
D. Operating Personnel
E. Protective Safety Devices and Certifications
F. Elevators and Aerial Lifts

VI. Excavation and Demolition

A. Tunnels and Shafts
   1. Internal combustion engines
   2. Ventilation plans
   3. Transportation systems and equipment
   4. Work environment testing
   5. Ground support
B. Blasting
   1. Blaster certification
   2. Written procedures
   3. Storage
   4. Transportation

C. Excavations Other Than Tunnels and Shafts
    1. Slide protections
    2. Support systems
    3. Inspections
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D. High Scaling
    1. Definition
    2. Personal protective equipment
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    1. Haul roads
    2. Equipment and Procedures

VII. Working Surfaces

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    2. Platforms, stairways, and ramps
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C. Scaffolding
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VIII. Protection of the Public

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B. Flagging Procedures
C. Jurisdictional Approvals

IX. Marine and Diving Operations

Detailed Plan and Written Procedures

X. Electrical Facilities

Substations

This outline provides guidance in preparing a safety program and does not cover all material that may be necessary. The contractor must review specifications and all safety and health regulations to ensure a comprehensive plan.

XI. Required Safety Program Coordination

1. Confined Space Program
2. Electrical and Lockout/Tagout Program

Appendix C

Electrical Grounding

Low-Voltage Equipment Grounding

The most frequently cited Office of Safety and Health Administration (OSHA) electrical violation is improper occupational grounding of equipment or circuits (Source: National Institute of Safety and Health [NIOSH] publication 98-131).

Equipment Grounding

Equipment grounding must comply with the National Electric Code (NEC) Article 250. All noncurrent-carrying metal enclosures for electrical equipment or wiring must be grounded. Equipment grounding means a continuous copper conductor connected between the grounding electrode (rod/grid) connection, at the source transformer, and at each enclosure and equipment frame. This is the most critical concept in equipment grounding.

Figure C-1 (right) shows an outdoor three-phase supply for a building remote from the powerplant and the building service disconnect.

Note in figure C-1, between the transformers and the service disconnect, the grounded conductor (neutral) and the equipment

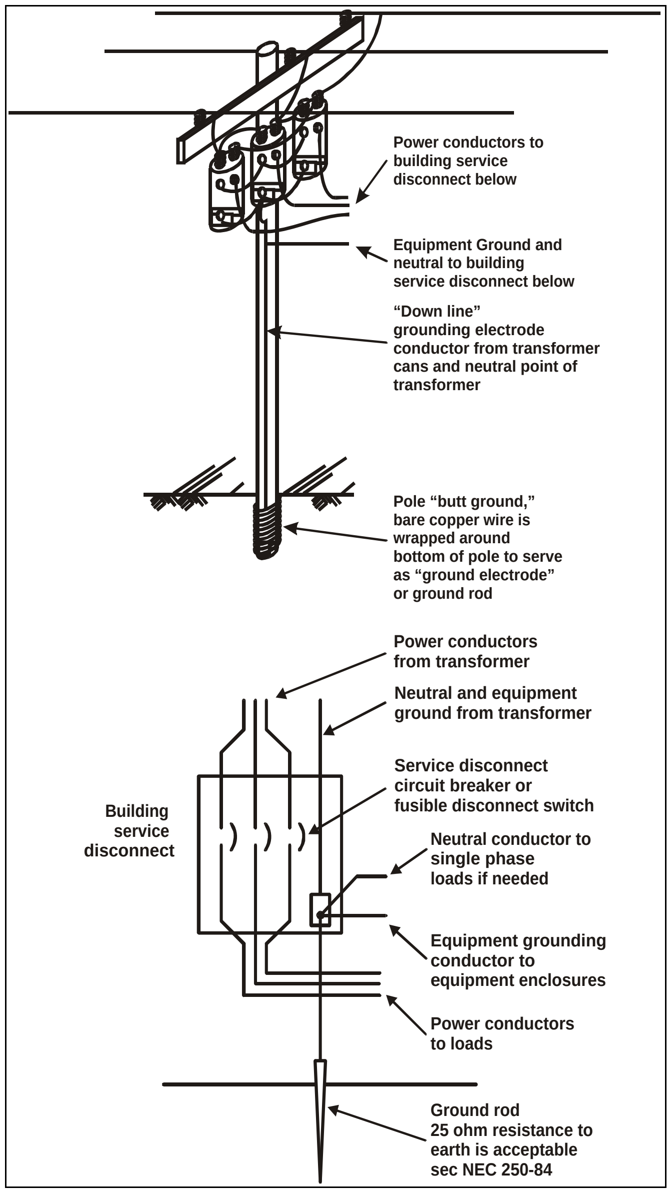

Figure C-1.

grounding conductor is the same conductor. This is permitted only on the line side of the service disconnect. On the load side of the service disconnect, the neutral cannot be used as the equipment grounding conductor. Even though the neutral may be needed for single-phase loads. There must be an equipment grounding conductor, run from the service disconnect ground connection to each enclosure and equipment frame (see NEC 250-23).

The Earth Shall Not Be Used as the Sole Equipment Grounding Conductor

There must be an electrically continuous (unbroken) conductor, installed between each electrical enclosure and the grounding electrode conductor (rod/grid/bed) at the source transformer (see NEC 250-51).

As shown in figure C-2, connections-to-earth (ground rods) and the earth have a resistance too high to be an effective equipment grounding conductor.

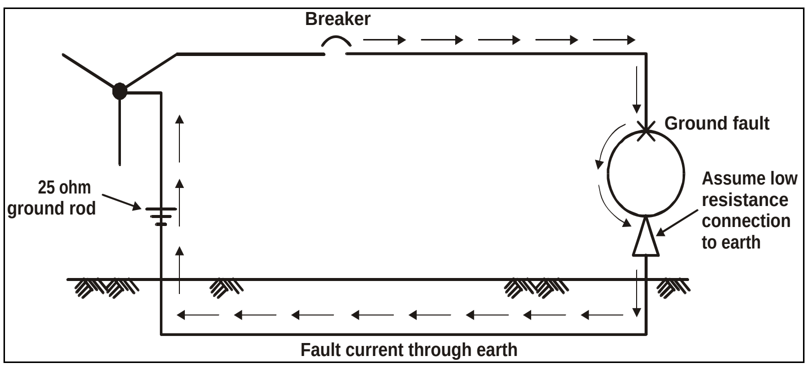

Figure C-2.

The most common misconception is that fault current is trying to “get to ground.” The correct concept is that fault current uses the earth as a conductor to complete the circuit back to the source transformer. The problem is that the earth, and connections to earth, are not good conductors.

A Grounding Electrode or Ground Rod Is Not for the Purpose of Clearing Ground Faults in Low-Voltage Circuits

A ground electrode or ground rod is intended to dissipate static, switching surges, and lightning. A ground rod and earth present a resistance too high for low-voltage breakers and fuses to open quickly. There must be a low-impedance equipment grounding conductor between each electrical enclosure and the source transformer grounding electrode.

During a ground fault, enough current must flow to open a breaker or fuse quickly to prevent shock, electrocution, or equipment damage. Even a few ohms in the grounding circuit will prevent, or greatly slow, the opening of a breaker or fuse.

If there is a ground fault and the circuit is not cleared, electrical enclosures, motor frames, and other conductive structures such as handrails and walkways can become energized. A person touching any of these may be shocked fatally or electrocuted.

For example, if you do not have an equipment grounding conductor, but you do have a good ground rod (NEC 250-84 indicates that a good ground rod is 25 ohms), Ohms law (I = V/R) gives the current flow. On a 480/277-volt system, voltage to ground is 277 volts. Therefore, the ground fault current would only be: I = 277/25 or 11 amps. This would not trip even a 15-amp breaker. In a 120-volt circuit, only 10 ohms in the equipment grounding circuit will make a 15-amp breaker fail to trip (I = 120/10 = 12 amps). This is not very much resistance; a rusty bolt can easily add this to a grounding circuit. As mentioned above, a shock or electrocution is the likely result. This illustrates why a low impedance equipment grounding conductor is so important.

Equipment grounding conductors must be run with the circuit conductors (see NEC 250-57b). This reduces impedance in the circuit facilitating opening the breaker or fuse.

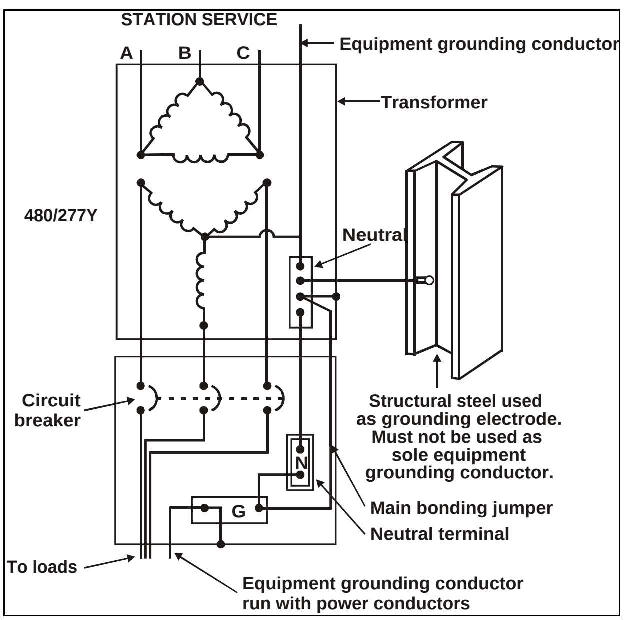

Figure C-3.

Building Steel Is Not Permitted to be Used as the Required Equipment Grounding Conductor (See NEC 250-58)

At right is a 3-phase transformer set-up inside a plant. Due to high impedance, rust and poor electrical connections where steel beams intersect. Building steel may be used as the grounding electrode (ground rod), but never as the equipment grounding conductor. A copper equipment grounding conductor must be installed to each enclosure and load.

Reclamation Does Not Permit Conduit, Cable Tray, Electrical Metallic Tubing (EMT), Liquidtite Conduit, Flexible Conduit (Flex), or Any Other Conductive Raceways as Equipment Grounding Conductors

Time, rust, moisture, vibration, and temperature changes all reduce integrity of the numerous electrical connections along the length of these enclosures. This increases resistance and prevents clearing the circuit in event of a ground fault. Therefore, Reclamation requires a copper grounding conductor be run with the power conductors from the source transformer grounding electrode connection to all enclosures and equipment frames, such as motor starters, motors, junction boxes, breaker panels, control panels, heaters, light fixtures, etc. Portable hand lamps with metal guards must also be grounded (see NEC 410-42b).

Ground Fault Circuit Interrupters (GFCI), for 125-Volt, 15- and 20-Amp Receptacles Are Required in All Damp and Wet (Conductive) Locations and Any Other Location Where Conductive Material Is Nearby

Any location is considered a damp/wet/conductive location if floors/walls are concrete, cinder block, or tile (see NEC 110-16(a)0. Outside locations require GFCI protection. Bathrooms, kitchens, shops and most other locations at Reclamation facilities are conductive locations and require GFCIs (see NEC Article 210, 1999 edition). If the standing surface is conductive material, or if grounded conductive material is within reach of a tool/appliance after it is plugged into a receptacle, the circuit must be GFCI protected. GFCI s must be tested each month or before each use by pressing the test button. Do not use a GFCI tester, as many of the designs are incorrect for proper testing.

Caution When Using Portable and Vehicle Mounted Generators

Reclamation requires GFCIs on all 120-volt receptacles mounted on any generator or vehicle frame. Most portable/vehicle-mounted generators have regular 120-volt receptacles without GFCIs. The neutrals are seldom grounded by the factory. See FIST 5-3 for the proper method to ground the neutrals and replace regular 120-volt receptacles with GFCIs on these generators. This work must be done by qualified electricians.

Portable and Vehicle (Trailer or Truck) Mounted Generators Do Not Require Ground Rods

If the aforementioned generators power only loads on the vehicle (such as lights), or if they power only cord and plug connected equipment from receptacles on the generator or vehicle, then they do not require grounds (see NEC 250-6). All neutrals on120/24-volt generators must be grounded (FIST 5-3), and ground pins of the 125-volt receptacles (GFCIs) must be bonded to the generator frame (not the vehicle frame).

Do Not Use Electrical Enclosures and Other Steel Structures as Equipment Grounding Conductors

For example, in the paragraph above, if the ground pins were bonded to a trailer frame, fault current would have to travel from the grounding pin to the steel frame of the trailer, along the steel trailer frame, to the generator frame, then to the generator winding. A rusty bolt or weld can add enough resistance to prevent opening a circuit breaker or fuse.

Electrical Enclosure

Inside an electrical enclosure, all grounding conductors must terminate on the same grounding connection. If there is more than one termination point for grounding conductors, a copper jumper must be installed between these two points, so the total grounding circuit will be copper. If this is not done, fault current must use the steel of the box and connections to the steel box as part of the equipment grounding conductor. Steel rusts and is not as good a conductor as copper; in addition, vibration and temperature changes loosen threaded connections. This adds resistance to the equipment grounding path and can easily prevent opening the breaker or fuse. Enclosures, walkways, and other conductive structures become energized. A shock or electrocution is the likely result.

Tools and Appliances

NEC 250-114 requires all cord and plug connected tools and appliances to be grounded. There are three exceptions that apply to powerplant usage:

1. Double insulated tools and appliances do not need to be grounded. Tools and appliances must be "listed." This means it must carry an Underwriters Laboratory (UL) or other testing laboratory label. In addition, it must be clearly marked "Double Insulated." It is recommended that Reclamation use "double insulated" tools and appliances whenever possible. Independent testing laboratories have proven, through testing, that double insulated tools are "no less safe" or even more safe than grounded tools.

2. Tools and portable hand lamps are not required to be grounded if they are supplied through an isolating transformer with an ungrounded secondary of not over 50 volts.

3. Toasters that may be in lunch rooms must not be grounded. Toasters do not appear in article 250 of the NEC; however, it has been addressed and tested by UL and has been found safer to remain ungrounded. UL testing and experience has shown that one will insert a knife or fork into the slots to remove stuck toast. Heating elements can easily be touched with a knife or fork while it is against the case, causing arcs, sparks, and perhaps a shock if the toaster is grounded. Therefore, toasters are to remain as they come from the manufacturer (that is, ungrounded).

Portable Cords/Extension Cords

All extension cords used at Reclamation facilities must be the grounding type. Never use an extension cord that has a missing ground pin, a damaged jacket, or a jacket that is pulled away from an end cord connector. All cords must be U.L. listed and be rated for "hard usage" or "extra hard usage." See NEC Table 400-4 for cord types and permitted usage. All cords used in Reclamation powerplants or construction sites must be rated for damp locations and/or outdoor use. The NEC article ratings show "damp locations." UL and some manufacturers rate some cords for "outdoor use." Either of these are acceptable for general use around Reclamation powerplants or construction sites. Cords that must be underwater must be rated "submersible." Some "outdoor-use" rated cords are also rated for submersible use; however, the specific manufacturer must be contacted to determine this use.

Caution: Standard SO cord with "jute" or paper filler is not suitable for use in wet or submersible locations. Jute and paper are natural fibers and will act as a wick, pulling water along the inside of the cord to electrical connections if the cord is nicked and is in a wet location.

Depending on the application, the following cord types and markings are permitted for portable cords or cables at Reclamation facilities. Others are also permitted if the applications meet NEC article 400 requirements. See NEC article 400 for ampacities and acceptable cord uses. See NEC 400-8 for uses not permitted.

"Water Resistant" indicates the cord is suitable for immersion in water; however, it may not be suitable for extended use outdoors, as it is not sunlight (UV) resistant. "W" indicates suitability for use outdoors and for immersion in water. "Outdoor" or "W-A" indicates suitability for use outdoors but not for submersion in water.

Some manufacturers make "Water Resistant," "Outdoor," "W-A," and type "W" as all the same cord but marked with only one of the above designations. Check with the supplier or manufacturer if there is a question of proper application of a cord or cable.

Do not run over portable cords or cables with pickup trucks, fork trucks or other vehicles. The internal conductors can be crushed together and cause ground faults and line-to-neutral faults. This is impossible to detect by looking at the outer cord jacket. When it is plugged into a receptacle for use with a tool, the tool case can become energized, causing a shock or electrocution. If a cord cannot be unplugged, build a protective bridge for the cord out of boards or other material.

Ground Fault Protection While Using Temporary Power

This applies to Reclamation and contractor activities involving temporary wiring used to supply power for equipment or tools during construction, maintenance, repair, remodeling, or similar activities (see NEC 305-6).

Ground fault protection for personnel shall be provided for all temporary wiring installations to comply with the paragraph below.

Ground Fault Circuit Interrupters

All 125-volt, single-phase, 15- and 20-amp receptacles that are not a part of the permanent wiring of a building or structure, and that are in use by personnel shall have GFCI protection. Cord sets that have built in GFCIs are permitted. This applies to all extension cords and portable generators (see the above sections where these items are covered).

125-volt, single-phase, 15- and 20-amp receptacles that are a part of the permanent wiring of a building or structure require GFCIs in all conductive areas.

Appendix D

Wire Rope

1.0 General

Data included in this appendix and the section on "Slings, Chains, and Accessories" include general information and specific requirements about the design and construction characteristics of commonly used wire rope and accessories.

1.1 General. Wire rope design and construction characteristics shown in this appendix are for reference only. Manufacturer's specification data may differ from these and must be used in determining safe working loads and proper application.

1.2 Materials. Wire rope may be manufactured from many grades and types of steel and alloys. They may be constructed from nonferrous materials or coated wires. Some of the more common grades with the differing designations are as follows:

a. Improved plow steel—monitor steel—purple grade—Level 3 steel[1]

b. Extra improved plow steel—monitor AA grade—purple plus—Level 4 steel[1, 2]

1.3 Terminology. Cross section AA.
General view.

1.3.1 Wire Rope. Figure D-1 shows the general terminology, structure, and cross-sectional views of wire rope.

1.3.2 Cores for Wire Rope. The core is the central member about which the main strands are laid. The principal function of the core is to provide a bearing for the strand. This foundation maintains the proper lateral position of the strands and permits their relative longitudinal motion in adjusting the distribution of stress. Figure D-2 shows the three common types of cores used in wire rope.

1.3.3 Wire Rope Lays. The lay direction of a wire rope is the direction in which the strands rotate around the rope, as seen receding from the observer and viewed from above. The lay direction of outer wires of a single strand is determined in the same manner. Figure D-3 shows the various lay combinations.

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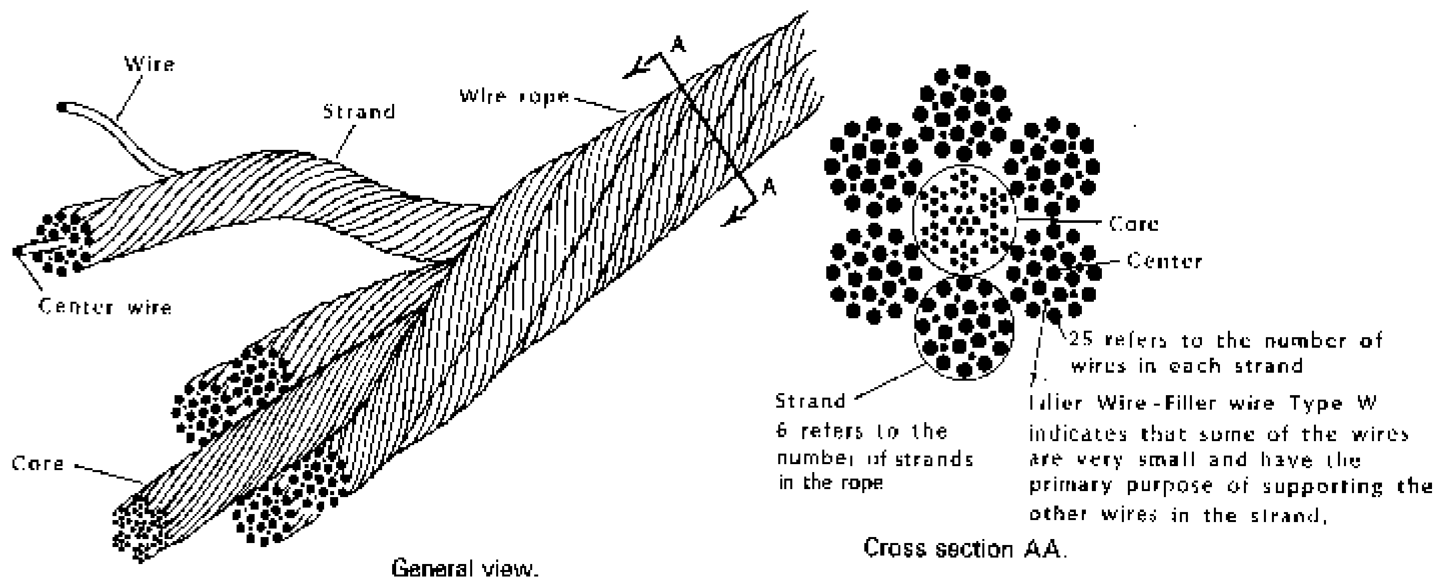
[1] These two major grade classifications and corresponding rope breaking strengths may vary with different manufacturer's and date of manufacturing.

[2] Application of these high strengths should be under the direction of manufacturer or a professional engineer.



General and cross sectional views showing general structure and terminology of wire ropes. Wire rope shown is a class 6×19, of the 6×25 filler wire type W construction. The rope is made up of six 25-wire strands. The strands are each laid 12-6-6-1; that is 12 outer wires, six filler wires, six inner wires, one center wire.

Figure D-1.—General terminology, structure, and cross-sectional views of wire rope.

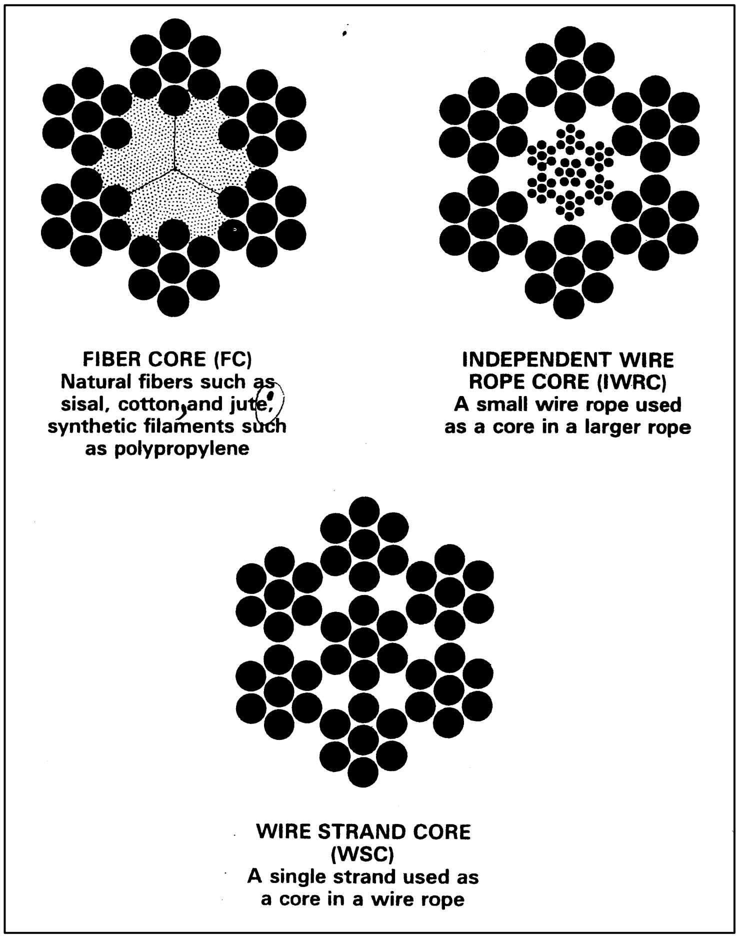


Figure D-2.—Three common types of cores used in wire rope.

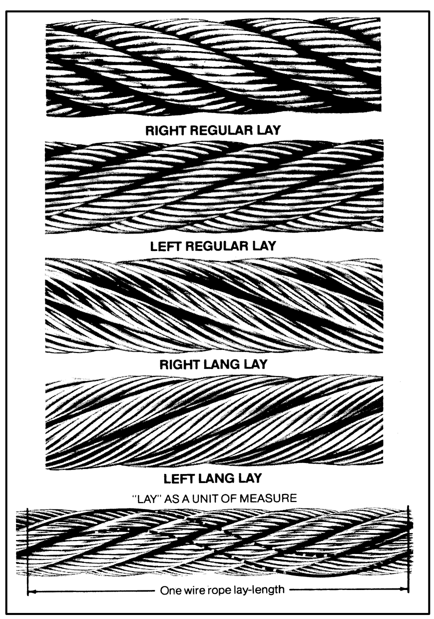


Figure D-3.—Various combinations of wire rope lays.

The lay as a unit of measure is the length a single strand extends in making one complete turn around the rope. Lay length is measured in a straight line parallel to the centerline of the rope; not by following the path of the strand.

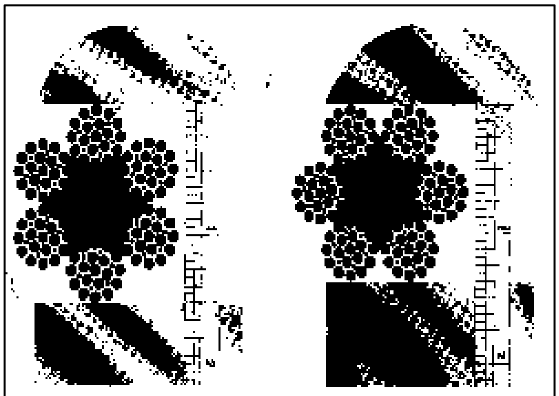


Figure D-4.—Right and wrong way to measure rope diameter.

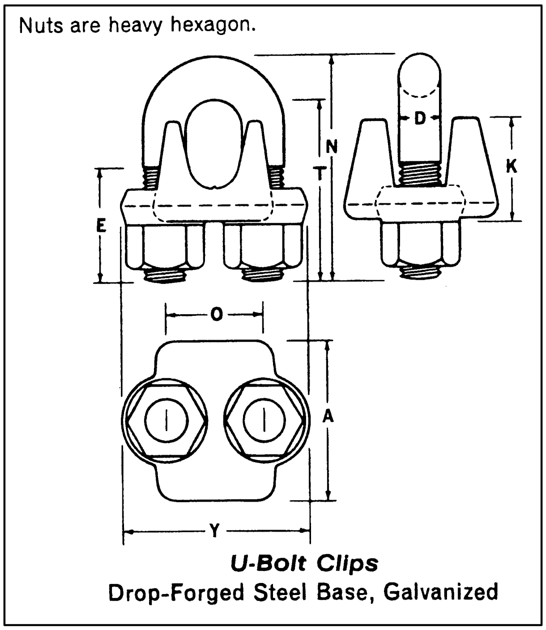


Figure D-5.—U-bolt clip construction details.

1.3.4 Rope Diameter. Figure D-4 shows the right and wrong way to measure rope diameter.

1.3.5 Rope Class. Wire rope is designed by class: 6x7 (6 strands, 7 wires); 6x19 (6 strands, 19 main wires per strand); 6x37 (6 strands, nominally 37 wires per strand). When "nominally" is used, the number of wires per strand may vary significantly (i.e., 6x19 nominal may have from 9 to 26 wires per strand).

2.0 Wire Rope End Connectors (fittings, end attachments, terminals)

2.1 General. Choosing proper end connectors (fittings) to be used with wire rope is second in importance only to selecting the rope itself. Connectors are subjected to the same loads as the wire rope used and must be properly designed and built to withstand the stresses imposed on them.

2.2 Wire Rope Clip Connectors. Wire rope clip connectors may use the U-bolt type or the twin base clip ("First" grip, double saddle) type. Use only new clips in making wire rope clip connectors.

2.2.1 U-bolt Type Clip. U-bolt clips shall be constructed of drop-forged steel bases protected by an application of a galvanized zinc coating (see figure D-5). Approximate dimensions and construction details are shown in table D-1.

Table D-1.—Dimensions for U-bolt clips

Rope diameter (inches)	Dimensions (inches)								Approximate weight (pounds)
	A	D	E	K	N	O	T	Y	
1/8	13/16	7/32	7/16	25/64	15/16	16/32	23/32	16/16	.05
3/16	15/16	1/4	8/16	1/2	1-7/32	19/32	31/32	1-5/32	.08
1/4	1-3/16	5/18	5/8	21/32	1-11/32	3/4	1-1/32	1-7/16	.17
5/16	1-5/16	3/8	3/4	23/32	1-11/16	7/8	1-5/16	1-11/16	.30
3/8	1-5/8	7/16	13/16	28/32	1-15/16	1	1-1/2	1-15/16	.41
7/16	1-13/16	1/2	1-1/16	1-1/84	2-3/8	1-3/16	1-7/8	2-8/32	.65
1/2	1-29/32	1/2	1-1/16	1-1/8	2-3/8	1-3/16	1-7/8	2-9/32	.75
9/16	2-1/16	9/16	1-7/16	1-7/32	2-13/16	1-5/16	2-1/4	2-31/64	1.00
5/8	2-1/16	9/16	1-7/16	1-11/32	2-13/16	1-5/16	2-1/4	2-1/2	1.00
3/4	2-1/4	5/8	1-9/16	1-25/84	3-3/8	1-1/2	2-3/4	2-27/32	1.40
7/8	2-11/16	3/4	1-13/16	1-5/8	3-7/8	1-3/4	3-1/8	3-11/32	2.40
1	2-5/8	3/4	2-1/8	1-49/84	4-1/4	1-7/8	3-1/2	3-15/32	2.50
1-1/8	2-13/16	3/4	2-1/4	1-28/32	4-5/8	2	3-7/8	3-18/32	3.00
1-1/4	3-1/8	7/8	2-1/2	2-11/64	5-1/8	2-5/16	4-1/4	4-1/8	4.50
1-3/8	3-1/8	7/8	2-11/16	2-5/16	5-1/2	2-3/8	4-5/8	4-3/16	5.20
1-1/2	3-17/32	7/8	2-13/16	2-23/32	5-13/16	2-19/32	4-15/16	4-5/16	5.90
1-5/8	3-5/8	1	2-7/8	2-21/32	6-5/16	2-3/4	5-5/16	4-3/4	7.30
1-3/4	3-13/16	1-1/8	3-3/16	2-58/64	6-7/8	3-1/16	5-3/4	5-9/32	9.80
2	4-7/16	1-1/4	3-5/8	3-9/32	7-11/16	3-3/8	6-7/16	5-7/8	13.40
2-1/4	4-9/16	1-1/4	4	3-15/16	8-3/8	3-7/8	7-1/8	6-3/8	15.70
2-1/2	4-11/16	1-1/4	4-3/8	4-7/16	8-15/16	4-1/8	7-11/16	6-5/8	17.90
2-3/4	5	1-1/4	4-1/2	4-7/8	9-8/16	4-3/8	8-5/16	6-7/8	22.00
3	5-5/16	1-1/2	5-1/32	5-11/32	10-11/16	4-3/4	9-2/16	7-5/8	30.50

There is only one correct way to attach U-bolt clips to wire rope ends. The base of the clip bears on the live end of the rope; the "U" of the bolt bears on the dead end with a thimble installed in the eye (see figure D-6).

The approximate number of clips and their spacing distance is shown in table D-2 and figure D-7. Consult the clip manufacturer for exact number of clips required and spacing dimensions.

2.2.2 Twin Base Clips. Twin base clips must be constructed of drop forged steel bases protected by an application of zinc coating (galvanized). Approximate dimension and construction details are shown in table D-3. Number of clips and their spacings are the same as shown for U-bolt clips.

Twin-base clips are installed as shown in figure D-8. Because of their special design, there is no top or bottom, and they cannot be installed incorrectly.

Additional information on installation of wire rope clips is in the *Rigging Manual.*

2.2.3 Joining Wire Ropes. Figure D-9 shows an acceptable method for joining wire ropes using a combination of clips and thimbles.

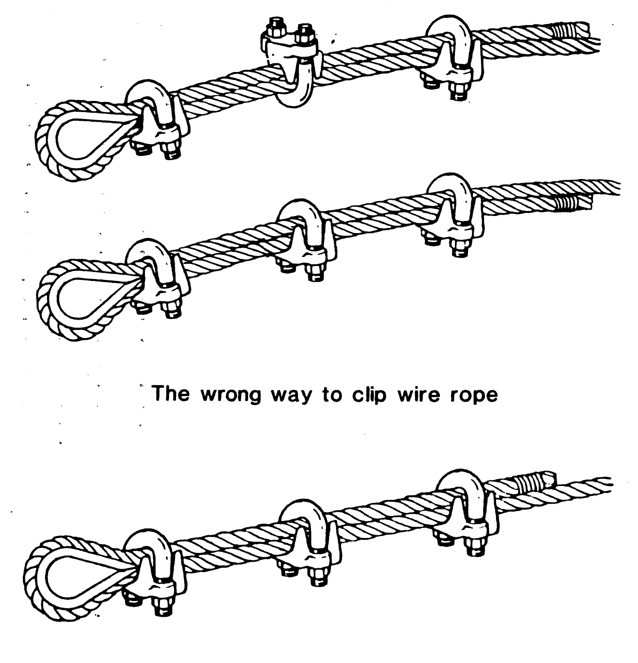


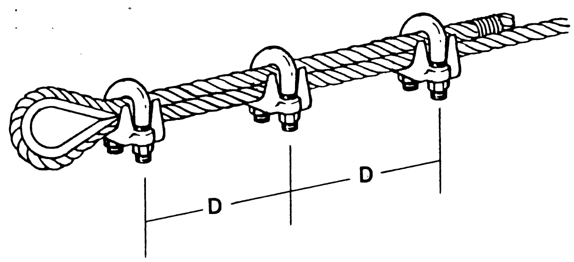
Figure D-6.—Right and wrong way to clip wire rope.

Table D-2.—Dimensions of twin-base clips

Rope diameter (inches)	Dimensions (inches)							Approxi-mate weight (pounds)
	A	B	D	d	J	K	L	N approx	
1/4	15/16	1-1/4	1/4	3/8	1-1/4	21/64	1/2	1-5/8	.21
5/16	1-1/16	1-11/32	5/16	3/8	1-16/32	7/16	5/8	1-15/16	.26
3/8	1-1/16	1-37/64	3/8	7/16	1-13/16	31/64	3/4	2-3/8	.38
7/16	1-1/4	1-7/8	7/16	1/2	2-11/64	9/16	1	2-3/4	.60
1/2	1-1/4	1-7/8	1/2	1/2	2-11/64	9/16	1	2-3/4	.60
9/16	1-1/2	2-8/32	8/16	5/8	2-11/16	11/16	1-1/4	3-1/2	1.08
5/8	1-1/2	2-8/32	5/8	5/8	2-11/16	11/16	1-1/4	3-1/2	1.08
3/4	1-3/4	2-27/64	3/4	5/8	2-3/4	55/64	1-1/2	3-3/8	1.34
7/8	2-1/8	2-61/64	7/8	3/4	3-5/16	31/32	1-3/4	4-1/8	2.20
1	2-1/4	3-1/16	1	3/4	3-23/32	1-3/16	2	4-5/8	2.68
1-1/8	2-5/16	3-3/16	1-1/8	3/4	4-3/32	1-8/32	2-1/4	5	2.96
1-1/4	2-1/2	3-8/16	1-1/4	7/8	4-1/4	1-11/32	2-1/2	5-1/4	4.03
1-3/8	3	4-1/8	1-3/8	1	5-9/16	1-9/16	2-3/4	7	6.58
1-1/2	3	4-1/8	1-1/2	1	5-9/16	1-9/16	3	7	6.58

Diameter of Rope Inches	No. Clips for Each Rope End*
3/16	3
1/4	3
5/16	3
3/8	3
7/16	3
1/2	3
5/8	3
3/4	3
7/8	4
1	4
1-1/8	5
1-1/4	5
1-3/8	6
1-1/2	6
1-5/8	6
1-3/4	6
2	6

Number of Clips



D=6 times rope diameter
Clip Spacing

Figure D-7.—Spacing dimensions for clips.

Table D-3.—Approximate design safety factors for wire rope

Type of service	Approximate safety factors
a. Mobile cranes	
Running ropes	3.5
Standing or pendant lines	3.0
b. Overhead and gantry cranes	5.0
c. Overhead hoists (underslung)	5.0
d. Portal, tower, pillar cranes	
Running ropes	3.5
Standing ropes	3.0
e. Hammer head tower cranes	5.0
f. Power passenger and freight elevators	7-12
g. Rope guided workmen hoist	
Hoist ropes	8.9
Guide ropes	7.0
h. Personnel hoists	8-11
i. Derricks	
Guy	3.0
Hoist	3.5
j. Slings	5.0
k. Material hoists	7.0

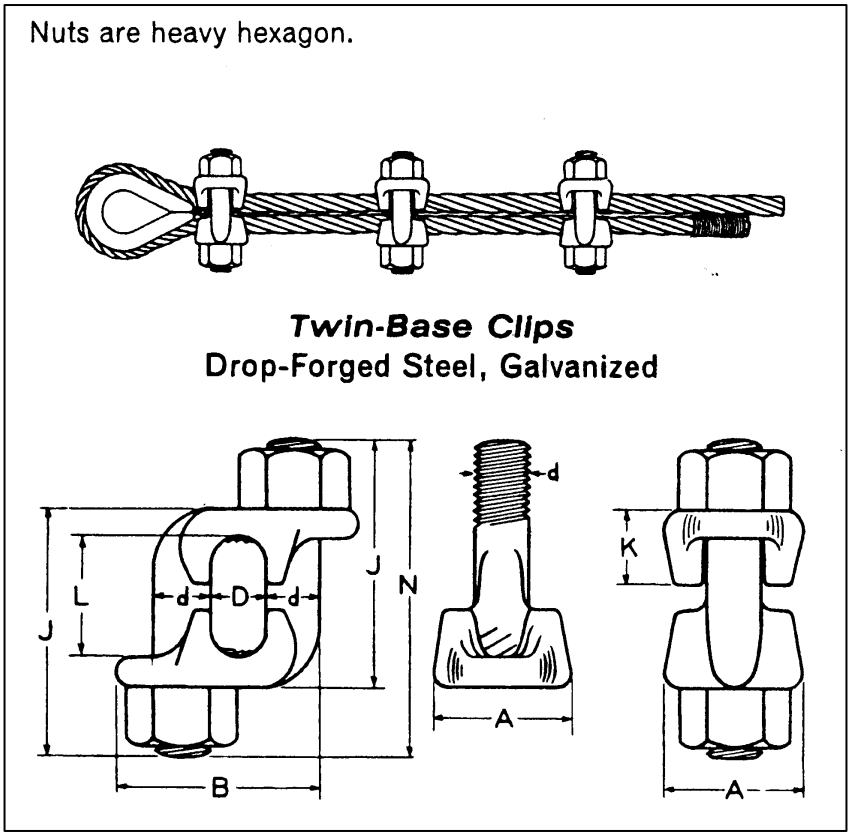


Figure D-8.—Twin-base clip installation.

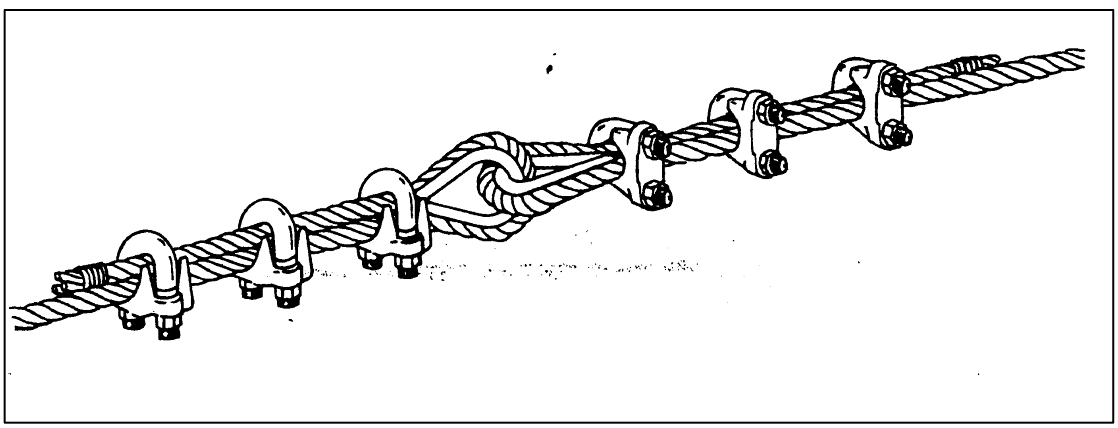


Figure D-9.—Wire ropes joined with clips and thimbles.

2.3 Wedge Socket. The construction industry uses wedge sockets extensively because they attach easily to a wire rope. In applying the socket, the live rope should lead out of the socket in a straight line. Figure D-10 shows a wedge socket. Figure D-11 shows two recommended methods of attaching the socket to the wire rope.

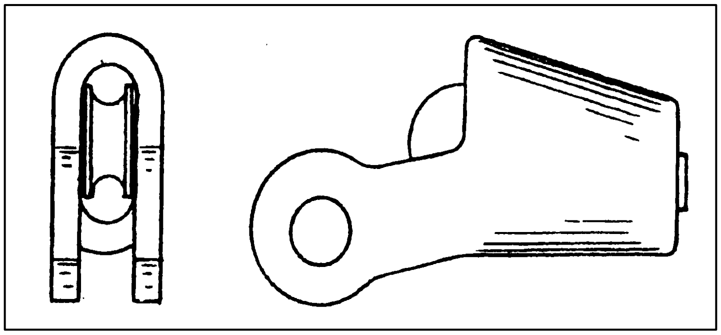


Figure D-10.—Wedge socket.

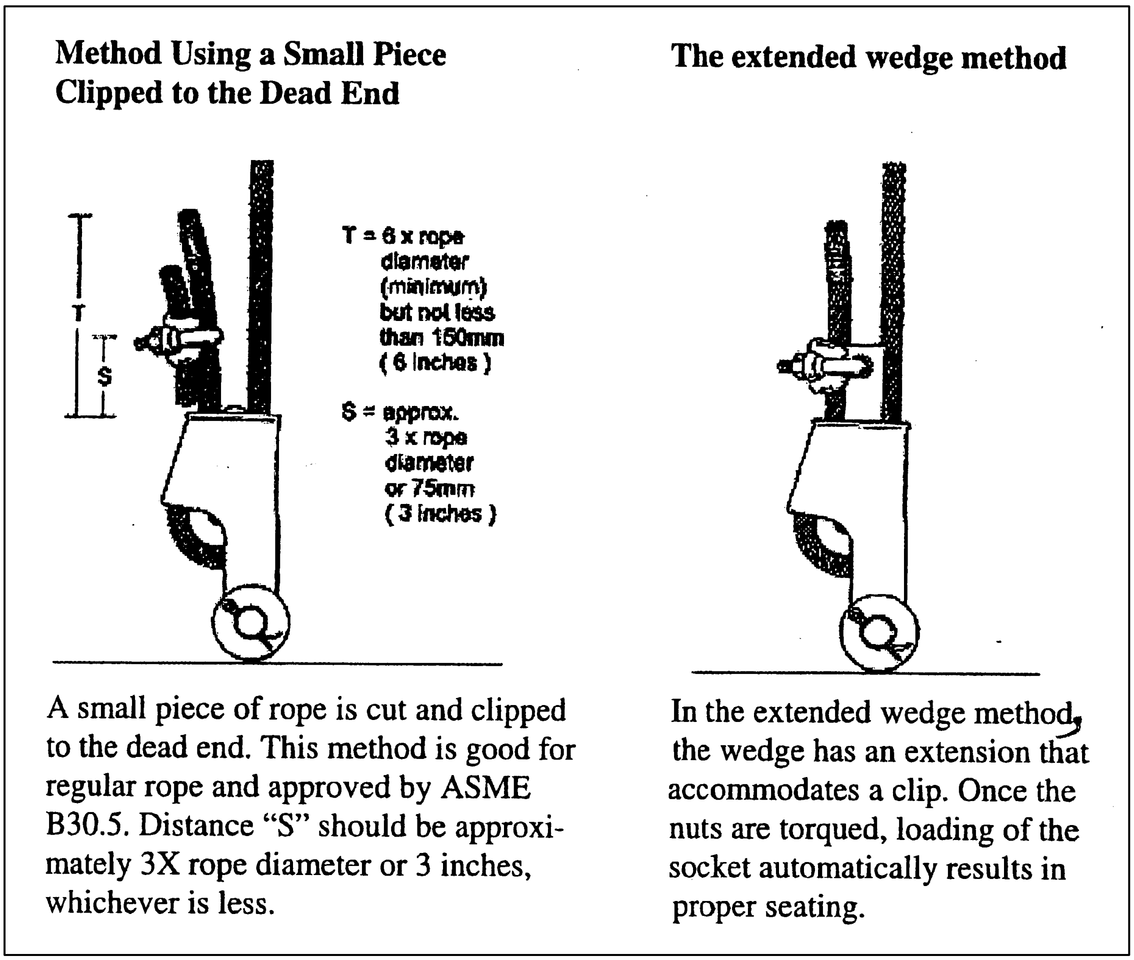


Figure D-11.—Two recommended methods of attaching the socket to the wire rope.

Regularly inspect the integrity of the wire rope at the point of exit at the dead-end side. High-velocity spin of wire rope when loading and unloading causes the rope to flip-flop, fatigue, and finally break off. When the wire rope has delivered each one-fifth of service life, remove the portion through the wedge and move the wedge up the rope to a new location.

2.4 Handmade Spliced Eyes. Spliced eyes are frequently used as wire rope end attachments (see figure D-12). They must incorporate rope thimbles to maintain rope strength and reduce wear. Because of the many forms of eye splices and the varying efficiencies, do not use these types of attachments in slings or hoisting operations.

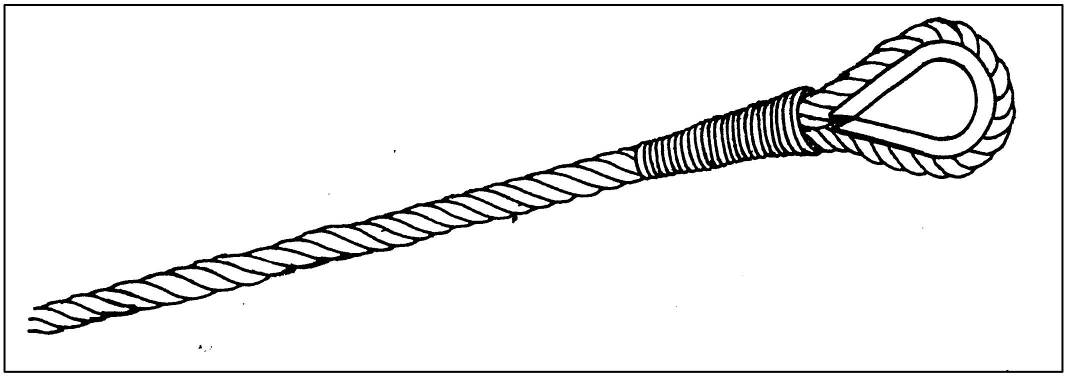


Figure D-12.—Example of a handmade spliced eye.

2.5 Manufactured Eye Splices. Manufactured eye splices, such as flemish eye, flemish eye plus serving, and flemish eye plus pressed metal sleeve are the most efficient attachments and should be considered for all hoisting operations. The zinc and swagged sockets are an excellent attachment for use in permanent nonmovable-type installation such as pendant lines and guy wires. They, like the manufactured eyes, must be constructed by well-trained, qualified personnel to ensure reliability.

2.6 Average Efficiency of Well-Made End Connectors on Terminals

a. Standard open and closed sockets. Attached with pure molten zinc:	100 percent
b. Flemish eye and pressed metal sleeve or swaged sockets on IWRC rope:	100 percent
c. Mechanically spliced eyes:	90 percent
d. Handmade eye splices:	80-90 percent
e. U-bolt clips (drop forged, new):	70-80 percent
f. Cast steel wedge sockets:	70 percent

Note: Percentages relate to rope breaking strength (i.e., a swaged socket has the same strength (100 percent) of the wire rope.

3.0 Common Safety Factors and Maximum (Safe) Working Loads

3.1 Safety Factors. The total stress in a wire rope, in service, is composed of several separate elements. These are reduced to a single tensile load value. When this value exceeds the breaking strength of the wire rope, a failure occurs.

The factor to provide a margin of safety between the applied tensile forces and the breaking strength of the rope is defined as the factor of safety.

Minimum safety factors for wire rope used in different types of service are contained in national standards (i.e., ANSI 17.1 safety code for elevators and escalators, ANSI/ASME B30.5 Mobile and Locomotive Cranes).

Table D-3 shows a partial compilation of approximate design safety factors. Refer to appropriate standards for precise requirements.

3.2 Maximum (Safe) Working Load. Calculate the maximum safe working load of wire rope, dividing the manufacturers' supplied breaking strength by the safety factor.

> ***Example:*** Calculate the maximum safe working load of a single-leg sling made from a 1/2-inch-diameter, 6X19 class wire rope constructed of improved plow steel (purple grade) material with poured zinc fittings and an independent wire rope core (IWRC).
>
> (1) Obtain the breaking strength of the wire rope from the 6X19 class table shown under paragraph 2.4.1 of this appendix (11.5 tons or 23,000 pounds).
>
> (2) Find the appropriate safety factor (5) for slings from table D-3 or from subsection 17.4 of the text.
>
> (3) Divide the breaking strength (23,000 pounds) by the safety factor (5) to obtain the maximum (safe) working load (4,600 pounds).

$$\text{Max (safe) working load} = \frac{23{,}000 \text{ pounds}}{5} = 4{,}600 \text{ pounds} \quad (1)$$

Conversely, to determine the actual safety factor under any condition of loading, multiply the rope breaking strength by the number of parts of line under load and divide this product by the actual working load.

> ***Example:*** Using a 1/2-inch-diameter, 6X19 class wire rope with the breaking strength shown, in a two-part line hoisting operation with a maximum load including weight of blocks, hooks, etc., of 9,200 pounds, calculate the actual safety factor.

$$\frac{23{,}000 \text{ pounds X } 2}{9{,}200 \text{ pounds}} = \frac{46{,}000 \text{ pounds}}{9{,}200 \text{ pounds}} = 5 \text{ safety factor}$$

Note: Consult the table of required safety factors or specify safety factor requirements contained in national standards to determine what type of service this specific hoisting system can be used for. In any service requiring a safety factor of 5 or less, the system would be satisfactory. In any system requiring a safety factor greater than 5, the system would be unsatisfactory.

Exercise caution in using this simplified method of calculation as some dynamic forces may need to be included in the maximum loading figure. Also, other factors such as sheave diameters, friction losses, hot environments, etc., may require higher safety factors.

4.0 Inspection and Retirement of Wire Rope

Eventually, all wire ropes deteriorate to the point that they are no longer safe for use. The frequency of inspections, the extent of the inspection, and the criteria for condemning wire ropes vary greatly for each type of service. Inspection frequencies and rope retirement criteria are usually found in specific national standards. If no standards exist for the type of service anticipated, the rope or equipment manufacturer or a professional engineer must develop the criteria. In no case shall the rope retirement criteria allow rope to be continued in any hoisting or load carrying service when one or more of the following deficiencies exist:

(a) Ropes are not of proper size, grade, or construction for the particular performance or function.

(b) In running ropes, six randomly distributed broken wires in one rope lay, or three broken wires in one strand in one rope lay. (A rope lay is the length along the rope in which one strand makes a complete revolution around the rope.)

(c) In pendants or standing ropes, evidence of more than one broken wire in one lay.

(d) Abrasion, scrubbing, or peening causing loss of more than one-third of the original diameter of the outside wires.

(e) Evidence of severe corrosion.

(f) Severe kinking, crushing, or other damage resulting in distortion of the rope structure.

(g) Evidence of any heat damage from a torch or arc caused by contact with electrical wires.

(h) Reduction from nominal rope diameter of more than 3/64 inch for diameters up to and including 3/4 inch; 1/16 inch for diameters 7/8 to 1-1/8 inches; and 3/32 inch for diameters 1-1/4 inch to 1-1/2 inches. Marked reduction in diameter indicates deterioration of the core, resulting in lack of proper support for the load carrying strands. Excessive rope stretch or elongation may also indicate internal deterioration.

(i) Evidence of “bird caging” or other distortion resulting in some members of the rope structure carrying more load than others.

(j) Noticeable rusting or development of broken wires in the vicinity of attachments.

See separate appendix on “Slings” for retirement criteria for wire rope used in slings.

Appendix E

Slings

Types

This appendix covers the types of slings made from alloy steel chain, wire rope, metal mesh, synthetic fiber rope (conventional, three-strand construction), synthetic web (nylon, polyester, and polypropylene), and synthetic round slings.

Definitions

"Angle of loading" is the inclination of a leg or branch of a sling measured from the horizontal or vertical plane, provided that an angle of loading of 5 degrees or less from the vertical may be considered a vertical angle of loading.

"Basket hitch" is a sling configuration in which the sling is passed under the load and has both ends, end attachments, eyes, or handles on the hook or a single master link.

"Braided wire rope" is a wire rope formed by plaiting component wire ropes.

"Bridle wire rope sling" is a sling composed of multiple wire rope legs with the top ends gathered in a fitting that goes over the lifting hook.

"Cable-laid endless sling-mechanical joint" is a wire rope sling made endless by joining the ends of a single length of cable-laid rope with one or two more metallic fittings.

"Cable-laid grommet-hand tucked" is an endless wire rope sling made from one length of rope wrapped six times around a core formed by hand tucking the ends of the rope inside the six wraps.

"Cable-laid rope" is a wire rope composed of six wire ropes wrapped around a fiber or wire rope core.

"Cable-laid rope sling-mechanical joint" is a wire rope sling made from a cable-laid rope with eyes fabricated by pressing or swaging one or more metal sleeves over the rope function.

"Choker hitch" is a sling configuration with one end of the sling passing under the load and through an end attachment, handle, or eye on the other end of the sling.

"Coating" is an elastomer or other suitable material applied to a sling, or to a sling component, to impart desirable properties.

"Cross rod" is a wire used to join spirals of metal mesh to form a complete fabric.

"Fabric (metal mesh)" is the flexible portion of a metal mesh sling consisting of a series of transverse coils and cross rods.

"Female handle (choker)" is a handle with a handle eye and a slot sized to permit passage of a male handle, thereby allowing the use of a metal mesh sling in a choker hitch.

"Handle" is a terminal fitting to which metal mesh fabric is attached.

"Handle eye" is an opening in a handle of a metal mesh sling, shaped to accept a hook, shackle, or other lifting device.

"Hitch" is a sling configuration in which the sling is fastened to an object or load, either directly to it or around it.

"Link" is a single ring of a chain.

"Male handle (triangle)" is a handle with a handle eye.

"Master coupling link" is an alloy steel, welded coupling link used as an intermediate link to join alloy steel chain to master links.

"Master link" or "gathering ring" is a forged or welded steel link used to support all members (legs) of an alloy steel chain sling or wire rope sling.

"Mechanical coup link" is a nonwelded, mechanically closed, steel link used to attach master links, hooks, etc., to alloy steel chain.

"Proof load" is the load applied when performing a proof test.

"Proof test" is a nondestructive tension test performed by the sling manufacturer, or an equivalent entity, to verify construction and workmanship of a sling.

"Rated capacity" or "working load limit" is the maximum working load permitted.

"Reach" is the effective length of an alloy steel chain sling measured from the top bearing surface of the upper terminal component to the bottom bearing surface of the lower terminal component.

"Selvage edge" is the finished edge of synthetic webbing designed to prevent unraveling.

"Sling" is an assembly that connects the load to the material handling equipment.

"Sling manufacturer" is a person or organization that assembles sling components into their final form for sale to testers.

"Spiral" is a single transverse coil that is the basic element that metal mesh is fabricated from.

"Strand laid endless sling-mechanical joint" is a wire rope sling made endless from one length of rope with the ends joined by one or more metallic fittings.

"Strand laid grommet-hand tucked" is an endless wire rope sling made from one length of strand wrapped six times around a core, formed by hand-tucking the ends of the strand inside the six wraps.

"Strand laid rope" is a wire rope made with strands (usually six or eight) wrapped around a fiber core, wire strand core, or independent wire rope core (IWRC).

"Vertical hitch" is a method of supporting a load by a single, vertical part or leg of the sling.

Safe Practices

Whenever any sling is used, observe the following practices:

(1) Do not use damaged or defective slings.

(2) Do not shorten slings with knots, bolts, or other makeshift devices, or kink sling legs.

(3) Do not load slings in excess of their rated capacities.

(4) Balance the loads of slings used in a basket hitch to prevent slippage.

(5) Securely attach slings to their loads.

(6) Pad or protect slings from the sharp edges of their loads.

(7) Keep suspended loads clear of all obstructions.

(8) Keep all employees clear of loads about to be lifted and of suspended loads.

(9) Do not place hands or fingers between the sling and its load while the sling is being tightened around the load.

(10) Prohibit shock loading.

(11) Do not pull a sling from under a load when the load is resting on the sling.

(12) Do not drag slings on the floor or over an abrasive surface.

Table E-1.—Correction table to compensate for chain link wear

Original nominal chain stock diameter (inches)	Reduce safe working Load by following % when diameter at worn section is as follows (inches)		Remove from service when diameter Is (inches)
	5%	10%	
1/4 = 0.250	0.244	0.237	0.233
3/8 = 0.375	0.366	0.356	0.335
1/2 = 0.500	0.487	0.474	0.448
5/8 = 0.625	0.609	0.593	0.559
3/4 = 0.750	0.731	0.711	0.671
7/8 = 0.875	0.853	0.830	0.783
1 = 1.000	0.975	0.949	0.895
1 1/8 = 1.125	1.100	1.070	1.010
1 1/4 = 1.250	1.220	1.190	1.120
1 3/8 = 1.375	1.340	1.310	1.230
1 1/2 = 1.500	1.460	1.430	1.340
1 5/8 = 1.625	1.590	1.540	1.450
1 3/4 = 1.750	1.710	1.660	1.570
1 7/8 = 1.875	1.830	1.780	1.680
2 = 2.000	1.950	1.900	1.790

Table E-2.—Safe working load (working load limit) for alloy steel chain slings (pounds)

Chain size, inches	Single breach sling–90-degree leading	Double sling			Triple and quadruple sling		
		Vertical angle[1]			Vertical angle[1]		
		30 degree	45 degree	60 degree	30 degree	45 degree	60 degree
		Horizontal angle[2]			Horizontal angle[2]		
		60 degree	45 degree	30 degree	60 degree	45 degree	30 degree
1/4	3,250	5,560	4,550	3,250	8,400	6,800	4,900
3/8	6,600	11,400	9,300	6,600	17,000	14,000	9,900
1/2	11,250	19,500	15,900	11,250	29,000	24,000	17,000
5/8	16,500	28,500	23,300	16,500	43,000	35,000	24,500
3/4	23,000	39,800	32,500	23,000	59,500	48,500	34,500
7/8	28,750	49,800	40,600	28,750	74,500	61,000	43,000
1	38,750	67,100	54,800	38,750	101,000	82,000	58,000
1-1/8	44,500	77,000	63,000	44,500	115,500	94,500	66,500
1-1/4	57,500	99,500	81,000	57,500	149,000	121,500	86,000
1-3/8	67,000	116,000	94,000	67,000	174,000	141,000	100,500
1-1/2	80,000	138,000	112,900	80,000	207,000	169,000	119,500
1-3/4	100,000	172,000	140,000	100,000	258,000	210,000	150,000

[1] Rating of multileg slings adjusted for angle of loading, measured as the included angle between the inclined leg and the vertical.

[2] Rating of multileg slings adjusted for angle of loading, between the inclined leg and the horizontal plane of the load.

* Other grades of proof-tested steel chains include Proof Coil, BBB Coil, and Hi-Test Chain. These grades are not recommended for overhead lifting and, therefore, are not covered by these standards.

Table E-3.—Safe working load for single leg slings 6 x 19 and 6 x 37 classification improved plow steel grade rope with fiber core (FC)

Rope		Safe working load, tons (2,000 lb)								
Diameter (inches)	Constr	Vertical			Choker			Vertical basket[1]		
		HT	MS	S	HT	MS	S	HT	MS	S
1/4	6 x 19	0.49	0.51	0.55	0.37	0.38	0.41	0.99	1.0	1.1
5/16	6 x 19	0.76	0.79	0.85	0.57	0.59	0.64	1.5	1.6	1.7
3/8	6 x 19	1.1	1.1	1.2	0.80	0.85	0.91	2.1	2.2	2.4
7/16	6 x 19	1.4	1.5	1.6	1.1	1.1	1.2	2.9	3.0	3.3
½	6 x 19	1.8	2.0	2.1	1.4	1.5	1.6	3.7	3.9	4.3
9/16	6 x 19	2.3	2.5	2.7	1.7	1.9	2.0	4.6	5.0	5.4
5/8	6 x 19	2.8	3.1	3.3	2.1	2.3	2.5	5.6	6.3	6.7
3/4	6 x 19	3.9	4.4	4.8	2.9	3.3	3.6	7.8	8.5	9.5
7/8	6 x 19	5.1	5.9	6.4	3.9	4.5	4.8	10.0	12.0	13.0
1	6 x 19	6.7	7.7	8.4	5.0	5.8	6.3	13.0	15.0	17.0
1-1/8	6 x 19	8.4	9.5	10.0	6.3	7.1	7.9	17.0	19.0	21.0
1-1/4	6 x 37	9.8	11.0	12.0	7.4	8.3	9.2	20.0	22.0	25.0
1-3/8	6 x 37	12.0	13.0	15.0	8.9	10.0	11.0	24.0	27.0	30.0
1-1/2	6 x 37	14.0	16.0	17.0	10.0	12.0	13.0	28.0	32.0	35.0
1-5/8	6 x 37	16.0	18.0	21.0	12.0	14.0	15.0	33.0	37.0	41.0
1-3/4	6 x 37	19.0	21.0	24.0	14.0	16.0	18.0	38.0	43.0	48.0
2	6 x 37	25.0	28.0	31.0	18.0	21.0	23.0	49.0	55.0	62.0

HT = Hand-tucked splice and hidden-tuck splice. For hidden-tuck splice (IWRC), use values in HT columns.
MS = Mechanical splice.
S = Swaged or zinc poured socket.

[1] These values only apply when the D/d ratio for HT slings is 10 or greater, and for MS and S slings is 20 or greater, where d = diameter of curvature around the body of the slip is bent, and d = diameter of rope.

Table E-4.—Safe working load for single leg slings 6 x 19 and 6 x 37 classification improved plow steel grade rope with independent wire rope core (IWRC)

Rope		Safe working load, tons (2,000 lb)								
		Vertical			Choker			Vertical basket[1]		
Diameter (inches)	Constr	HT	MS	S	HT	MS	S	HT	MS	S
1/4	6 x 19	0.53	0.56	0.59	0.40	0.42	0.44	1.0	1.1	1.2
5/16	6 x 19	0.81	0.87	0.92	0.61	0.65	0.69	1.6	1.7	1.8
3/8	6 x 19	1.1	1.2	1.3	0.86	0.93	0.98	2.3	2.5	2.6
7/16	6 x 19	1.5	1.7	1.8	1.2	1.3	1.3	3.1	3.4	3.5
½	6 x 19	2.0	2.2	2.3	1.5	1.6	1.7	3.9	4.4	4.6
9/16	6 x 19	2.5	2.7	2.9	1.8	2.1	2.2	4.9	5.5	5.8
5/8	6 x 19	3.0	3.4	3.6	2.2	2.5	2.7	6.0	6.8	7.2
3/4	6 x 19	4.2	4.9	5.1	3.1	3.6	3.8	8.4	9.7	10.0
7/8	6 x 19	5.5	6.6	6.9	4.1	4.9	5.2	11.0	13.0	14.0
1	6 x 19	7.2	8.5	9.0	5.4	6.4	6.7	14.0	17.0	18.0
1-1/8	6 x 19	9.0	10.0	11.0	6.8	7.8	8.5	18.0	21.0	23.0
1-1/4	6 x 37	10.0	12.0	13.0	7.9	9.2	9.9	21.0	24.0	26.0
1-3/8	6 x 37	13.0	15.0	16.0	9.6	11.0	2.0	25.0	29.0	32.0
1-1/2	6 x 37	15.0	17.0	19.0	11.0	13.0	14.0	30.0	35.0	38.0
1-5/8	6 x 37	18.0	20.0	22.0	13.0	15.0	17.0	35.0	41.0	44.0
1-3/4	6 x 37	20.0	24.0	26.0	15.0	18.0	19.0	41.0	47.0	51.0
2	6 x 37	26.0	30.0	33.0	20.0	23.0	25.0	53.0	61.0	66.0

HT = Hand-tucked splice and hidden-tuck splice. For hidden-tuck splice (IWRC), use values in HT columns.
MS = Mechanical splice.
S = Swaged or zinc poured socket.
[1] These values only apply when the D/d ratio for HT slings is 10 or greater, and for MS and S slings is 20 or greater, where D = diameter of curvature around the body of the slip is bent, and d = diameter of rope.

Table E-5.—Safe working load for single leg slings, cable-laid rope–mechanical splice 7 x 7 x 7 and 7 x 7 x19 constructions galvanized aircraft grade rope 7 x 6 x 19 IWRC construction improved plow steel grade rope

Rope		Safe working load, tons (2,000 lb)		
Diameter (inches)	**Constr**	**Vertical**	**Center**	**Vertical basket[1]**
1/4	7 x 7 x 7	0.50	0.38	1.0
3/8	7 x 7 x 7	1.1	0.81	2.2
1/2	7 x 7 x 7	1.8	1.4	3.7
5/8	7 x 7 x 7	2.8	2.1	5.5
3/4	7 x 7 x 7	3.8	2.9	7.6
5/8	7 x 7 x 19	2.9	2.2	5.8
3/4	7 x 7 x 19	4.1	3.0	8.1
7/8	7 x 7 x 19	5.4	4.0	11.0
1	7 x 7 x 19	6.9	5.1	14.0
1-1/8	7 x 7 x 19	8.2	6.2	16.0
1-1/4	7 x 7 x 19	9.9	7.4	20.0
3/4	7 x 6 x 19 IWRC	3.8	2.8	7.6
7/8	7 x 6 x 19 IWRC	5.0	3.8	10.0
1	7 x 6 x 19 IWRC	6.4	4.8	13.0
1-1/8	7 x 6 x 19 IWRC	7.7	5.8	15.0
1-1/4	7 x 6 x 19 IWRC	9.2	6.9	18.0
1-5/16	7 x 6 x 19 IWRC	10.0	7.5	20.0
1-3/8	7 x 6 x 19 IWRC	11.0	8.2	22.0
1-1/2	7 x 6 x 19 IWRC	13.0	9.6	26.0

[1] These values only apply when the D/d ratio is 10 or greater, where D = diameter of curvature around which the body of the sling is bent, and d = diameter of rope.

Table E-6.—Safe working load for single leg slings 8-part and 6-part braided rope 6 x 7 and 7 x 19 construction improved plow steel grade rope 7 x 7 construction galvanized aircraft grade rope

Component ropes		Safe working load, tons (2,000 lb)					
Diameter (inches)	Constr	Vertical		Choker		Basket vertical to 30 degree[1]	
		8-part	6-part	8-part	6-part	8-part	6-part
3/32	6 x 7	0.42	0.32	0.32	0.24	0.74	0.55
1/8	6 x 7	0.75	0.57	0.57	0.42	1.3	0.98
3/16	6 x 7	1.7	1.3	1.3	0.94	2.9	2.2
3/32	7 x 7	0.51	0.39	0.38	0.29	0.89	0.67
1/8	7 x 7	0.95	0.71	0.71	0.53	1.6	1.2
3/16	7 x 7	2.1	1.5	1.5	1.2	3.6	2.7
3/16	6 x 19	1.7	1.3	1.3	0.98	3.0	2.2
1/4	6 x 19	3.1	2.3	2.3	1.7	5.3	4.0
5/16	6 x 19	4.8	3.6	3.6	2.7	8.3	6.2
3/8	6 x 19	6.8	5.1	5.1	3.8	12.0	8.9
7/16	6 x 19	9.3	6.9	6.9	5.2	16.0	12.0
1/2	6 x 19	12.0	9.0	9.0	6.7	21.0	15.0
9/16	6 x 19	15.0	11.0	11.0	8.5	26.0	20.0
5/8	6 x 19	19.0	14.0	14.0	10.0	32.0	24.0
3/4	6 x 19	27.0	20.0	20.0	15.0	46.0	35.0
7/8	6 x 19	36.0	27.0	27.0	20.0	62.0	47.0
1	6 x 19	47.0	35.0	35.0	26.0	81.0	61.0

[1] These values only apply when the D/d ratio is 20 or greater, where D = diameter of curvature around which the body of the sling is bent, and d = diameter of component rope.

**Table E-7.—Safe working load for 2-leg and 3-leg bridle slings
6 x 19 and 6 x 37 classification
improved plow steel grade rope with fiber core (FC)**

Rope		Safe working load, tons (2,000 lb)											
		2-leg bridle slings						3-leg bridle slings					
Diameter (inches)	Constr	Vertical 30 degrees Horizontal 60 degrees		45-degree angle		45-degree angle		Vertical 30 degrees Horizontal 60 degrees		45-degree angle		45-degree angle	
		HT	MS	HT	MS	HT	MS	HT	MS	HT	MS	HT	MS
1/4	6 x 19	0.85	0.88	0.70	0.72	0.49	0.51	1.3	1.3	1.0	1.1	0.74	0.7
5/16	6 x 19	1.3	1.4	1.1	1.1	0.76	0.79	2.0	2.0	1.6	1.7	1.1	1.2
3/8	6 x 19	1.8	1.9	1.5	1.6	1.1	1.1	2.8	2.9	2.3	2.4	1.6	1.7
7/16	6 x 19	2.5	2.6	2.0	2.2	1.4	1.5	3.7	4.0	3.0	3.2	2.1	2.3
1/2	6 x 19	3.2	3.4	2.6	2.8	1.8	2.0	4.8	5.1	3.9	4.2	2.8	3.0
9/16	6 x 19	4.0	4.3	3.2	3.5	2.3	2.5	6.0	6.5	4.9	5.3	3.4	3.7
5/8	6 x 19	4.8	5.3	4.0	4.4	2.8	3.1	7.3	8.0	5.9	6.5	4.2	4.6
3/4	6 x 19	6.8	7.6	5.5	6.2	3.9	4.4	10.0	11.0	8.3	9.3	5.8	6.6
7/8	6 x 19	8.9	10.0	7.3	8.4	5.1	5.9	13.0	15.0	11.0	13.0	7.7	8.9
1	6 x 19	11.0	13.0	9.4	11.0	6.7	7.7	17.0	20.0	14.0	16.0	10.0	11.0
1-1/8	6 x 19	14.0	16.0	12.0	13.0	8.4	9.5	22.0	24.0	18.0	20.0	13.0	14.0
1-1/4	6 x 37	17.0	19.0	14.0	16.0	9.8	11.0	25.0	29.0	21.0	23.0	15.0	17.0
1-3/8	6 x 37	20.0	23.0	17.0	19.0	12.0	13.0	31.0	35.0	25.0	28.0	18.0	20.0
1-1/2	6 x 37	24.0	27.0	20.0	22.0	14.0	16.0	36.0	41.0	30.0	33.0	21.0	24.0
1-5/8	6 x 37	28.0	32.0	23.0	26.0	16.0	18.0	43.0	48.0	35.0	39.0	25.0	28.0
1-3/4	6 x 37	33.0	37.0	27.0	30.0	19.0	21.0	49.0	56.0	40.0	45.0	28.0	32.0
2	6 x 37	43.0	48.0	35.0	39.0	25.0	28.0	64.0	72.0	52.0	59.0	37.0	41.0

HT = Hand-tucked splice.
MS = Mechanical splice.

Table E-8.—Safe working load for 2-leg and 3-leg bridle slings 6 x 19 and 6 x 37 classification improved plow steel grade rope with independent wire rope core (IWRC)

Rope		Safe working load, tons (2,000 lb)											
		2-leg bridle slings						3-leg bridle slings					
Diameter (inches)	Constr	Vertical 30 degrees Horizontal 60 degrees		45-degree angle		45-degree angle		Vertical 30 degrees Horizontal 60 degrees		45-degree angle		45-degree angle	
		HT	MS	HT	MS	HT	MS	HT	MS	HT	MS	HT	MS
1/4	6 x 19	0.92	0.97	0.75	0.79	0.53	0.56	1.4	1.4	1.1	1.2	0.79	0.84
5/16	6 x 19	1.4	1.5	1.1	1.2	0.81	0.87	2.1	2.3	1.7	1.8	1.2	1.3
3/8	6 x 19	2.0	2.1	1.6	1.8	1.1	1.2	3.0	3.2	2.4	2.6	1.7	1.9
7/16	6 x 19	2.7	2.9	2.2	2.4	1.5	1.7	4.0	4.4	3.3	3.6	2.3	2.5
1/2	6 x 19	3.4	3.8	2.8	3.1	2.0	2.2	5.1	5.7	4.2	4.6	3.0	3.3
9/16	6 x 19	4.3	4.8	3.5	3.9	2.5	2.7	6.4	7.1	5.2	5.8	3.7	4.1
5/8	6 x 19	5.2	5.9	4.2	4.8	3.0	3.4	7.8	8.8	6.4	7.2	4.5	5.1
3/4	6 x 19	7.3	8.4	5.9	6.9	4.2	4.9	11.0	13.0	8.9	10.0	6.3	7.3
7/8	6 x 19	9.6	11.0	7.8	9.3	5.5	6.6	14.0	17.0	12.0	14.0	8.3	9.9
1	6 x 19	12.0	15.0	10.0	12.0	7.2	8.5	19.0	22.0	15.0	18.0	11.0	13.0
1-1/8	6 x 19	16.0	18.0	13.0	15.0	9.0	10.0	23.0	27.0	19.0	22.0	13.0	16.0
1-1/4	6 x 37	18.0	21.0	15.0	17.0	10.0	12.0	27.0	32.0	22.0	26.0	16.0	18.0
1-3/8	6 x 37	22.0	25.0	18.0	21.0	13.0	15.0	33.0	38.0	27.0	31.0	19.0	22.0
1-1/2	6 x 37	26.0	30.0	21.0	25.0	15.0	17.0	39.0	45.0	32.0	37.0	23.0	26.0
1-5/8	6 x 37	31.0	35.0	25.0	29.0	18.0	20.0	46.0	53.0	38.0	43.0	27.0	31.0
1-3/4	6 x 37	35.0	41.0	29.0	33.0	20.0	24.0	53.0	61.0	43.0	50.0	31.0	35.0
2	6 x 37	46.0	53.0	37.0	43.0	26.0	30.0	68.0	79.0	56.0	65.0	40.0	46.0

HT = Hand-tucked splice.
MS = Mechanical splice.

Table E-9.—Safe working load for 2-leg and 3-leg bridle slings, cable-laid rope–mechanical splice only
7 x 7 x 7 and 7 x 7 x 19 constructions galvanized aircraft grade rope
7 x 6 x 19 independent wire rope core (IWRC) construction improved plow steel grade rope

Rope		Safe working load, tons (2,000 lb)					
		2-leg bridle slings			3-leg bridle slings		
Diameter (inches)	Constr	Vertical 30 degrees Horizontal 60 degrees	45-degree angle	Vertical 60 degrees Horizontal 30 degrees	Vertical 30 degrees Horizontal 60 degrees	45-degree angle	Vertical 60 degrees Horizontal 30 degrees
1/4	7 x 7 x 7	0.87	0.71	0.50	1.3	1.1	0.75
3/8	7 x 7 x 7	1.9	1.5	1.1	2.8	2.3	1.6
1/2	7 x 7 x 7	3.2	2.6	1.8	4.8	3.9	2.8
5/8	7 x 7 x 7	4.8	3.9	2.8	7.2	5.9	4.2
3/4	7 x 7 x 7	6.6	5.4	3.8	9.9	8.1	5.7
5/8	7 x 7 x 19	5.0	4.1	2.9	7.5	6.1	4.3
3/4	7 x 7 x 19	7.0	5.7	4.1	10.0	8.6	6.1
7/8	7 x 7 x 19	9.3	7.6	5.4	14.0	11.0	8.1
1	7 x 7 x 19	12.0	9.7	6.9	18.0	14.0	10.0
1-1/8	7 x 7 x 19	14.0	12.0	8.2	21.0	17.0	12.0
1-1/4	7 x 7 x 19	17.0	14.0	9.9	26.0	21.0	15.0
3/4	7 x 6 x 19 IWRC	6.6	5.4	3.8	9.9	8.0	5.7
7/8	7 x 6 x 19 IWRC	8.7	7.1	5.0	13.0	11.0	7.5
1	7 x 6 x 19 IWRC	11.0	9.0	6.4	17.0	13.0	9.6
1-1/8	7 x 6 x 19 IWRC	13.0	11.0	7.7	20.0	16.0	11.0
1-1/4	7 x 6 x 19 IWRC	16.0	13.0	9.2	24.0	20.0	14.0
1-5/16	7 x 6 x 19 IWRC	17.0	14.0	10.0	26.0	21.0	15.0
1-3/8	7 x 6 x 19 IWRC	19.0	15.0	11.0	28.0	23.0	16.0
1-1/2	7 x 6 x 19 IWRC	22.0	18.0	13.0	33.0	27.0	19.0

Table E-10.—Safe working load for 2-leg and 3-leg bridle slings, 8-part and 6-part braided rope
6 x 7 and 6 x 19 construction improved plow steel grade rope
7 x 7 construction galvanized aircraft grade rope

Component rope		Safe working load, tons (2,000 lb)											
		2-leg bridle slings						3-leg bridle slings					
Diameter (inches)	Constr	Vertical 30 degrees Horizontal 60 degrees		45-degree angle		Vertical 60 degrees Horizontal 30 degrees		Vertical 30 degrees Horizontal 60 degrees		45-degree angle		Vertical 60 degrees Horizontal 30 degrees	
		8-part	6-part	8-part	6-part	8-part	6-part	8-part	6-part	8-part	6-part	8-part	6-part
3/32	6 x 7	0.74	0.55	0.60	0.45	0.42	0.32	1.1	0.83	0.90	0.68	0.64	0.48
1/8	6 x 7	1.3	0.98	1.1	0.80	0.76	0.57	2.0	1.5	1.6	1.2	1.1	0.85
3/16	6 x 7	2.9	2.2	2.4	1.8	1.7	1.3	4.4	3.3	3.6	2.7	2.5	1.9
3/32	7 x 7	0.89	0.67	0.72	0.55	0.51	0.39	1.3	1.0	1.1	0.82	0.77	0.58
1/8	7 x 7	1.6	1.2	1.3	1.0	0.95	0.71	2.5	1.8	2.0	1.5	1.4	1.1
3/16	7 x 7	3.6	2.7	2.9	2.2	2.1	1.5	5.4	4.0	4.4	3.3	3.1	2.3
3/16	6 x 19	3.0	2.2	2.4	1.8	1.7	1.3	4.5	3.4	3.7	2.8	2.6	1.9
1/4	6 x 19	5.3	4.0	4.3	3.2	3.1	2.3	8.0	6.0	6.5	4.9	4.6	3.4
5/16	6 x 19	8.3	6.2	6.7	5.0	4.8	3.6	12.0	9.3	10.0	7.6	7.1	5.4
3/8	6 x 19	12.0	8.9	9.7	7.2	6.8	5.1	18.0	13.0	14.0	11.0	10.0	7.7
7/16	6 x 19	16.0	12.0	13.0	9.8	9.3	6.0	24.0	18.0	20.0	15.0	14.0	10.0
1/2	6 x 19	21.0	15.0	17.0	13.0	12.0	9.0	31.0	23.0	25.0	19.0	18.0	13.0
9/16	6 x 19	26.0	20.0	21.0	16.0	15.0	11.0	39.0	29.0	32.0	24.0	23.0	17.0
5/8	6 x 19	32.0	24.0	26.0	20.0	19.0	14.0	48.0	36.0	40.0	30.0	28.0	21.0
3/4	6 x 19	46.0	35.0	38.0	28.0	27.0	20.0	69.0	52.0	56.0	42.0	40.0	30.0
7/8	6 x 19	62.0	47.0	51.0	38.0	36.0	27.0	94.0	70.0	76.0	57.0	54.0	40.0
1	6 x 19	81.0	61.0	66.0	50.0	47.0	35.0	122.0	91.0	99.0	74.0	70.0	53.0

Table E-11.—Safe working load for strand laid grommet– hand tucked improved plow steel grade rope

Rope body		Safe working load, tons (2,000 lb)		
Diameter (inches)	Constr	Vertical	Choker	Vertical basket[1]
1/4	7 x 19	0.85	0.64	1.7
5/16	7 x 19	1.3	1.0	2.6
3/8	7 x 19	1.9	1.4	3.8
7/16	7 x 19	2.6	1.9	5.2
1/2	7 x 19	3.3	2.5	6.7
9/16	7 x 19	4.2	3.1	8.4
5/8	7 x 19	5.2	3.9	10.0
3/4	7 x 19	7.4	5.6	15.0
7/8	7 x 19	10.0	7.5	20.0
1	7 x 19	13.0	9.7	26.0
1-1/8	7 x 19	16.0	12.0	32.0
1-1/4	7 x 37	18.0	14.0	37.0
1-3/8	7 x 37	22.0	16.0	44.0
1-1/2	7 x 37	26.0	19.0	52.0

[1] These values only apply when the D/d ratio is 5 or greater, where D = diameter of curvature around which the rope is bent, and d = diameter of rope body.

Table E-12.—Safe working load for cable laid grommet–hand tucked 7 x 6 x 7 and 7 x 6 x 19 constructions improved plow steel grade rope 7 x 7 x 7 construction galvanized aircraft grade rope

Cable body		Safe working load, tons (2,000 lb)		
Diameter (inches)	Constr	Vertical	Choker	Vertical basket[1]
3/8	7 x 6 x 7	1.3	0.95	2.5
9/16	7 x 6 x 7	2.8	2.1	5.6
5/8	7 x 6 x 7	3.8	2.8	7.6
3/8	7 x 7 x 7	1.6	1.2	3.2
9/16	7 x 7 x 7	3.5	2.6	6.9
5/8	7 x 7 x 7	4.5	3.4	9.0
5/8	7 x 6 x 19	3.9	3.0	7.9
3/4	7 x 6 x 19	5.1	3.8	10.0
15/16	7 x 6 x 19	7.9	5.9	16.0
1-1/8	7 x 6 x 19	11.0	8.4	22.0
1-5/16	7 x 6 x 19	15.0	11.0	30.0
1-1/2	7 x 6 x 19	19.0	14.0	39.0
1-11/16	7 x 6 x 19	24.0	18.0	49.0
1-7/8	7 x 6 x 19	30.0	22.0	60.0
2-1/4	7 x 6 x 19	42.0	31.0	84.0
2-5/8	7 x 6 x 19	56.0	42.0	112.0

[1] These values only apply when the D/d ratio is 5 or greater, where D = diameter of curvature around which the rope is bent, and d = diameter of rope body.

Table E-13.— Safe working load for strand-laid endless slings—mechanical joint improved plow steel grade rope

Cable body		Safe working load, tons (2,000 lb)		
Diameter (inches)	Constr	Vertical	Choker	Vertical basket[1]
1/4	6 x 19 IWRC	0.92	0.69	1.8
3/8	6 x 19 IWRC	2.0	1.5	4.1
1/2	6 x 19 IWRC	3.6	2.7	7.2
5/8	6 x 19 IWRC	5.6	4.2	11.0
3/4	6 x 19 IWRC	8.0	6.0	16.0
7/8	6 x 19 IWRC	11.0	8.1	21.0
1	6 x 19 IWRC	14.0	10.0	28.0
1-1/8	6 x 19 IWRC	18.0	13.0	35.0
1-1/4	6 x 37 IWRC	21.0	15.0	41.0
1-3/8	6 x 37 IWRC	25.0	19.0	50.0
1-1/2	6 x 37 IWRC	29.0	22.0	59.0

[1] These values only apply when the D/d ratio is 5 or greater, where D = diameter of curvature around which the rope is bent, and d = diameter of rope body.

Table E-14.—Safe working load for cable-laid endless slings–mechanical joint 7 x 7 x 7 and 7 x 7 x 19 constructions galvanized aircraft grade rope 7 x 6 x 29 IWRC construction improved plow steel grade rope

Cable body		Safe working load, tons (2,000 lb)		
Diameter (inches)	Constr	Vertical	Choker	Vertical basket[1]
1/4	7 x 7 x 7	0.83	0.62	1.6
1/8	7 x 7 x 7	1.8	1.3	3.5
½	7 x 7 x 7	3.0	2.3	6.1
5/8	7 x 7 x 7	4.5	3.4	9.1
3/4	7 x 7 x 7	6.3	4.7	12.0
5/8	7 x 7 x 19	4.7	3.5	9.5
3/4	7 x 7 x 19	6.7	5.0	13.0
7/8	7 x 7 x 19	8.9	6.6	18.0
1	7 x 7 x 19	11.0	8.5	22.0
1-1/8	7 x 7 x 19	14.0	10.0	28.0
1-1/4	7 x 7 x 19	17.0	12.0	33.0
3/4	7 x 6 x 19 IWRC	6.2	4.7	12.0
7/8	7 x 6 x 19 IWRC	8.3	6.2	16.0
1	7 x 6 x 19 IWRC	10.0	7.9	21.0
1-1/8	7 x 6 x 19 IWRC	13.0	9.7	26.0
1-1/4	7 x 6 x 19 IWRC	16.0	12.0	31.0
1-3/8	7 x 6 x 19 IWRC	18.0	14.0	37.0
1-1/2	7 x 6 x 19 IWRC	22.0	16.0	43.0

[1] These values only apply when the D/d ratio is 5 or greater, where D = diameter of curvature around which the rope is bent, and d = diameter of rope body.

Table E-15.—Safe working loads for nylon rope slings

Rope diameter nominal (inches)	Nominal weight per 100 feet (pounds)	Minimum breaking strength (pounds)	Safe working load in pounds (safety factor = 9)											
			Eye and eye sling						Endless sling					
			Vertical hitch	Choker hitch	Basket hitch: angle of rope to horizontal				Vertical hitch	Choker hitch	Basket hitch: angle of rope to horizontal			
					90˚	60˚	45˚	30˚			90˚	60˚	45˚	30˚
					Angle of rope to vertical						Angle of rope to vertical			
					0˚	30˚	45˚	60˚			0˚	30˚	45˚	60˚
1/2	6.5	6,080	635	320	1,270	1,100	900	635	1,140	570	2,290	1,980	1,620	1,140
9/16	8.3	7,600	790	395	1,580	1,370	1,120	790	1,420 1,850 2,540	710	2,840	2,460	2,010	1,420
5/8	10.5	9,880	1,030	515	2,060	1,780	1,460	1,030		925	3,710	3,210	2,620	1,850
3/4	14.5	13,490	1,410	705	2,820	2,440	1,990	1,410		1,270	5,080	4,400	3,590	2,540
13/16	17.0	16,150	1,680	840	3,360	2,910	2,380	1,680	3,020	1,510	6,050	5,240	4,280	3,020
7/8	20.0	19,000	1,980	990	3,960	3,430	2,800	1,980	3,560	1,780	7,130	6,170	5,040	3,560
1	26.0	23,750	2,480	1,240	4,960	4,300	3,510	2,480	4,460	2,230	8,930	7,730	6,310	4,460
1-1/16	29.0	27,360	2,850	1,430	5,700	4,940	4,030	2,850	5,130	2,570	10,300	8,890	7,260	5,130
1-1/8	34.0	31,350	3,270	1,640	6,540	5,660	4,620	3,270	5,890	2,940	11,800	10,200	8,330	5,890
1-1/4	40.0	35,625	3,710	1,860	7,420	6,430	5,250	3,710	6,680	3,340	13,400	11,600	9,450	6,680
1-5/16	45.0	40,850	4,260	2,130	8,520	7,380	6,020	43,260	7,670	3,830	15,300	13,300	10,800	7,670
1-1/2	55.0	50,350	5,250	2,630	10,500	9,090	7,420	5,250	9,450	4,730	18,900	16,400	13,400	9,450
1-5/8	68.0	61,750	6,440	3,220	12,900	11,200	9,110	6,440	11,600	5,800	23,200	20,100	16,400	11,600
1-3/4	83.0	74,100	7,720	3,860	15,400	13,400	10,900	7,720	13,900	6,950	27,800	24,100	19,700	13,900
2	95.0	87,400	9,110 10,500	4,560	18,200	15,800	12,900	9,110	16,400	8,200	32,800	28,400	23,200	16,400
2-1/8	109.0	100,700		5,250	21,000	18,200	14,800	10,500	18,900	9,450	37,800	32,700	26,700	18.900
2-1/4	129.0	118,570	12,400	6,200	24,800	21,500	17,500	12,400	22,300	11,200	44,600	38,700	31,600	22,300
2-1/2	149.0	133,000	13,900	6,950	27,800	24,100	19,700	13,900	25,000	12,500	50,000	43,300	35,400	25,000
2-5/8	168.0	153,900	16,000	8,000	32,000	27,700	22,600	16,000	28,800	14,400	57,600	49,900	40,700	28,800

Table E-16.—Safe working load for polyester rope slings

Rope diameter nominal (inches)	Nominal weight per 100 feet (pounds)	Minimum breaking strength (pounds)	Safe working load in pounds (safety factor = 9)											
			Eye and eye sling						Endless sling					
			Vertical hitch	Choker hitch	Basket hitch: angle of rope to horizontal				Vertical hitch	Choker hitch	Basket hitch: angle of rope to horizontal			
					90°	60°	45°	30°			90°	60°	45°	30°
					Angle of rope to vertical						Angle of rope to vertical			
					0°	30°	45°	60°			0°	30°	45°	60°
1/2	8.0	6,080	635	320	1,270	1,100	900	635	1,140	570	2,290	1,980	1,620	1,140
9/16	10.2	7,600	790	395	1,580	1,370	120	790	1,420	710	2,840	2,460	2,010	1,420
5/8	13.0	9,500	990	495	1,980	1,710	1,400	990	1,780	890	3,570	3,090	2,520	1,780
3/4	17.5	11,875	1,240	620	2,480	2,150	1,750	1,240	2,230	1,120	4,470	3,870	3,160	2,230
13/16	21.0	14,725	1,540	770	3,080	2,670	2,180	1,540	2,770	1,390	5,540	4,800	3,920	2,770
7/8	25.0	17,100	1,780	890	3,560	3,080	2,520	1,780	3,200	1,600	6,410	5,550	4,530	3,200
1	30.5	20,900	2,180	1,090	4,360	3,780	3,080	2,180	3,920	2,960	7,850	6,800	5,550	3,920
1-1/16	34.5	24,225	2,530	1,270	5,060	4,380	3,580	2,530	4,550	2,280	9,110	7,990	6,440	4,550
1-1/8	40.0	28,025	2,920	1,460	5,840	5,060	4,130	2,920	5,260	2,630	10,500	9,100	7,440	5,260
1-1/4	46.3	31,540	3,290	1,650	6,580	5,700	4,650	3,290	5,920	2,960	11,800	10,300	8,380	5,920
1-5/16	52.5	35,625	3,710	1,860	7,420	6,430	5,250	3,710	6,680	3,340	13,400	11,600	9,450	6,680
1-1/2	66.8	44,460	4,630	2,320	9,260	8,020	6,550	4,630	8,330	4,170	16,700	14,400	11,800	8,330
1-5/8	82.0	54,150	5,640	2,820	11,300	9,770	7,980	5,640	10,200	5,080	20,300	17,600	14,400	10,200
1-3/4	98.0	64,410	6,710	3,360	13,400	11,600	9,490	6,710	12,100	6,040	24,200	20,900	17,100	12,100
2	118.0	76,000	7,920	3,960	15,800	13,700	11,200	7,920	14,300	7,130	28,500	24,700	20,200	14,300
2-1/8	135.0	87,400	9,110	4,460	18,200	15,800	12,900	9,110	16,400	8,200	32,800	28,400	23,200	16,400
2-1/4	157.0	101,650	10,600	5,300	21,200	18,400	15,000	10,600	19,100	9,540	38,200	33,100	27,000	19,100
2-1/2	181.0	115,900	12,100	6,050	24,200	21,000	17,100	12,100	21,800	10,900	43,600	37,700	30,800	21,800
2-5/8	205.0	130,150	13,600	6,800	27,200	23,600	19,200	13,600	24,500	12,200	49,000	42,400	34,600	24,500

Table E-17.—Safe working load for polypropylene rope slings

Rope diameter nominal (inches)	Nominal weight per 100 feet (pounds)	Minimum breaking strength (pounds)	Safe working load in pounds (safety factor = 6)												
			Eye and eye sling						Endless sling						
			Vertical hitch	Choker hitch	Basket hitch: angle of rope to horizontal				Vertical hitch	Choker hitch	Basket hitch: angle of rope to horizontal			
					90˚	60˚	45˚	30˚			90˚	60˚	45˚	30˚
					Angle of rope to vertical						Angle of rope to vertical			
					0˚	30˚	45˚	60˚			0˚	30˚	45˚	60˚
1/2	4.7	3,990	645	325	1,290	1,120	910	645	1,160	580	2,320	2,010	1,640	1,160
9/16	6.1	4,845	780	390	1,560	1,350	1,100	780	1,400	700	2,810	2,430	1,990	1,400
5/8	7.5	5,890	950	475	1,900	1,650	1,340	950	1,710	855	3,420	2,960	2,420	1,710
3/4	10.7	8,075	1,300	650	2,600	2,250	1,840	1,300	2,340	1,170	4,680	4,050	3,310	2,340
13/16	12.7	9,450	1,520	760	3,040	2,630	2,150	1,520	2,740	1,370	5,470	4,740	3,870	2,740
7/8	15.0	10,925	1,760	880	3,520	3,050	2,490	1,760	3,170	1,580	6,340	5,490	4,480	3,170
1	18.0	13,300	2,140	1,070	4,280	3,700	3,030	2,140	3,850	1,930	7,700	6,670	5,450	3,860
1-1/16	20.4	15,200	2,450	1,230	4,900	4,240	3,460	2,450	4,410	2,210	8,820	7,640	6,240	4,410
1-1/8	23.7	17,385	2,800	1,400	5,600	4,850	3,960	2,800	5,040	2,520	10,100	8,730	7,130	5,040
1-1/4	27.0	19,950	3,210	1,610	6,420	5,560	4,540	3,210	5,780	2,890	11,600	10,000	8,170	5,780
1-5/16	30.5	22,325	3,600	1,800	7,200	6,240	5,090	3,600	6,480	3,240	13,000	11,200	9170	6,480
1-1/2	38.5	28,215	4,540	2,270	9,080	7,860	6,420	4,540	8,170	4,090	16,300	14,200	11,600	8,170
1-5/8	47.5	34,200	5,510	2,760	11,000 13,200	9,540	7,790	5,510	9,920	4,960	19,800	17,200	14,000	9,920
1-3/4	57.0	40,850	6,580	3,290	15,900	11,400	9,300	6,580	11,800	5,920	23,700	20,500	16,800	11,800
2	69.0	49,400	7,960	3,980	18,700	13,800	11,300	7,960	14,300	7,160	28,700	24,800	20,300	14,300
2-1/3	80.0	57,950	9,330	4,670		16,200	13,200	9,330	16,800	8,400	33,600	29,100	23,800	16,800
2-1/4	92.0	65,550	10,600	5,300	21,200	18,400	15,000	10,600	19,100	9,540	38,200	33,100	27,000	19,100
2-1/2	107.0	76,000	12,200	6,100	24,400	21,100	17,300	12,200	22,000	11,000	43,900	38,000	31,100	22,000
2-5/8	120.0	85,500	13,800	6,900	27,600	23,900	19,600	13,800	24,800	12,400	49,700	43,000	35,100	24,800

Table E-18.—Safe working load for synthetic web slings–1,000 pounds per inch of width–single ply

Sling body width (inches)	Triangle–choker slings, type I; triangle–triangle slings, type II; eye and eye with flat eye slings, type III; eye and eye with twisted eye slings, type IV						Endless slings, type V						Return eye slings, type VI					
	Vertical	Choker	Vertical basket	30˚ basket	45˚ basket	60˚ basket	Vertical	Choker	Vertical basket	30˚ basket	45˚ basket	60˚ basket	Vertical	Choker	Vertical basket	30˚ basket	45˚ basket	60˚ basket
1	1,000	750	2,000	1,700	1,400	1,000	1,600	1,300	3,200	2,800	2,300	1,600	800	650	1,600	1,400	1,150	800
2	2,000	1,500	4,000	3,500	2,800	2,000	3,200	2,600	6,400	5,500	4,500	3,200	1,600	1,300	3,200	2,800	2,300	1,600
3	3,000	2,200	6,000	5,200	4,200	3,000	4,800	3,800	9,600	8,300	6,800	4,800	2,400	1,950	4,800	4,150	3,400	2,400
4	4,000	3,000	8,000	6,900	5,700	4,000	6,400	5,100	12,800	11,100	9,000	6,400	3,200	2,600	6,400	5,500	4,500	3,200
5	5,000	3,700	10,000	8,700	7,100	5,000	8,000	6,400	16,000	13,900	11,300	8,000	4,000	3,250	8,000	6,900	5,650	4,000
6	6,000	4,500	12,000	10,400	8,500	6,000	9,600	7,700	19,200	16,600	13,600	9,600	4,800	3,800	9,600	8,300	6,800	4,800

Notes:
1. All angles shown are measured from the vertical.
2. Capacities for intermediate widths not shown may be obtained by interpolation.

Table E-19.—Safe working load for synthetic web slings–1,200 pounds per inch of width–single ply

Sling body width (inches)	Triangle–choker slings, type I; triangle–triangle slings, type II; eye and eye with flat eye slings, type III; eye and eye with twisted eye slings, type IV						Endless slings, type V						Return eye slings, type VI					
	Vertical	Choker	Vertical basket	30˚ basket	45˚ basket	60˚ basket	Vertical	Choker	Vertical basket	30˚ basket	45˚ basket	60˚ basket	Vertical	Choker	Vertical basket	30˚ basket	45˚ basket	60˚ basket
1	1,200	900	2,400	2,100	1,700	1,200	1,900	15,300	3,800	3,300	2,700	1,900	950	750	1,900	1,650	1,350	950
2	2,400	1,800	4,800	4,200	3,400	2,400	3,800	3,000	7,600	6,600	5,400	3,800	1,900	1,500	3,800	23,830	2,700	1,900
3	3,600	2,700	7,200	6,200	5,100	3,600	5,800	4,600	11,600	10,000	8,200	5,800	2,850	2,250	5,700	4,950	4,050	2,850
4	4,800	3,600	9,600	8,300	6,800	4,800	7,700	6,200	15,400	13,300	10,900	7,700	3,800	3,000	7,600	6,600	5,400	3,800
5	7,000	4,500	12,000	10,400	8,500	6,000	9,600	7,700	19,200	16,600	13,600	9,600	4,750	3,750	9,500	8,250	6,750	4,750
6	7,200	5,400	14,400	12,500	10,200	7,200	11,500	9,200	23,200	19,900	16,300	11,500	5,800	4,600	11,600	10,000	8,200	5,800

Notes: 1. All angles shown are measured from the vertical.
2. Capacities for intermediate widths not shown may be obtained by interpolation.

Table E-20.—Safe working load for synthetic web slings–1,600 pounds per inch of width–single ply

Sling body width (inches)	Triangle–choker slings, type I; triangle–triangle slings, type II; eye and eye with flat eye slings, type III; eye and eye with twisted eye slings, type IV						Endless slings, type V						Return eye slings, type VI					
	Verti-cal	Choker	Vertical basket	30˚ basket	45˚ basket	60˚ basket	Vertical	Choker	Vertical basket	30˚ basket	45˚ basket	60˚ basket	Vertical	Choker	Vertical basket	30˚ basket	45˚ basket	60˚ basket
1	1,600	1,200	3,200	2,800	2,300	1,600	2,600	2,100	5,200	4,500	3,700	2,00	1,50	1,050	2,600	2,250	1,850	1,300
2	3,200	2,400	6,400	5,500	4,500	3,200	5,100	4,100	10,200	8,800	7,200	5,100	2,600	2,100	5,200	4,500	3,700	2,00
3	4,800	3,600	9,600	8,300	6,800	4,00	7,700	6,200	15,400	13,300	10,900	7,700	3,900	3,150	7,800	6,750	5,500	3,900
4	6,400	4,800	12,800	11,100	9,000	6,400	10,100	8,200	20,400	17,00	14,400	10,200	5,100	4,100	10,200	8,800	7,200	5,100
5	8,000	6,000	16,000	13,800	11,300	8,000	12,800	10,200	25,600	22,200	18,100	12,800	6,400	5,150	12,800	11,050	9,050	6,400
6	9,600	7,200	19,200	16,600	13,600	9,600	15,400	12,300	30,800	26,700	21,800	15,400	7,700	6,200	15,400	13,300	10,900	7,700

Notes: 1. All angles shown are measured from the vertical.
2. Capacities for intermediate widths not shown may be obtained by interpolation.

Table E-21.—Single leg polyester roundslings–endless and eye and eye type (safe working load in pounds)

Size (see note)	Vertical	Choker	Vertical basket	60° basket	45° basket	30° basket
1	2,600	2,100	5,200	4,500	3,700	2,600
2	5,300	4,200	10,600	9,200	7,500	5,300
3	6,400	6,700	16,800	14,500	11,900	8,400
4	10,600	8,500	21,200	18,400	15,000	10,600
5	13,200	10,600	26,400	22,900	18,700	13,200
6	16,800	13,400	33,600	29,100	23,800	16,800
7	21,200	17,000	42,400	36,700	30,000	21,200
8	25,000	20,000	50,000	43,300	35,400	25,000
9	31,000	24,800	62,000	53,700	43,800	31,000
10	40,000	32,000	80,000	69,300	56,600	40,000
11	53,000	42,400	106,000	91,800	74,900	53,000
12	66,000	52,800	132,000	114,300	93,300	66,000
13	90,000	72,000	180,000	155,900	127,300	90,000

Note: Roundslings are identified by the vertical rated load shown on the tag. The size numbers in this column have been adopted by the Web Sling and Tiedown Association to describe certain polyester round slings. They are included for reference only.

Table E-22.—Safe working loads for forged alloy steel shackles

Safe working loads for shackles (forged alloy steel)		
Material diameter (inches)	**Inside width at pin (inches)**	**Safe working load, tons (2,000 lb)**
3/16 = 0.187	3/8= 0.375	0.33
1/4 = 0.250	15/32 = 0.468	0.50
5/16 = 0.312	17/32 = 0.531	0.75
3/8 = 0.375	21/32 = 0.656	1.00
7/16 = 0.437	23/32 = 0.718	1.50
1/2 = 0.500	13/16 = 0.812	2.00
5/8 = 0.625	1-1/16 = 1.062	3.25
3/4 = 0.750	1-1/4 = 1.250	4.75
7/8 = 0.875	1-7/16 = 1.437	6.50
1 = 1.000	1-11/16 = 1.687	8.50
1-1/8 = 1.125	1-13/16 = 1.812	9.50
1-1/4 = 1.250	2-1/32 = 2.031	12.0
1-3/8 = 1.375	2-1/4 = 2.250	13.5
1-1/2 = 1.500	2-3/8 = 2.375	17.0
1-3/4 = 1.750	2-7/8 = 2.875	25.0
2 = 2.000	3-1/4 = 3.250	35.0
2-1/2 = 2.500	4-1/8 = 4.125	50.0
3 = 3.000	5 = 5.000	75.0
3-1/2 = 3.500	5-3/4 = 5.750	100
4 = 4.000	6-1/2 = 6.500	130

Appendix F

Record of Performance Inspection and Test—Crawler, Locomotive, Truck, and Wheel Cranes

General

All mobile cranes must be performance inspected and tested by the owner and/or contractor in accordance with the provisions contained herein; in the section entitled “Hoisting Equipment, Piledrivers, and Conveyors; and on attached forms entitled “Brake Performance Test Record” and “Performance Load Test Record.” Such inspections and tests must be conducted (a) prior to initial onsite operation; (b) periodically, but at least once each 12-month period; (c) whenever the crane is modified, altered, or undergoes extensive repair, including rerigging; and (d) when directed by the Contracting Officer’s Representative (COR). For contractor equipment, such inspections and tests must be conducted in the presence of a Reclamation representative and recorded in the appropriate places on inspection records. The forms will then be signed by a contractor and Reclamation representative and submitted to Reclamation. Initial and periodic crane inspections and tests will be conducted onsite after the crane has been assembled or reassembled and fully rigged for operation. Manufacturer’s, contractor’s, or owner’s offsite inspections and tests must not be conducted until all appropriate performance inspection items are found to be available and in acceptable condition.

Item	Description	Available/ Acceptable
(1) Manufacturer's operating and maintenance manuals	Manufacturer's operating and maintenance instructions and manuals must accompany all mobile hoisting equipment. These manuals set for the inspection operation and maintenance criteria that is not available from any other source.	
(2) Maintenance "frequent" and "periodic" inspection records	Inspection and maintenance records must be complete and current. Unless owner can produce these records, this performance inspection will not be continued until the appropriate maintenance and inspections are completed and current records developed. (See ANSI/ASME B30.5)	
(3) Reverse signal alarm	An automatic reverse signal alarm is installed and functions when unit is placed in reverse gear or is moving in reverse. The alarm has been field tested.	
(4) Audible warning device	The crane is equipped with an audible warning device having the control lever(s) within reach of the operator(s) when seated in the operating position(s).	
(5) Lights	On-highway type equipment has, as a minimum, two taillights, two stoplights, flashing emergency lights (forward and backward), turn signals (forward and backward), or combination turn, flashing, stopping lights, and backup light. DOT requirements shall govern when applicable. Off-highway type equipment must have two headlights, two combination stop and tail lights, and backup light. On- or off- highway equipment, when used in restricted visibility situations, must have floodlamps to illuminate working areas.	
(6) Cabs	Cabs are provided with safety glazed windows in the front and both sides. Visibility forward includes a vertical range adequate to cover the boom point at all times. A windshield wiper is provided for front window. An effective heater and defroster system is provided. Cab doors (whether of sliding or swinging type) have a restraining system while crane is traveling or operating. Operator's door swings outward or slides rearward. Operator is provided clear passageway from the operator station to exit door.	
(7) Access	Walking surfaces are of the skid-resistant type. Platforms are provided with guardrails. Access system incorporates the three-point support method. One foot - 2 hands; 1 hand - 2 feet on ladders or handholds at all times. (See SAE J185 or Federal Motor Carrier Safety Regulations 399.207, Truck and Tractor Access Regulations.)	

Item	Description	Available/ Acceptable
(8) Fire extinguishers	One 2A 40 B:C fire extinguisher is mounted near operator's station and accessible from a ground location.	
(9) Fenders	Truck-mounted cranes are equipped with fenders. Self-propelled cranes are equipped with manufacturer available fenders.	
(10) Seat belts	Truck-mounted cranes have seat belts conforming to DOT standards. Self-propelled cranes have seat belts conforming to DOT or appropriate SAE standards.	
(11) Guarding	Exposed moving parts, such as gears, chains, reciprocating or rotating parts, are guarded or isolated.	
(12) Exhaust system	Engine exhaust gases are piped outside of cab and/or discharged away from operator. Exhaust pipes are guarded or insulated to protect operating and maintenance personnel.	
(13) Swing clearance protection	Materials for guarding rear swing area are available.	
(14) High-voltage warning sign	High-voltage warning signs displaying Reclamation requirements are installed at operator's station and at strategic locations on the crane.	
(15) Operator physical exam	Operator has evidence of undergoing and satisfactorily completing a physical examination within the preceding 12 months.	
(16) Boom stops	Telescoping shock-absorbing or hydraulic-type boom stops meeting SAE J 220 (see SAE J220) are installed in a manner that resists boom overtopping.	
(17) Jib boom stops	Jib booms are restrained from backward overturning.	
(18) Boom angle indicator	A boom angle indicator, readable from the operator station, is installed and field tested for accuracy.	
(19) Boom hoist disconnect	A boom hoist disconnect, shutoff or hydraulic relief, is provided to automatically stop the boom hoist when the boom reaches a predetermined high angle. The disconnect has been field tested.	

Item	Description	Available/ Acceptable
(20) Two-block damage prevention device	All cranes with telescoping booms are equipped with a two-block damage prevention feature that has been onsite tested in accordance with manufacturer's requirements. All cranes to be used in manskip or shaft sinking operations are equipped with two-block prevention devices on all hoistlines intended to be used in the operation. The two-block device has automatic capabilities for controlling functions that may cause a two-blocking condition. A two-block prevention device which sounds an alarm only is not acceptable. Two-blocking devices have been tested during this inspection.	
(21) Power-controlled lowering	Cranes for use in manskip or shaft sinking operations are equipped for power-controlled lowering operation on all hoistlines. Cranes with free	
(22) Leveling indicating device	A device or procedure for leveling the crane is provided.	
(23) Sheaves	Sheave grooves are smooth and free from surface defects, cracks, or worn places that could cause rope damage. The bottom of the sheave groove forms a close-fitting saddle for the rope being used. Lower load blocks are equipped with close-fitting guards. Load hoisting sheaves have a pitch diameter not less than 18 times the nominal diameter of rope used. Lower block pitch diameters are not less than 16 times the nominal rope diameter.	
(24) Main boom, jib boom, boom extension	Boom jibs, or extensions are not cracked or corroded. Bolts and rivets are tight. Certification that repaired boom members meet manufacturer's original design standard must be attached to this form. Noncertified repaired members must not be used until recertified.	
(25) Load hooks and hook blocks	Hooks and blocks are permanently labeled with rated capacity. Hooks and blocks are counterweighted to overhaul line from highest hook position. Hooks do not have cracks or throat openings more then 15 percent of normal or twisted off center more than 10 degrees from the longitudinal axis. All hooks are equipped with effective safety catches.	

Item	Description	Available/ Acceptable
(26) Ropes	Ropes are proper size, grade, and construction for the particular performance or function. They do not have the following deficiencies: a. In running ropes, six randomly distributed broken wires in one rope lay, or three broken wires in one rope lay, or three broken wires in one strand in one rope lay. (A rope lay is the length along the rope in which one strand makes a complete revolution around the rope.) b. In pendants or standing ropes, evidence of more than one broken wire in one lay. c. Abrasion, scrubbing, or peening causing loss of more than one-third of the original diameter of the outside wires. d. Evidence of visible corrosion. e. Kinking, crushing, or other damage resulting in distortion of the rope structure. f. Evidence of any heat damage from a torch or arc caused by contact with electrical wire. g. Reduction from nominal rope diameter of more than 3/64 inch for diameter up to and including 3/4; 1/16 inch for diameters 7/8 inch to 1-1/8 inches; 3/32 inch for diameters 1-1/4 to 1-1/2 inches. Marked for reduction in diameter indicates deterioration of the core, resulting in lack of proper support for the load-carrying strands. Excessive rope stretch or elongation may also be an indication of internal deterioration. h. Evidence of “bird caging” or other distortion resulting in some members of the rope structure carrying more load than others. i. Noticeable rusting or development of broken wires in the vicinity of attachments.	

Item	Description	Available/ Acceptable
(27) Hydraulic hoses, fittings, and tubing	Flexible hoses are sound and show no signs of leaking at the surface or its junction with the metal and couplings. Hoses show no blistering or abnormal deformation to the outer covering. There are no leaks at threaded or clamped joints that cannot be eliminated by normal tightening or recommended procedures. There is no evidence of excessive abrasion or scrubbing on the outer surfaces of hoses, rigid tubing, or hydraulic fittings.	
(28) Outriggers	Outrigger number, locations, types, and type of control are in accordance with manufacturer's specifications. Outriggers are designed and operated to relieve all weight from wheels or racks within the boundaries of the outriggers. If not, the manufacturer's specifications and operating procedures must be clearly defined. Outriggers are visible to the operator or a signal person during extension or setting.	
(29) Load rating chart	A durable rating chart(s) with legible letters and figures is attached to the crane in a location accessible to the operator while at the controls. The rating chart contains the following data: a. A full and complete range of manufacturer's crane b. Optional equipment on the crane such as outriggers and extra counterweight which affect ratings. c. A work area chart for which capacities are listed in the load rating chart (i.e., overside, over read, over front). d. Weights of auxiliary equipment (i.e., load block, jibs, boom extensions). e. A clearly distinguishable list of ratings based on structural, hydraulic, or other factors rather than stability. f. A list of no-load work areas. g. A description of hoistline reeving requirements.	
(30) Hoisting rope specifications	Rotation-resistant rope and fiber core rope are not being used for boom hoist reeving. Socketing is being done in the manner specified by manufacturer. Eye splices meet manufacturer's requirements or these standards.	

Item	Description	Available/ Acceptable
(31) Tires	Tires are the size recommended by the manufacturer for the anticipated load. Tire conditions are satisfactory, and the tires are inflated to recommended pressures.	
(32) Braking systems	(a) Trucks and self propelled cranes: Truck cranes and self propelled cranes mounted on rubber-tired chassis or frames manufactured after July 1, 1967, are equipped with a service brake system, secondary stopping (emergency brake) system, and a parking brake system. All systems conform to J/ISO 3450, Braking Performance Rubber-tired Construction Machines, or Department of Transportation Federal Motor Carrier Safety Regulations 393.40 applicable provisions of this appendix and RSHS. Rubber-tired equipment manufactured prior to July 1967 are equipped with an effective service braking system having, as a minimum, features, components, accessories, and capabilities set forth on form entitled "Brake Performance Test Record." The units are also equipped with an effective secondary stopping system meeting these requirements unless the owner/operator can show written evidence that such systems were not required by the standards or regulations in force at the date of manufacture and are not available from the manufacturer. The braking systems have been inspected and tested and found to be in conformance with applicable requirements contained in the referenced standards and on an attached brake performance test record form. Further, the inspection and test results have been recorded on the aforementioned form. (b) Crawler cranes: Crawler cranes are provided with brakes or other locking devices that effectively hold the machine stationary on level grade during the working cycle. The braking system is capable of stopping and holding the machine on the maximum grade recommended for travel. The brakes or locks are arranged to engage or remain engaged in the event of loss of operating pressure or power. (c) Locomotive cranes: Locomotive cranes are provided with an effective braking system(s) that is capable of stopping and holding the cranes on the maximum grade recommended for travel. Further, a manual engagement means is provided to hold the machine stationary during the working cycle. Such means must be arranged to engage or remain engaged in the event of loss of operating power or pressure.	

Performance Inspection

The performance inspection must as a minimum, include the following features, components, accessories, and tests.

Performance Test Procedure

Upon completion of a satisfactory performance inspection and Part I of the performance load test record form, the crane can be prepared for testing. The crane must be placed on level ground (or railroad tracks if rail type). Outriggers, if provided, must be firmly set and relieve all weight from wheels within the boundary of the outriggers. The owner or contractor must select a test weight and boom radius that will provide a test load of 110 percent of the manufacturer's rating for the selected radius when the boom angle is between 30 degrees and 60 degrees above the horizontal. The load will be raised and lowered and rotated through 360 longitudinal degrees or manufacturer's specified maximum degree of rotation. The load must remain in the raised position for 10 minutes, then be lowered to the ground and critical load-bearing parts inspected for damage. (Note: Paint chipping or cracking, or deformation of structural members usually denotes a serious structural deficiency.) This testing procedure is basic for all cranes. Cranes to be used with jibs or boom tip extensions or manually extended boom sections must have these components tested in accordance with the above procedures. (Note: If the jib or boom extension is to remain in place during main hoist line operation, the basic test must be conducted with the jib or extension in place and test loads adjusted accordingly).

Hydraulic or other type cranes with telescoping booms must be further tested during telescoping operations. Cranes to be used in pick and carry operations must be tested with a load consistent with owner/contractor intended operation but never greater than the manufacturer's Secom-mediation. Cranes to be used in manskip or shaft sinking operations must be further tested in the power-controlled lowering mode. This test can be integrated into the basic testing procedure by raising the load a second time and lowering it under power to near ground level, and suspending it there an additional 10 minutes. Cranes without free falling capabilities need only be tested in the power-controlled lowering mode. (Caution: Exercise extreme care in determining mobile cranes test load).

Once manufacturer's rating charts are consulted to determine maximum loading at chosen radius, rigging limitations must be computed to ensure wire rope safety factors are not exceeded. Such determination is made by: (1) adding selected load weight to weight of all auxiliary handling devices such as hoist block, hooks, slings, etc.; (2) dividing this figure by number of parts of line to obtain hoisting load per single part of line; (3) obtaining manufacturer's specified breaking strength for type of rope being used (i.e., a 3/4-inch Manioc steel rope of 6 - by 35 filler wire constructed with independent wire rope core has a breaking strength of 25.6 tons); and (4) dividing or guy ropes. Compare this resultant figure with single part line load to determine if selected load exceeds safe load. If safe load is exceeded, a new weight consistent with calculated line load must be chosen. (Note: Calculated safe single part line load multiplied by number parts of line sets the maximum crane load rating under existing rigging conditions regardless of maximum crane rating set by manufacturer).

Computation of Test Radius[1]

W_t	=	Test weight (weight + sheave + rigging or dynamiter reading)	=	_____	lbs.
W.c.	=	Computed weight = test weight = $\underline{W_t}$ = ___	=	_____	lbs.
W.g.	=	Crane chart rated capacity (use next weight greater than W.c.)	=	_____	lbs.
WL	=	Crane chart rated capacity (use next weight less than W.c.)	=	_____	lbs.
W	=	Weight difference (W.g. - W.c.) = ____ - ____	=	_____	lbs.
WO	=	Weight difference (W.g. - WL) = ____ - _____	=	_____	lbs.
R.	=	Radius shown on crane chart for W.g.	=	_____	ft.
RLL	=	Radius shown on crane chart for WL	=	_____	ft.
r	=	Radius difference (RLL - R.) = _____ - _____	=	_____	ft.
R_o	=	Computed radius difference = $\frac{\text{w x r}}{\text{WO}}$ = $\underline{\text{--x–}}$	=	_____	ft.
T_r	=	Test radius (R. + R_o) + ____ + ____	=	_____	ft.

[1] Contractor's test radius can be checked by the above formula for an estimate, but is not to be used for determining the actual test radius.

Braking System Requirements and Test Procedures

Part 1 - General

Truck cranes and self-propelled cranes mounted on rubber tired chassis or frames must have braking systems conforming to the section entitled "Mobile and Stationary Mechanized Equipment" and Item 32 of performance inspection criteria. Further, the crane's braking systems must incorporate the features, components, accessories, and performance capabilities required under parts II and III of this form.

Cranes that meet the requirements of item 32 and part II of this form and the section entitled "Mobile and Stationary Mechanized Equipment" shall be brake tested in accordance with the requirements, methods, and procedures described in that section and in part III of this form. Record the results in parts V, VI, and VII of this form. Sign the completed form in part VIII and submit it to Reclamation. Equipment failing brake test(s) must not be place into service or performance load tested until the braking system has been repaired and satisfactorily tested.

Part II - Braking Systems, Features, Components, Accessories

A. Service Braking System

1. All cranes must have an effective service braking system. The service brake system must be capable of stopping and holding an unloaded crane on a 25-percent grade with the boom and other applicable components in the transport position recommended by the manufacturer. This requirement applies to both forward and reverse directions. The braking system also must be capable of bringing the crane to a stop within the distances and under the conditions specified in part III.

2. The service braking system must be the type that can be foot-applied or released by the operator while sitting in the operating position.

3. Cranes must have service brakes on all wheels except:

   a. Truck cranes with three or more axles need not have brakes on the front wheels unless equipped with two steerable axles, and then the wheels on one such axle must be equipped with brakes.

   b. Self-propelled cranes may have only two braked wheels (one lefthand, one right-hand) if the system meets the stopping distance requirements (part III).

B. Secondary Braking System

1. All cranes, unless exempted by paragraph 20.6.3 of RSHS or item 32, must have an secondary braking system.

2. The system must be capable of being applied manually by a person seated in the operating position. The system must be arranged so it cannot be released from the operator's seat after any application, unless immediate replication can be made from the operator position.

3. The system may, in addition to manual activation, be activated automatically. If equipped with an automatic activation feature, the automatic application must occur after a warning device is activated.

4. The system must be capable of bringing the crane to a stop within the distances and under the conditions specified in part III.

C. Parking Brake System

1. All cranes must have an effective parking brake system.

2. The braking system must be capable of being applied by a person seated in the operator's seat.

3. The braking system can be applied by the driver's muscular efforts, by spring actions, or by other energy, provided that the brake will remain in the applied position despite any contraction of brake parts, exhaustion of

energy source, or leakage of fluid. The brake shall be such that it cannot be released unless adequate energy is available to make immediate further application with required effectiveness.

4. The braking systems must be capable of holding the crane stationary under the conditions specified in part III.

D. Features, Components, Accessories

1. Braking systems utilizing air, or vacuum energy assist devices must be equipped with a gage that indicates the pressure or vacuum available for braking.

2. Braking systems utilizing air, hydraulic (other than brake pedal pressure), or vacuum assist energy devices must be equipped with a readily visible or audible continuous warning device at the operator's position. The device will actuate: (a) before air or hydraulic pressure drops below 50 percent or maximum operating energy level; (b) when vacuum in the supply reservoir is less than 8 inches of mercury; or (c) before or upon application of dual hydraulic type systems. Gauges indicating pressure or vacuum do not meet this requirement.

3. All braking systems utilizing air, pressure, or vacuum for braking must have reserve capacity or a reservoir of sufficient capacity to ensure a full-service brake application with the engine stopped, without depleting the air pressure or vacuum below 70 percent of operating pressure or vacuum.

Part III - Brake Testing Methods and Procedures

All trucks and self-propelled cranes mounted on rubber-tired chassis or frames must undergo the braking performance tests required by the section entitled "Mobile and Stationary Mechanized Equipment." Conduct such tests in accordance with the following methods and /or procedures.

A. General

1. All tests must be conducted with applicable braking systems at full charge.

2. Units must be tested in an unloaded condition with all attachments and components in the transport position recommended by the manufacturer.

3. All stopping tests must be conducted from a 20-mile-per-hour speed.

4. Stopping tests must be conducted with the transmission in the gear range commensurate with the 20-mile-per-hour testing speed. The power train may be disengaged prior to completing the stop.

5. Auxiliary retarders must not be used in the test unless the retarders are simultaneously activated by the applicable brake control system.

6. Stopping distances must be measured from the point at which the brake control is applied to the point at which the machine stops.

7. Means must be provided to determine equipment weight and stopping distance with an accuracy of plus or minus 2 percent and test speed with an accuracy of plus or minus 5 percent.

B. Service and Secondary Braking System

1. Service and secondary braking tests must be conducted on a level (less than 1-percent grade in direction of travel and 3 percent at right angles to travel), clean, swept dry surfaces at least 18 feet 0 inches wide. The course length will be sufficient for accelerating from 0 to 20 miles per hour and providing a stopping distance equal to 1-1/2 times that shown for the emergency braking system.

Units utilizing a dual system for meeting emergency brake system requirements must have each system independently tested (i.e., each system of a dual hydraulic system must be tested independently).

2. Service and secondary braking system must have the following stopping capabilities when traveling at 20 miles per hour:

Machine GVWR	Service brake	Secondary brake
Up to 50,000	55 feet	146 feet
Over 50,000	62 feet	156 feet

The unit will not deviate from a 12-foot-wide lane before or during the test. Do not permit any wheels to drag during the service brake tests.

C. Parking Brake System

1. Conduct parking brake system tests on a dry, swept, 15-percent grade surface. Conduct the tests with the unit facing both up and down the slope.

2. Once the unit is in place and the parking brake is set, release all other holding devices and braking systems and place the transmission in the neutral position. Any energy assist sources (air, vacuum, hydraulic) will be depleted. The unit must remain in this condition without movement for 5 minutes.

D. Energy Recovery Test

1. The braking system's primary power source must have the following recovery capabilities:

a. Air. Seventy percent of maximum brake pressure when the service brakes are fully applied 12 times at the rate of 4 applications per minute with the engine running at maximum governed revolutions per minute.

b. Vacuum. Seventy-percent maximum brake vacuum after one full (pedal depressed to full limit of travel) service brake application with engine stopped.

c. Hydraulic. Pedal cannot be depressed to within 1 inch of floor or limit of travel on any one full application of the pedal.

BRAKE PERFORMANCE TEST RECORD

TRUCK CRANES AND SELF-PROPELLED CRANES MOUNTED ON RUBBER-TIRED CHASSIS OR FRAMES

General Information		
Date of Test	Specification No.	
Contractor		Subcontractor
Description (Make and Model)		
Serial No., or Contractor's No.		Year of Manufacture
Service Brake System Test		
Type (air, vacuum, mechanical, hydraulic, comb.)		No. of axles with Brakes
Condition of Test Course (Surface and Grade)		
Weight of Vehicle (Manufacturer's Gross Vehicle Weight Rating- GVWR)		
Pressure or Vacuum Maintained During Braking □ Satisfactory □ Deficient		
Pressure or Vacuum Recovery		
Warning Device for Stored Energy Systems □ Satisfactory □ Deficient		
Stopping Distance (Satisfactory or Deficient in Comparison with Appropriate Table) Feet Traveled________ Feet Traveled________ 1st Trial Satisfactory □ Deficient □ 2nd Trial Satisfactory □ Deficient □		
Holding Performance on Grade Satisfactory □ Deficient □		
Emergency Stopping System		
Type	Manual Only	Manual/Automatic
Stopping Distance (Satisfactory or Deficient in Comparison with Appropriate Table) Feet Traveled________ Satisfactory □ Deficient □		
Parking System Tests		
Holds on 15% Grade Forward □ Reverse □		Remains Applied for 5 Minutes Forward □ Reverse □
Signatures		
Tested by (Contractor Representative): Signature: Title:		Witnessed by (Government Rep): Signature: Title:

<table>
<tr><td colspan="5">PERFORMANCE LOAD TEST RECORD
(Crawler, Locomotive, Truck and Wheel Cranes)</td></tr>
<tr><td colspan="5">Part I</td></tr>
<tr><td>Specification No.</td><td colspan="4">Name of Contractor</td></tr>
<tr><td>Make</td><td>Model</td><td colspan="3">Serial No.</td></tr>
<tr><td colspan="2">Rated Capacity</td><td colspan="3">Counterweight lbs.</td></tr>
<tr><td colspan="2">Length of Boom (if hydraulic, open / closed)</td><td colspan="3">Condition of Boom</td></tr>
<tr><td>Length of Jib</td><td>Weight</td><td>Condition of Jib</td><td colspan="2">Rated Capacity</td></tr>
<tr><td>Length of Boom Extension</td><td>Weight</td><td>Condition of Extension</td><td colspan="2">Rated Capacity</td></tr>
<tr><td>Boom Hoist Line Size</td><td>Breaking Strength</td><td>No. Parts of Line</td><td colspan="2">Pendant Line Size</td></tr>
<tr><td>Load Line Size (main)</td><td>Breaking Strength</td><td>No. Parts of Line</td><td>Class</td><td>Rotation Resistance
yes no</td></tr>
<tr><td>Whipline Size (runner or aux)</td><td>Breaking Strength</td><td>No. Parts of Line</td><td>Class</td><td>Rotation Resistance
yes no</td></tr>
<tr><td>Sheave Pitch Diameter</td><td>Boom Hoisting</td><td>Load Hoisting</td><td colspan="2">Load Block (lower)</td></tr>
<tr><td colspan="5">Equipped with Power Controlled Lowering: ☐ Load line ☐ Whipline ☐ Jibline ☐ Boom hoist line</td></tr>
<tr><td colspan="2">Type Boom Stops Main Boom Jib Boom</td><td colspan="3">Condition of Stops-Main Boom Jib Boom</td></tr>
<tr><td colspan="5">Type Mounting: ☐Track ☐Crawler Standard ☐Truck ☐ Self-Propelled (rubber tired)</td></tr>
<tr><td colspan="5">Part II Performance Test- Main Boom</td></tr>
<tr><td colspan="2">Test Load in Pounds (include sheave rigging and weight of other equipment as specified by owner's manual)</td><td>Test Radius</td><td>Boom Angle</td><td>Manufac. Load Rating at Radius</td></tr>
<tr><td colspan="2">Degree of Swing</td><td colspan="3">Outriggers</td></tr>
<tr><td colspan="5">Satisfactory: ☐ Lifting ☐ Swinging ☐ Lowering ☐ Braking</td></tr>
</table>

Part III	**Travel under Load Test** (if crane is going to travel under load on actual work)	
Load in Pounds	Boom Radius	Load Rating at Radius
Part IV	**Performance Test - Jib or Boom Extension**	
Load in Pounds	Boom Radius	Jib Used
Degree of Swing	Outriggers	
Satisfactory: ☐ Lifting ☐ Swinging	☐ Lowering ☐ Braking	
Remarks:		
Part V	**Signatures**	
Bureau Representative Date:	Contractor Representative Date:	
Note: (1) Load testing of cranes will be conducted in accordance with performance testing requirements contained herein and set forth in the section entitled, "Hoisting Equipment, Piledrivers, and Conveyors." (2) Contractors are responsible for equipment meeting or exceeding minimum specified requirements and/or standards, conducting required load tests, and signature of Government representative on the form only indicates the contractor did effect tests in accordance with Reclamation requirements. (3) Load tests will not be conducted until performance inspection requirements have been met.		

Appendix G

Record of Performance Inspection and Break Test—On-Highway Type Mobile Equipment

General

Nonexempt on-highway trucks, truck tractor/trailer combinations, transmix trucks, dump trucks, buses, manhaul units, and rubber-tired excavators and other similar on-highway-type equipment must be performance inspected and tested by the contractor and/or owner in accordance with provisions contained herein and in the section entitled "Mobile and Stationary Mechanized Equipment." (Cranes will be inspected and tested in accordance with the section entitled "Hoisting Equipment, Piledrivers, and Conveyors.") The contractor/owner must conduct the inspections and tests prior to initial onsite use, annually thereafter, and when directed by Reclamation.

Initial and annual inspections and tests must be conducted in the presence of a Bureau of Reclamation representative and recorded using performance inspection criteria below and on the "Brake Performance Test Record" or a form that provides the same information. The form will then be signed and submitted to the appropriate Reclamation representative. Initial and periodic inspections and tests must be conducted onsite after the vehicle has been assembled or reassembled and prepared for operation. Manufacturer, contractor, or owner offsite inspections and tests must not be conducted until all appropriate performance inspection items are found to be available and in acceptable condition.

Performance Inspection

The performance inspection must, as a minimum, include the following features, components, accessories, and tests.

Item	Description	Available/ Acceptable
(1) Manufacturer's operating and maintenance manual	Manufacturer's operating and maintenance manuals or similar instructions must accompany equipment.	
(2) Maintenance and inspection records	Maintenance and inspection records must accompany the equipment. Unless the owner can produce such records, a complete inspection and maintenance program will be carried out and recorded.	
(3) Reverse signal alarm	An automatic reverse signal alarm is installed and functions when unit is placed in reverse gear or is moving in reverse. Requirements for this device may be waived if the equipment will not be operating in close proximity to personnel on foot or in congested areas. The alarm has been field tested.	
(4) Audible warning device	The unit is equipped with an audible warning device having the control lever within reach of the operator when seated in the operating position.	

Item	Description	Available/ Acceptable
(5) Lights	Equipment meets DOT requirements but never less than two headlights (one on each side), one red taillight on each side, one red stoplight on each side, and directional signal lights on each side both front and rear. Backup lights and floodlamps to illuminate working areas in restricted visibility situations.	
(6) Cabs	All equipment must have cabs with shatter-resistant glazing in all windows, heaters, defrosters, rearview mirrors, and windshield wipers. Windshield must be free of discoloration or damage that affects safe operation. There must be at least one window on each side of driver compartment. Engine exhaust gases are piped outside and/or discharged away from operation.	
(7) Towing	Towing devices used on any combination of vehicles must be structurally adequate for the load imposed and securely and properly mounted. A locking device must be provided on fifth-wheel and tow bar systems to prevent accidental separation of units. Safety chains must be provided for towed units up to 3,000 pounds gross weight, and automatic break away stopping systems for towed units over 3,000 pounds gross weight.	
(8) Fenders and mudflaps	All equipment with maximum speed exceeding 15 mph and traveling on unsurfaced roads are provided with fenders and splash and stone throw protection. Haul trucks must conform to these requirements regardless of road surface. Trucks with beds or other structural members extending beyond wheel width and in a manner that prevents or eliminates danger from wheel thrown objects meets fender requirements. Reclamation may exempt fenders when not available from manufacturer.	
(9) Seatbelts	Seatbelts and anchorages meeting DOT requirements are installed for the operator and all passengers.	
(10) Emergency equipment	Vehicles exceeding 10,000 pound gross weight, buses, and manhaul units, are equipped with one 12-inch square red flag, three reflective markers, wheel chocks for each unit, one 2-A:40-B:C dry chemical fire extinguisher. When transporting flammable or explosive cargo, two 2A 40 B:C extinguishers are required.	
(11) Access	Access to cab or other work location on the equipment has sufficient steps and handholds to provide a three-point contact system for employees ascending or descending from work or operator positions. The first step is no more than 24 inches from ground level, or no more than 20 inches, unless means are provided for two handholds.	

Item	Description	Available/ Acceptable
(12) Fill openings	Fill hatches on water tank trucks or trailers are guarded by either reducing the size of the opening to a maximum of 8 inches in diameter or by attaching a heavy metal grill over the opening.	
(13) Dump trucks	Dump trucks of all descriptions are equipped with: (1) latches or other means for preventing accidental movement of trip handles or dump body operating levers. (2) A permanent mounted manual device to prevent accidental lowering of dump body or bed. (3) Cab protection if loaded or unloaded by crane, loader, or shovel. Trucks without this protection are equipped with a readily visible sign instructing the operator to leave the cab during loading or unloading operations.	
(14) End-dump trailers designed for on-highway hauling and used in off-road hauling	End-dump trailers are equipped with a tipover protection device with continuous monitoring display of the trailer box position at the equipment operator station to provide the operator with a quick and easily read indicator that shows safe, marginal, and unsafe degrees of lateral tilt. Additional requirements are: (1) an indicating audible alarm that signals an unsafe degree of tilt (alarm should have an on-off switch so it can be switched off when not dumping); (2) sufficient indicator lighting to be visible for night operations; and (3) hookup flexibility for easy interchange between tractors and trailers.	
(15) Transmix trucks lockout device	Transmix trucks are equipped with a lockout device that prevents use of exterior controls until interior gear arrangement and brakes are in proper position. Providing equal protection acceptable to Reclamation meets this requirement.	
(16) Braking systems	A bus, truck, tractor, or combination of vehicles or similar type equipment have the following braking systems conforming to these requirements, the RSHS, and DOT requirements. 1. A service braking system. 2. A parking brake system. 3. A secondary brake system. (Equipment manufactured prior to July 1967 may be exempted from this requirement unless the system was available from the manufacturer at date of manufacture, is presently available from the manufacturer, or was required by the standard in force at time of manufacture.) The above braking systems have been installed, inspected, and tested and found to be in conformance with applicable requirements contained in the referenced standards and on the Brake Performance Test Record form. Further, the inspection and test results have been recorded on the aforementioned form.	

Brake Performance Test Record

Part I - General

Nonexempt on-highway type trucks, truck-tractor/ combinations, transmix trucks, dump trucks, excavators, and similar on-highway type equipment must have braking systems conforming to Reclamation Safety and Health Standards and performance inspection criteria. The equipment must incorporate the features, components, accessories, and performance capabilities required under part II and part III.

Equipment found to meet the requirements of this form and RSHS section entitled, "Mobile and Stationary Mechanized Equipment" must be brake tested in accordance with the requirements, methods, and procedures described in part III and the RSHS. Results must be recorded in parts V, VI, and VII of this form. The completed form must be signed in part VIII and submitted to Reclamation.

Equipment failing brake test(s) must not be placed into service until the braking system has been repaired and satisfactorily tested.

Part II - Braking Systems Features, Components, Accessories, and Performance Capabilities

A. Service Braking System

1. All equipment must have an effective service braking system. The service brake system must have the capability of stopping and holding the equipment when loaded to the gross vehicle weight (GVW) on the maximum slope of intended travel. This requirement applies to both forward and reverse directions. The braking system also must be capable of bringing the equipment to a stop within the distances and under the conditions specified in part III.

2. The service brake system is the type that is foot applied or released by the operator while sitting in the operating position.

3. Equipment must have brakes on all wheels.

B. Secondary Braking System

1. All equipment, unless exempted, has a secondary brake system.

2. The system is capable of being applied manually by a person seated in the operating position. The system is arranged so it cannot be released from the operator's seat after an application, unless immediate reapplication can be made from the operator position.

3. The secondary brake system can be separate from the service brake system or an interconnected system. If an interconnected system is used, it must be designed, constructed, and maintained so failure of any part of the operating mechanism of one or more systems (except service brake activation pedal or valve in a dual hydraulic system) does not reduce the effectiveness of the vehicle's stopping capability below the secondary brake stopping performance requirements.

4. The system may, in addition to manual activation, be activated automatically. If equipped with an automatic feature dependent upon pressure or vacuum forces, the automatic application will not occur until a warning device is activated.

5. The system must be capable of bringing the equipment to a stop within the distances and under the condition specified in part III.

C. Parking Brake System

1. The equipment has an effective parking brake system or combination maxi-brake parking brake system.

2. The parking brake is capable of being applied by a person seated in the operator's seat.

3. The parking brake may be applied by the driver's muscular effort, or by spring action, or by any other energy, provided that energy source is isolated from other sources.

4. The parking brake system is held in the applied position by energy other than fluid pressure, air pressure, vacuum, or electric energy. The system must be such that it cannot be released unless adequate energy is available upon release to make further application with the required effectiveness.

5. The braking system is capable of holding the equipment stationary under the conditions specified in part III.

D. Features, Components, Accessories

1. Braking systems utilizing air, stored hydraulic, or vacuum energy must be equipped with a gage that indicates the pressure or vacuum available for braking.

2. Braking systems utilizing air, stored hydraulic, or vacuum energy must be equipped with a readily visible or audible low energy, continuous warning device at the operator's position. The device will activate: (a) before air or hydraulic pressure drops below 50 percent of maximum energy level; (b) when vacuum in the supply reservoir is less than 8 inches Hg, (c) before or upon application of dual hydraulic type systems. Gages indicating pressure or vacuum are not acceptable for meeting this requirement.

3. Braking systems may use common components (see secondary brake system requirements).

4. Braking systems utilizing air, stored hydraulic pressure, or vacuum for braking must be equipped with reserve capacity or a reservoir of sufficient capacity to insure a full service brake application with the engine stopped without depleting the air or hydraulic pressure or vacuum below 70 percent of operating pressure of vacuum.

Part III - Brake Testing Methods and Procedures

All equipment referenced in this appendix and section entitled "Mobile and Stationary Mechanized Equipment," unless exempted, must undergo the braking performance tests required. Such tests must be conducted in accordance with the following methods and/or procedures.

A. General

1. All tests must be conducted with applicable braking systems at full charge.

2. Units must be tested at maximum loading.

3. All dynamic stopping tests must be conducted from a 20-mile-per-hour speed.

4. Stopping tests must be conducted with the transmission in the gear range commensurate with the 20-mile-per-hour testing speed. The power train may be disengaged prior to completing the stop.

5. Auxiliary retarders must not be used in the test, unless the retarders are simultaneously activated by the applicable brake control system.

6. Stopping distances must be measured from the point at which the brake control is applied to the point at which the machine stops.

7. Means must be provided to determine weight of the equipment and stopping distance with an accuracy of plus or minus 2 percent and test speed with an accuracy of plus or minus 5 percent.

B. Service and Secondary Braking System

1. Service and secondary dynamic braking tests must be conducted on a level (less than

1-percent grade in direction of travel and 3-percent grade at right angles to travel) clean, swept dry surfaces at least 18 feet 0 inches wide. The course length must be sufficient for accelerating from 0 to 20 miles per hour and providing a stopping distance equal to 1-1/2 times that shown for the emergency braking system. Static service brake holding tests shall be conducted on maximum grade of intended travel.

2. Service and secondary braking system must have the following stopping capabilities when traveling at 20 miles per hour:

Equipment	Service Break	Secondary break
Light trucks and buses to 10,000 pounds	25	85
Trucks and buses over 10,000 pounds	35	85
Combination of vehicles	45	85

The units must not deviate from a 12-foot-wide lane prior to or during tests. No wheels shall drag during the service braking test.

3. Units utilizing a dual system for meeting emergency brake system requirements must have each system independently tested (i.e., each system of a dual hydraulic system can be tested independently by freely releasing the fluid to the atmosphere at the point of simulated failure in the dormant system). Each system must be capable of stopping the machine in the distance shown under secondary brakes.

C. Parking Brake System

1. Parking brake system tests must be conducted on a dry, swept, 15-percent grade surface. The tests must be conducted with the unit facing both up and down the slope. Once the unit is in place and the parking brake set, all other holding devices must be released and the transmission placed in the neutral position. Any energy assist sources (air, vacuum, hydraulic) will be depleted. The unit must remain in this condition without movement for 5 minutes.

D. Energy Recovery Test

1. Air and air assist systems. With engine off and brakes applied listen for sounds or not any other evidence of air leakage. If no leakage is found, make a full-pressure application and hold for 1 minute. Pressure must not drop below 70 percent of operation pressure. Again, check for sounds or leakage of air.

2. Vacuum and vacuum assist systems. Turn engine off and depress the brake pedal with a light pressure for 10 seconds, and then press hard for 10 seconds. Determine if brake pedal moves or there is noise or other evidence of leaking system. Vacuum loss should not exceed 70 percent of normal operating level, nor should the brake pedal come within 1 inch of floor or travel stop.

3. Hydraulic or stored hydraulic pressure systems. Follow the procedure for vacuum system for straight hydraulic system or air system procedures for stored hydraulic pressure system.

BRAKE PERFORMANCE TEST RECORD		
Non-Highway Type Trucks 10,000 Pounds GVW and Over, Truck-Tractor/Trailer Combinations, Transmix Trucks, Dump Trucks, Excavators, and Similar Type Equipment		
General Information		
Date of Test	Specification No.	
Contractor		Subcontractor
Description (Make and Model)		
Serial No., or Contractor's No.		Year of Manufacture
Service Brake System Test		
Type (air, vacuum, mechanical, hydraulic, comb.)		No. of axles with Brakes
Condition of Test Course (Surface and Grade)		
Weight of Vehicle (Manufacturer's Gross Vehicle Weight Rating- GVWR)		
Pressure or Vacuum Maintained During Braking □ Satisfactory □ Deficient		
Pressure or Vacuum Recovery		
Warning Device for Stored Energy Systems □ Satisfactory □ Deficient		
Stopping Distance (Satisfactory or Deficient in Comparison with Appropriate Table) Feet Traveled________ Feet Traveled________ 1st Trial Satisfactory □ Deficient □ 2nd Trial Satisfactory □ Deficient □		
Holding Performance on Grade Satisfactory □ Deficient □		
Emergency Stopping System		
Type	Manual Only	Manual/Automatic
Stopping Distance (Satisfactory or Deficient in Comparison with Appropriate Table) Feet Traveled________ Satisfactory □ Deficient □		
Parking System Tests		
Holds on 15% Grade Forward □ Reverse □		Remains Applied for 5 Minutes Forward □ Reverse □
Signatures		
Tested by (Contractor Representative): Signature: Title:		Witnessed by (Government Rep): Signature: Title:

Appendix H

Record of Performance—Inspection and Brake Test—Off-Highway, Wheel-Type Construction Machines, Loaders, Dumpers, Scrapers, Graders, Tractor Water Wagons, and Similar-Type Machines

General

All nonexempt, off-highway, wheel-type construction machines described above and in section 20 of Reclamation Safety and Health Standards must be performance inspected and brake tested by the owner and/or contractor: (a) prior to initial onsite operation; (b) at least once annually thereafter; and (c) whenever directed to do so by Reclamation.

Such inspections and tests must be conducted in the presence of a Bureau of Reclamation representative and recorded in the appropriate places on this form. The form will then be signed and submitted to Reclamation. Initial and periodic performance inspection and brake tests must be conducted onsite after each unit has been assembled, reassembled, and/or prepared for operation. Manufacturer's or owner's offsite inspection and tests must not be substituted for onsite inspections and tests. Performance brake tests must not be conducted until all appropriate inspection items are found to be available and in acceptable condition.

Performance Inspection

The performance inspection must, as a minimum, include the following features, components, accessories, and tests.

Item	Description	Available/ acceptable
(1) Manufacturer's operating and maintenance manuals	Manufacturer's operating and maintenance manuals shall accompany all off-highway, rubber-tired equipment covered by section 20 and this appendix. These manuals set forth inspection, operation, and maintenance criteria that is not available from any other source.	
(2) Maintenance and "frequent" and "periodic" inspection records	Inspection and maintenance records must be complete and current. Unless owner can produce these records, brake tests will not be conducted until the appropriate maintenance and inspections have been performed and current records developed.	

Item	Description	Available/ acceptable
(3) Reverse signal alarm	An automatic reverse signal alarm is installed and functions when machine is placed in reverse gear or is moving in reverse. It has been field tested.	
(4) Audible warning device	All operator-controlled machines are equipped with an audible warning device having the control lever(s) within reach of the operator(s) when seated in the operating position(s). The device has been field tested.	
(5) Lights	Off-highway use. A minimum of two head lamps mounted symmetrically on the front. Head lamps must provide adequate illumination for a distance that exceeds machine maximum stopping distance at maximum speed. Two stop lamps at rear of machines for day operation, plus two tail lamps and one backup lamp for night operation. Work area floodlamps for night operation, including scraper bowl lamp, motor grader blade and front lamp, bucket lamps, ripper lamps. One rotating amber lamp visible in all directions on motor graders, front-end loaders and similar slow moving machines used on public or haul roads or in borrow or fill areas. On-highway use equipment intended for use on highways, public roads, or in public accessible areas must be equipped for highway operation.	
(6) Cabs	Cabs are provided with safety glazed windows, heaters, defrosters, windshield wipers, door restraints, and rearview mirror on bidirectional machines.	
(7) Access	Walking surfaces are of the skid-resistant type. Platforms are provided with guardrails. Access systems incorporate the three-point support method; one foot- two hands; one hand-two feet on handholds or ladders at all times.	
(8) Fire extinguisher or fire suppression systems	Two 2A 40 B:C extinguishers are required on vehicles transporting flammable or explosive materials. Two 2A 40 B:C extinguishers and a fixed nozzle fire- suppression system are required on all diesel-powered equipment operated underground. All other equipment must be equipped with the type and number of extinguishers or suppression systems deemed necessary by Reclamation.	
(9) Fenders	Machines with a maximum speed exceeding 15 mph are equipped with fenders or operator tire guards conforming to SAE J321 or devices providing equivalent protection.	

Item	Description	Available/ acceptable
(10) Seatbelts	Machines with installed ROPS are equipped with operable seatbelts conforming with criteria set forth in applicable SAE standards (See table-1, RSHS section 20.) Only seatbelts permanently and legibly marked or labeled with: (1) year of manufacture; (2) model and style number; (3) trademark of manufacturer, distributor, or importer; and (4) design and test data certification are acceptable.	
(11) Exhaust systems	Engine exhaust gases are piped outside of cab and/or discharged away from operator. Exhaust pipes are guarded or insulated to protect operating and maintenance personnel.	
(12) ROPS	Machine is equipped with a rollover protective structure that has a permanently attached label that certifies the structure conforms to applicable SAE standard. Nonlabeled structures must not be used without a manufacturer's or PE's written confirmation that the structure meets the aforementioned criteria or practices. ROPS showing signs of damage, repair, or modification must not be used on equipment unless recertified.	
(13) FOPS	Machine is equipped with falling object protective structure unless the contractor representative notes on this inspection report that the machine will not be loaded and/or used in a manner that would subject the operator to falling material. Installed FOPS will be certified as conforming with SAE J/ISO 3449 criteria by a permanent label on the structure or the contractor has a written certification from the manufacturer or PE.	
(14) Operator enclosure	Tractors, loaders, or forestry machines used in tree clearing operations, winching operations, or other operations where objects may intrude into the operator's area are equipped with enclosures conforming to SAE J1084. Equivalent protective enclosures acceptable to Reclamation meet this requirement.	
(15) Emergency steering	Wheeled earthmoving machines such as tractors, scrapers, wheel loaders, graders, and dumpers manufactured in or after 1980 using a power steering system are equipped with emergency steering provisions meeting SAE J1511.	

Item	Description	Available/ acceptable
(16) Dump truck safety devices	Dump trucks of all descriptions are equipped with: a. Trip handle or dump-body operating levers, safety latches, or an equivalent protective system for preventing accidental movement of the lever. b. Permanently mounted device for preventing accidental lowering of dump body or bed during inspection or maintenance operations. c. Operator protective cab shield or canopy to protect operator during machine loading or unloading operations. Machines without this protection will display a suitable warning sign directing the operator to leave the cab during the loading or unloading process.	
(17) Brake systems	All off-highway, wheel-type machines (regardless of age) are equipped with an operable and effective service braking system, emergency stopping (brake) system, and parking brake system. The braking systems conform fully with the criteria contained in SAE J/ISO 3450, this appendix, and RSHS section 20. If the machine was manufactured prior to 1980, its braking system may conform with the SAE standard under which it was manufactured, if that standard requires the three braking systems and failure of a common component or system will not reduce machine stopping capability below the emergency stopping performance criteria shown on the attached "Brake Performance Test Record" form. In no circumstances can dropping the scraper bowl, loader bucket, or grader/tractor blade or equipment loads be considered as an emergency braking system. Reclamation may exempt emergency braking systems requirements for compactors and rollers manufactured prior to 1976 if such systems are not available from the manufacturer. Additionally, compactors and rollers intended for use on 3 percent or less grades can be Reclamation exempted from brake performance test requirements. The braking systems have been inspected, tested, and found to conform with applicable requirements contained in the referenced standards and on attached brake performance test record form. Further, the inspection and test results have been recorded on the inspection form.	

Braking System Requirements and Test Procedures

Part I - General

Nonexempt, off-highway, wheel type machines must have braking systems conforming to the section "Mobile and Stationary Mechanized Equipment" and item 17 of this appendix (performance inspection criteria). Further, the machines braking systems must incorporate the features, components, accessories, and performance capabilities required under parts II and III of this form

Machines found to meet the requirements of item 17 and part 11 of this form and the section "Mobile and Stationary Mechanized Equipment" must be brake tested in accordance with the requirements, procedures, and methods described in part III of this form. Results must be recorded in parts V, VI, and VII of this form. The completed form shall be signed in part VIII and submitted to Reclamation. Equipment failing brake test(s) must not be placed into service until the braking system has been repaired and satisfactorily tested.

Part II - Braking Systems, Features, Components, and Accessories

A. Service Braking System

1. All machines must have an effective service braking system. The service braking system must have the capability equivalent to holding the respective machine under the following conditions:

Machine	Grade	Condition
Loaders	30%	Loaded to manufacturer's gross weight rating and distribution with bucket in SAE carry position.
Dumpers and tractor scrapers	25%	Loaded to manufacturer's gross weight rating and distribution.
Graders	30%	Cutting edge to be in the transport position.
Tractors with dozers	30%	Lowest part of cutting edge to be 18 feet above test surface
Compactor loaders	20%	All conditions of loading

2. The braking system must be capable of bringing the machine to a stop within the distances and under the conditions specified in part III.

3. The service braking system must be of the type that can be applied or released by the operator while sitting in the operating position.

4. All tractor scrapers and dumpers must have braked wheels on at least one axle of the prime mover and one axle of each trailing unit. All other machines may have only two braked wheels (one right hand, one left hand) if the system meets stopping distance requirements of part Ill.

5. With the machine stationary, the service braking system's primary power source must have the capability of delivering at least 70 percent of maximum brake pressure when the brakes are fully applied twelve (12) times at rate of four (4) applications per minute with the engine at maximum governed speed for dumpers and tractor scrapers and twenty (20) times at the rate of six (6) applications per minute for loaders, graders, tractors with dozer, compactors, and rollers.

6. The service braking system using stored energy must be equipped with a warning device that activates before system energy drops below 50 percent of manufacturer's specified maximum operating energy level. The device must be readily visible and/or audible to the operator and provide a continuous warning. Gages indicating pressure or vacuum do not meet these requirements.

B. Emergency Stopping Systems

1. All machines, unless exempted elsewhere, must be equipped with an emergency stopping system.

2. The emergency stopping system must be capable of bringing the machine to a stop within the distance and under the conditions specified in part III.

3. The emergency system must be capable of being applied from the operator's position. The system must be arranged so that it cannot be released by the operator unless immediate reapplication can be made from the operator's seat to stop the machine or combination of machines.

4. In addition to the manual control, the emergency stopping system may also be applied automatically. If an automatic system is used, the automatic application must occur after the warning device is actuated.

C. Parking Brake System

1. All machines must be equipped with a parking system capable of being applied from the operators position. The brake must be such that it cannot be released unless immediate reapplication can be made by the operator.

2. The parking system, when applied, must maintain the parking performance despite any contraction of the brake parts, exhaustion of energy, or leakage of any kind.

D. Features, Components, and Accessories

1. Braking systems utilizing stored energy or vacuum assist device must be equipped with a gage that indicates the pressure or vacuum available for braking.

2. Braking systems may use common components; however, a failure of a common component must not reduce the effectiveness of the machine stopping capability below the emergency stopping performance requirement.

Part III - Brake Testing Methods and Procedures

All off-highway, wheel-type machines described in the RSHS section, "Mobile and Stationary Equipment" and, unless exempted elsewhere, must undergo the braking performance tests required. Such tests must be conducted in accordance with the following methods and procedures.

A. General

1. All tests must be conducted with applicable braking systems fully charged.

2. Units will be tested under the following condition:

Machine	Conditions
Loaders	Unloaded with bucket in carry position (The vertical distance from ground to center-line of bucket hinge pin, with the angle of approach at 15 degrees
Dumpers and tractor scrapers	Loaded to manufacturer's gross machine weight rating and distribution.
Tractors with dozers	Lowest part of cutting edge 18 inches above test surface.
Compactors or rollers	Maximum fuel, oil, sprinkler system water, and ballast as actually in use when operating.
Graders	Cutting edge to be in the transport position.

3. All dynamic stopping tests must be conducted from 20 mph, except compactor and roller stopping tests will be conducted from 10 mph or the maximum rated speed, if less than 10 mph.

4. Stopping tests shall be conducted with the transmission in the gear range commensurate with 20 mph testing speed. The power train may be disengaged prior to completing the stop. On machines using hydrostatic drives, the drive train shall be disengaged to eliminate the retarding torque of the transmission.

5. Auxiliary retarders shall not be used in the test unless the retarder is simultaneously activated by the applicable brake control system.

6. Stopping distances shall be measured from the point at which the brake control is applied to the point at which the machine stops.

7. Means shall be provided to determine weight of equipment and stopping distances with an accuracy of plus or minus 2 percent and test speeds with an accuracy of plus or minus 5 percent.

B. Services and Emergency Braking Systems

1. Service and emergency dynamic braking tests shall be conducted on a level (less than 1 percent grade in direction of travel and 3 percent at right angles to travel) clean swept dry surface. The course length will be sufficient for accelerating from 0 to 20 mph (10 mph for compactors and rollers) and providing a stopping distance equal to 1-1/ 2 times that shown for the emergency braking system. Static service brake holding tests shall be conducted on the greater of 15 percent grade or maximum grade of intended travel.

2. Service and emergency braking systems shall have the following stopping capabilities in feet when traveling at 20 mph (10 mph for compactors and rollers).

Machine	Machine weight (lbs)	Service braking	Emergency braking
Loaders tractors with dozers	Up to 36,000 Over 36,000 to 70,000 Over 70,000 to 140,000 Over 140,000 to 280,000 Over 280,000	45 61 75 89 111	135 183 225 267 333
Dumpers	Up to 100,000 Over 100,000 to 200,000 Over 200,000 to 400,000	59 74 96 118	153 173 202 231
Combination dumpers and dumper trains	Up to 100,000 Over 100,000 to 200,000 Over 200,000 to 400,000 Over 400,000 Over 400,000	59 89 125 177	153 192 241 310
Tractor scrapers	Up to 50,000 Over 50,000 to 100,000 Over 100,000 to 150,000 Over 150,000	58 73 88 102	151 170 190 209
Graders	Up to 35,000 Over 35,000 to 70,000 Over 70,000	42 54 75	126 162 225
Compactor rollers	Up to 12,000 Over 12,000 to 30,000 Over 30,000	23.7 27.4 31.1	56.5 60.2 63.9

C. Parking Brake System

1. Parking brake systems must be conducted on a dry, 15-percent grade surface. The tests must be conducted with the unit facing both up and down the slope. Once the unit is in place and the parking brake set, all other holding devices and braking systems must be released and the transmission placed in the neutral position. Any stored energy assist sources (air, vacuum, hydraulic) must be depleted. The unit must remain in this condition without movement for 5 minutes.

D. Energy Recovery Test

Energy recovery tests must be conducted as follows:

a. Machine will be placed on the stopping test surface. The engine speed will be increased to the maximum governed revolutions per minute. The system storage pressure or vacuum will be allowed to increase until gages indicate the system is at the manufactured full rated level. The brakes on dumpers and tractor scrapers must be fully applied four times per minute for 3 consecutive minutes. During this test procedure, the pressure/vacuum gage must never read less than 70 percent of full rated reading. The brakes on loaders, graders, tractors with dozer, compactor, and rollers must be fully applied 6 times per minute for 3-1/2 consecutive minutes. During this test procedure, the gage must never read less than 70 percent of full rated reading.

BRAKE PERFORMANCE TEST RECORD

OFF-HIGHWAY WHEEL-TYPE CONSTRUCTION MACHINES

Refer to Section 19 of the Reclamation Safety and Health Standards (RSHS).
This form is to be used in conjunction with Appendix G of the RSHS

FOR BRAKING SYSTEM REQUIREMENTS AND TEST PROCEDURES SEE RSHS APPENDIX G (PARTS I, II, AND III)

GENERAL INFORMATION

PART IV

DATE OF TEST	SPECIFICATIONS NO.
CONTRACTOR	SUBCONTRACTOR
DESCRIPTION *(Make and Model)*	
SERIAL NO. OR CONTRACTOR'S NO.	YEAR OF MANUFACTURE

SERVICE BRAKE SYSTEM TEST

PART V

TYPE (air, vacuum, mechanical, hydraulic, comb..)	NO. OF AXLES WITH BRAKES NO. BRAKED WHEELS R.H. L. H.
CONDITION OF TEST COURSE (Surface and Grade)	
WEIGHT OF VEHICLE (Manufacturer's Gross Vehicle Weight Rating) (GVWR)	
PRESSURE OR VACUUM MAINTAINED DURING BRAKING SATISFACTORY ☐ DEFICIENT ☐	
PRESSURE OR VACUUM RECOVERY (See Reverse side for criteria)	
WARNING DEVICE FOR ENERGY SYSTEMS SATISFACTORY☐ DEFICIENT☐	
STOPPING DISTANCE (Satisfactory or Deficient in Comparison with Appropriate Table) FEET TRAVELED FEET TRAVELED 1ST TRIAL SATISFACTORY ☐ DEFICIENT ☐ 2ND TRIAL SATISFACTORY ☐ DEFICIENT ☐	
HOLDING PERFORMANCE ON GRADE (See reverse side for holding performance criteria) SATISFACTORY☐ DEFICIENT☐	

EMERGENCY STOPPING SYSTEM

PART VI

TYPE	MANUAL ONLY	MANUAL/AUTOMATIC
STOPPING DISTANCE (Satisfactory or Deficient in Comparison with Appropriate Table) FEET TRAVELED ____________ SATISFACTORY☐ DEFICIENT☐		

PARKING SYSTEM TESTS

PART VII

HOLDS ON 15% GRADE	FORWARD ☐	REVERSE ☐	REMAINS APPLIED FOR FIVE MINUTES	FORWARD ☐	REVERSE ☐

PART VIII

TESTED BY (Contractor's Representative) (Signature) (Title) (Date)	WITNESSED BY (Government Representative) (Signature) (Title) (Date)

NOTE:
(1)Brake Performance test will be conducted in accordance with the performance criteria outlined in RSHS Appendix G (Parts I,II, III) or in the latest edition of appropriate Society of Automotive Engineers braking performance standards or recommended Practices.
(2) Contractors are responsible for equipment meeting or exceeding minimum requirements and/or standards and inspecting and testing equipment, and signature of Government representative on this form only indicates the Contractor did effect an inspection and test in accordance with Bureau of Reclamation requirements.

Appendix I

Cleanout Operations

Clean all concrete placing pipelines using one or more of the following procedures:

1. Suction. Insert a soft, sponge rubber ball into the end hose. Use the pump to suck the concrete and ball back into the hopper.

2. Water Pressure Procedure. Attach a specialized pipe cleaning head to the pump side of the pipeline. Make a paper plug from wet, double-folded, close-furled empty cement bags; place it in the head, followed by a sponge rubber ball; and arrange it so the bags contact the concrete. Apply water pressure to the ball through a head connection.

If the concrete and water are to be wasted at the discharge end, leave the bends and end hoses in place. If the water is to be retained in the pipe and returned to the pump, remove the elbows and end hoses and attach a catch basket to the end of the pipe. Arrange the catch basket so the plug and ball remain in the end of the pipe and seal in the water. Then, use air or water pressure to force the water back through the pipe to the pump.

3. Compressed Air Procedure. This procedure for cleaning pipelines is very hazardous and requires exact methods and special equipment to ensure safety of personnel. Only use this procedure with the approval of the Contracting Officer's Representative or office head and in accordance with the following, or equivalent, safe methods:

a. Have a trained employee supervise blowing out operations.

b. Move all nonessential personnel to a safe location.

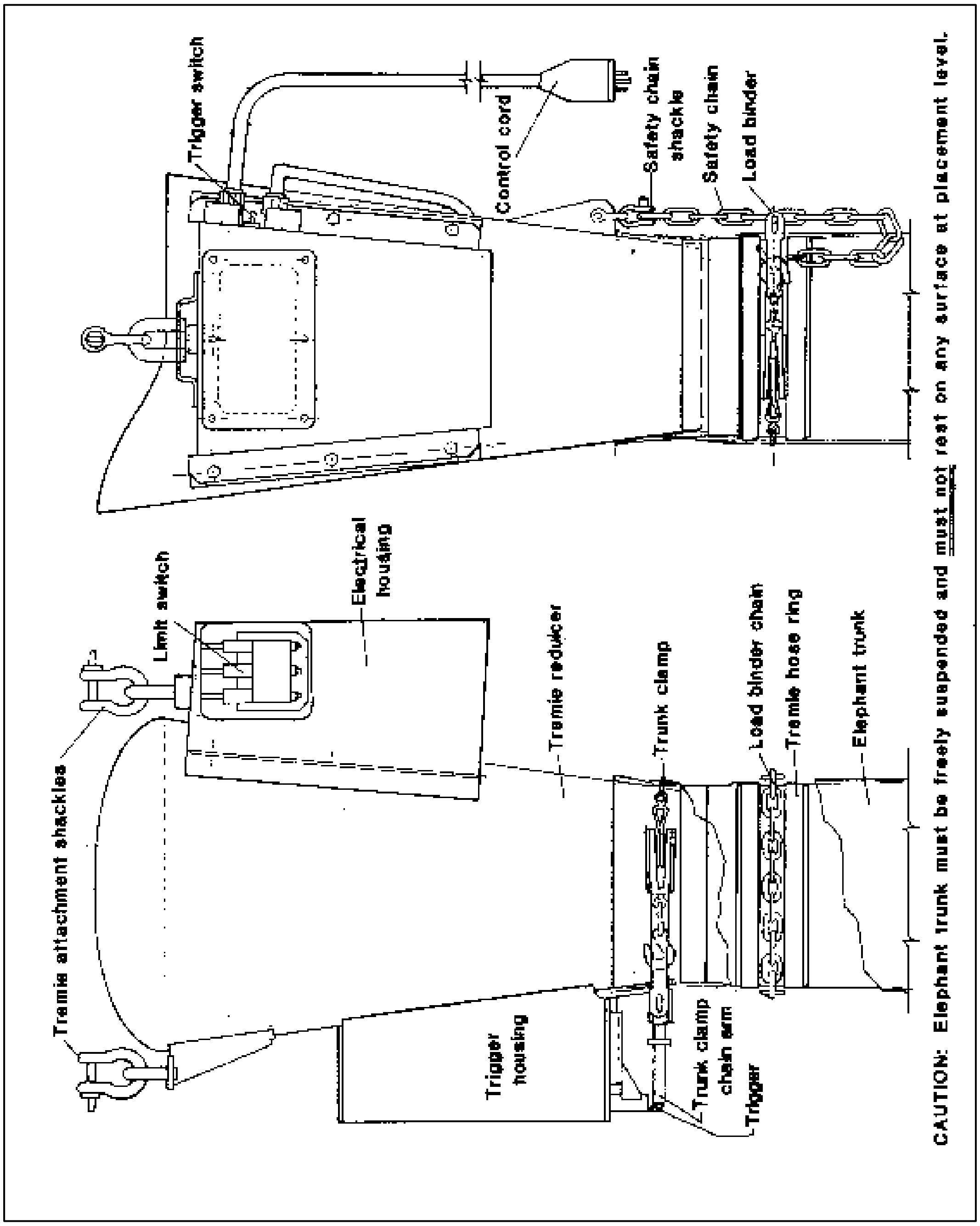
c. Equip the pipeline inlet end with a blowing hood, complete with ball and plug.

d. Remove bends and end hose from pipeline discharge end. Attach a catch basket to the pipeline discharge end. The catch basket must be correctly sized to allow the concrete to flow freely, while preventing the plug and ball from exiting the pipeline and breaking the hermetical seal that keeps the compressed air in the line.

e. Slowly build up pressure in the pipe until the air gauge indicates movement of concrete, but never beyond 150 pounds per square inch. Constantly monitor the air pressure until the plug enters the catch basket.

f. Relieve the air pressure to zero gage pressure through an air relief cock in the blowing head before working on the line or removing the catch basket and plug.

Caution: Exercise extreme care when cleaning vertical pipes with compressed air. High-pressure air pockets that cannot be relieved through the relief cock can be created in the line where the concrete column separates. Column separation occurs when the bottom of the line is disconnected before the blowing head is attached.



Appendix J

Explosives

Distance for Storage

Table J-1.—Distances for storage of explosives

Explosives		Distances in feet when storage is barricaded			
Pounds over	Pounds not over	Inhabited buildings	Passenger railways	Public highways	Separation of magazines
2	5	70	51	30	6
5	10	90	64	35	8
10	20	110	81	45	10
20	30	125	93	50	11
30	40	140	103	55	12
40	50	150	110	60	14
50	75	170	127	70	15
75	100	190	139	75	16
100	125	200	150	80	18
125	150	215	159	85	19
150	200	235	175	95	21
200	250	255	189	105	23
250	300	270	201	110	24
300	400	295	221	120	27
400	500	320	238	130	29
500	600	340	253	135	31
600	700	355	266	145	32
700	800	375	278	150	33
800	900	390	289	155	35
900	1,000	400	300	160	36
1,000	1,200	425	318	165	39
1,200	1,400	450	336	170	41
1,400	1,600	470	351	175	43
1,600	1,800	490	366	180	44
1,800	2,000	505	378	185	45
2,000	2,500	545	408	190	49
2,500	3,000	580	432	195	52
3,000	4,000	635	474	210	58
4,000	5,000	685	513	225	61
5,000	6,000	730	546	235	65
6,000	7,000	770	573	245	68
7,000	8,000	800	600	250	72
8,000	9,000	835	624	255	75
9,000	10,000	865	645	260	78
10,000	12,000	875	687	270	82
12,000	14,000	885	723	275	87
14,000	16,000	900	756	280	90

Table J-1. Distances for storage of explosives (continued)

Explosives		Distances in feet when storage is barricaded			
Pounds over	**Pounds not over**	**Inhabited buildings**	**Passenger railways**	**Public highways**	**Separation of magazines**
16,000	18,000	940	786	285	94
18,000	20,000	975	813	290	98
20,000	25,000	1,055	876	315	105
25,000	30,000	1,130	933	340	112
30,000	35,000	1,205	981	360	119
35,000	40,000	1,275	1,026	380	124
40,000	45,000	1,340	1,068	400	129
45,000	50,000	1,400	1,104	420	135
50,000	55,000	1,460	1,140	440	140
55,000	60,000	1,515	1,173	455	145
60,000	65,000	1,565	1,206	470	150
65,000	70,000	1,610	1,236	485	155
70,000	75,000	1,655	1,263	500	160
75,000	80,000	1,695	1,293	510	165
80,000	85,000	1,730	1,317	520	170
85,000	90,000	1,760	1,344	530	175
90,000	95,000	1,790	1,368	540	180
95,000	100,000	1,815	1,392	545	185
100,000	110,000	1,835	1,437	550	195
110,000	120,000	1,855	1,479	555	205
120,000	130,000	1,875	1,521	560	215
130,000	140,000	1,890	1,557	565	225
140,000	150,000	1,900	1,593	570	235
150,000	160,000	1,935	1,629	580	245
160,000	170,000	1,965	1,662	590	255
170,000	180,000	1,990	1,695	600	265
180,000	190,000	2,010	1,725	605	275
190,000	200,000	2,030	1,755	610	285
200,000	210,000	2,055	1,782	620	295
210,000	230,000	2,100	1,836	635	315
230,000	250,000	2,155	1,890	650	337
250,000	275,000	2,215	1,950	670	360
275,000	300,000	2,275	2,000	690	385

Note 1. "Explosive materials" means explosives, blasting agents, and detonators.

Note 2. "Explosives" means any chemical compound, mixture, or device, the primary or common purpose of which is to function by explosion. A list of explosives determined to be within the coverage of "18 U.S.C. Chapter 40, Importation, Manufacture, Distribution and Storage of Explosive Materials" is issued annually by the Director of the Alcohol, Tobacco, and Firearms Division.

Note 3. "Blasting agents" means any material or mixture, consisting of fuel and oxidizer, intended for blasting, not otherwise defined as an explosive, provided that the finished product, as mixed for use or shipment, cannot be detonated by means of a number 8 test blasting cap when unconfined.

Note 4. "Detonator" means any device containing a detonating charge that is used for initiating detonation in an explosive. The term includes, but is not limited to, electric blasting caps of instantaneous and delay types, blasting caps for use with safety fuses, and detonating-cord delay connectors.

Note 5. "Magazine" means any building or structure, other than an explosives manufacturing building, used for the permanent storage of explosive materials.

Note 6. "Natural barricade" means natural features of the ground, such as hills, or timber of sufficient density that the surrounding exposures which require protection cannot be seen from the magazine when the trees are bare of leaves.

Note 7. "Artificial barricade" means an artificial mound or revetted wall of earth with a minimum thickness of 3 feet.

Note 8. "Barricaded" means that a building containing explosives is effectually screened from a magazine, building, railway, or highway, either by a natural barricade, or by an artificial barricade of such height that a straight line from the top of any sidewall of the building containing explosives to the eave line of any magazine, or building, or to a point above the center of a railway or highway, will pass through such intervening natural or artificial barricade.

Note 9. "Inhabited building distance" is the minimum allowable separation between explosive storage areas and public/private places of residence or assembly, commercial facilities and utilities, recreational facilities, project visitor areas, and Government and contractor work and storage areas or places where workers gather, whether indoors or outdoors.

Note 10. "Railway" means any steam, electric, or other railroad or railway which carries passengers for hire.

Note 11. "Highway" means any street or public road. "Public Highways Class A to D" are highways with average traffic volume of 3,000 or less vehicles per day as specified in "American Civil Engineering Practice" (Abbett, Vol. 1, Table 46, Sec. 3-74, 1956 Edition, John Wiley and Sons).

Note 12. When two or more storage magazines are located on the same property, each magazine must comply with the minimum distances specified from inhabited buildings, railways, and highways, and, in addition, they should be separated from each other by not less than the distances shown for "Separation of magazines," except that the quantity of explosives contained in cap magazines shall govern in regard to the spacing of said cap magazines from magazines containing other explosives. If any two or more magazines are separated from each other by less than the specified "Separation of magazines" distances, then such two or more magazines, as a group, must be considered as one magazine, and the total quantity of explosives stored in such group must be treated as if stored in a single magazine located on the site of any magazine of the group, and must comply with the minimum distances specified from other magazines, inhabited buildings, railways, and highways.

Note 13. Storage in excess of 300,000 pounds of explosives in one magazine is prohibited.

Note 14. This table is not applicable to transportation of explosives or any handling or temporary storage necessary or incident thereto. It is not intended to apply to bombs, projectiles, or other heavily encased explosives.

For transportation purposes, the Department of Transportation in Title 49 Transportation CFR Parts 1-199 subdivides explosives into three classes:

Class A—Maximum Hazard

Class B—Flammable Hazard

Class C—Minimum Hazard

Note 15. All types of blasting caps in strengths through No. 8 cap should be rated at 1½ pounds of explosives per 1,000 caps. For strengths higher than No. 8 cap, consult the manufacturer.

Note 16. For quantity and distance purposes, detonating cord of 50 or 60 grains per foot should be calculated as equivalent to 9 pounds of high explosives per 1,000 feet. Heavier or lighter core loads should be rated proportionately.

Note 17. When a building containing explosives is not barricaded, the distance shown in the above tables should be doubled.

Note 18. These tables are for minimum distances applicable to any human exposed to explosive hazards on or off Government-owned property.

Table J-2.—Recommended separation distances of ammonium nitrate and blasting agents from explosives or blasting agents[1]

Donor weight		Minimum separation distance of receptor when barricaded [2] (feet)		Minimum thickness of artificial barricades[5] (inches)
Pounds over	Pounds not over	Ammonium nitrate[3]	Blasting agent[4]	
	100	3	11	12
100	300	4	14	12
300	600	5	18	12
600	1,000	6	22	12
1,000	1,600	7	25	12
1,600	2,000	8	29	12
2,000	3,000	9	32	15
3,000	4,000	10	36	15
4,000	6,000	11	40	15
6,000	8,000	12	43	20
8,000	10,000	13	47	20
10,000	12,000	14	50	20
12,000	16,000	15	54	25
16,000	20,000	16	58	25
20,000	25,000	18	65	25
25,000	30,000	19	68	30
30,000	35,000	20	72	30
35,000	40,000	21	76	30
40,000	45,000	22	79	35
45,000	50,000	23	83	35
50,000	55,000	24	86	35
55,000	60,000	25	90	35
60,000	70,000	26	94	40
70,000	80,000	28	101	40
80,000	90,000	30	108	40
90,000	100,000	32	115	40
100,000	120,000	34	122	50
120,000	140,000	37	133	50
140,000	160,000	40	144	50
160,000	180,000	44	158	50
180,000	200,000	48	173	50
200,000	220,000	52	187	60
220,000	250,000	56	202	60
250,000	275,000	60	216	60
275,000	300,000	64	230	60

Note 1. Recommended separation distances to prevent explosion of ammonium nitrate and ammonium nitrate-based blasting agents by propagation from nearby stores of high explosives or blasting agents referred to in the table as the “donor.” Ammonium nitrate, by itself, is not considered to be a donor when applying this table. Ammonium nitrate, ammonium nitrate-fuel oil or combinations thereof are acceptors. If stores of ammonium nitrate are located within the sympathetic detonation distance of explosives or blasting agents, one-half the mass of the

ammonium nitrate should be included in the mass of the donor. The distances apply to the separation of stores only. The "Table of Distances" shall be used in determining separation distances from inhabited buildings, passenger railways, and public highways.

Note 2. When the ammonium nitrate gas and/or blasting agent is not barricaded, the distances shown in the table shall be multiplied by six. These distances allow for the possibility of high velocity metal fragments from mixers, hoppers, truck bodies, sheet metal structures, metal containers, and the like which may enclose the "donor." Where storage is in bullet-resistant magazines[1] recommended for explosives or where the storage is protected by a bullet-resistant wall, distances and barricade thicknesses in excess of those prescribed in the "Table of Distances" are not required.

Note 3. The distances in the table apply to ammonium nitrate that passes the insensitivity test prescribed in the definition of ammonium nitrate fertilizer promulgated by the National Plant Food Institute;[2] and ammonium nitrate failing to pass said test shall be stored at separation distances determined by competent persons and approved by the authority having jurisdiction.

Note 4. The distances referred to in Note 3 apply to nitro-carbo-nitrates and blasting agents which pass the insensitivity test prescribed in the U.S. Department of Transportation (DOT) regulations.

Note 5. Earth, or sand dikes, or enclosures filled with the prescribed minimum thickness of earth or sand are acceptable artificial barricades. Natural barricades, such as hills or timber of sufficient density that the surrounding exposures, which require protection, cannot be seen from the "donor" when the trees are bare of leaves, are also acceptable.

Note 6. When the ammonium nitrate must be counted in determining the distances to be maintained from inhabited buildings, passenger railways, and public highways, it may be counted at one-half its actual weight because its blast effect is lower.

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1 For construction of bullet-resistant magazines, see *IME Publication No. 1*.

2 *Definition and Test Procedures for Ammonium Nitrate, Fertilizer,* National Plant Food Institute, November 1964.

Appendix K

Glossary of Terms, Definitions, and Acronyms

The following definitions apply to this and other documents related to the U.S. Bureau of Reclamation Safety and Occupational Health Standards unless specifically stated in the section.

Abatement Plan	A written plan identifying the deficiency, date of correction, individual(s) responsible for correction, interim corrective measures, and a justification for delay in immediate correction of the deficiency.
Accepted/Acceptable	A term denoting when a written procedure, practice, method, program, engineering design, or employee qualification criteria submittal, which, after a cursory review by an authorized Reclamation representative, is determined to generally conform to safety and health or contractual requirements. Acceptance or acceptability of such submittals in no way relieves the submitting entity from ensuring employees a safe and healthful work environment or complying with all contractual requirements and good engineering practices.
Accident	An unplanned event that results in injury, illness, death, property damage, mission interruption, or other loss that has a negative effect on the mission.
Approved	A method, equipment, procedure, practice, tool, etc., which is sanctioned, confirmed, as acceptable for a particular use or purpose by a person or organization authorized to render such approval or judgment.
Attendant	An attendant is a person trained, authorized, and designated to perform attending duties as prescribed in the confined space program. The individual must have no other tasks except to be stationed outside the permit required confined space to monitor the entrants.
Authorized Person	A person approved or assigned by the employer to perform a specific type of duty or to assume a specific responsibility.

Blanking or Binding	The absolute closure of a pipe, line, or duct by the fastening of a solid plate that completely covers the bore and that is capable of withstanding the maximum pressure of the pipe, line, or duct with no leakage beyond the plate.
Buddy System	A team of two diving partners on a diving operation. The buddy divers are jointly responsible for the assigned mission. Each diver keeps track of depth and time during the dive. Each diver must watch out for the safety and well-being of his buddy and be alert for symptoms of nitrogen narcosis, decompression sickness, and carbon dioxide intoxication.
Certification	The process and documentation of testing and validating an individual, system, or component, preferably by an independent testing agency, for compliance with established criteria.
Certified or Licensed	One who possesses a license or certificate issued by a recognized authority, attesting that he/she has been trained and/or tested and is competent and qualified in a specific field of endeavor.
Certified or Licensed (employee, craftsman, or professional)	One who possesses a certificate or license (or has been licensed or certified by a recognized authority) attesting that he/she has been trained or tested and is competent and qualified in a specific field of endeavor.
Clearance	A process used to establish, under tightly controlled discipline, a safe environment in which workers can perform their tasks on specific electrical, hydraulic, pneumatic, or mechanical equipment and/or facilities. It includes the actions of systematically isolating the equipment from all sources of hazardous energy and using lockout/tagout procedures for the operating and control points for these sources of energy. It also includes a written statement with documentation (switching program) declaring that the equipment to be worked on has been deenergized and isolated from hazardous sources of energy

Clearance (minimum distance)	The distance from uninsulated, energized equipment that is considered safe. The term "minimum distance" is preferred to avoid confusion with "Clearance."
Codes	Rules and standards adopted by a governmental agency as mandatory regulations having the force and effect of law. Also used to describe a body of standards.
Collateral Duty Safety Representative (CDSR)	An employee who is formally charged, on a part-time basis, with safety program duties and responsibilities, in addition to regularly assigned duties. The assigned CDSR must have training prior to assuming the assignment, and periodically during the period of assignment.
Competent Person	A person who by training and/or experience is capable of performing specifically assigned duties and responsibilities. Further, the person is capable of recognizing existing and predictable hazards or conditions which are unsanitary, hazardous, or dangerous and is authorized to initiate prompt corrective action.
Confined Space	A confined space is a space that is large enough and configured for an employee to enter and perform assigned work, but has limited or restricted means of entry and egress, and is not designed for continuous human occupancy.
Confined Space Program	A confined space program is a site-specific program that establishes the procedures for entry into permit required confined spaces, and identifies the persons authorized to perform the various duties at each entry.
Contaminant	Any material, that, by nature of its composition or reaction with other materials, is potentially capable of causing injury, death, illness, damage, loss, or pain.
Contractor	Any individual or firm under contractual agreement with Reclamation or its subunits for the performance of services and products, such as construction, maintenance, and hazardous waste activities, including subcontractors of a prime contractor.

Danger	A term denoting liability or potential to cause injury, death, illness, damage, loss, or pain.
Deadman Switch	A switch that requires constant pressure to supply electrical current to the circuit.
Defect	Any characteristic or condition that weakens or reduces the strength of a procedure, material, or object of which it is a part.
Designated Person	An employee who has been trained or is qualified and assigned the responsibility to perform a specific task.
Double Block and Bleed	The closure of a line, duct, or pipe by closing and locking or tagging two in-line valves and by opening and locking or tagging a drain or vent valve in the line between the two closed valves.
Employer	A contractor or Reclamation project/area manager who has employees engaged in work for or in Reclamation controlled areas.
Energized Facility Maintenance	Maintenance work on an energized conductor or part of its supporting structure. Also includes work on a deenergized component (busing, disconnect switch, etc.) located near an energized conductor or part.
Engulfment	The surrounding and effective capture of a person by a liquid or flowable solid substance that can be aspirated to cause death by filling and plugging the respiratory system or that can exert enough force on the body to cause death by strangulation, constriction, or crushing.
Entrant	An entrant is a person trained and authorized to enter confined spaces under conditions documented in the confined space permit.
Entry Supervisor	A person trained, authorized, and designated (such as employer or foreman) by a written permit to be responsible for determining if acceptable entry conditions are present at a permit required confined space, authorizes each entry, oversees entry operations, and terminates entries when violations or hazards occur. The entry supervisor may also serve as an attendant if the individual meets requirements as an attendant.

Equipment	Any machine, device, or apparatus—electrical, mechanical, or hydraulic—including transmission lines, piping systems, and waterways.
Foreman (Job Supervisor)	The person directly in charge of personnel at the worksite, regardless of operating or payroll title.
Groundman	A person working at ground level in support of a lineman working aloft.
Hazard	A dangerous condition, potential or inherent, that can bring about an interruption or interfere with the expected orderly progress of an activity.
Hazardous Atmosphere	An atmosphere that may expose employees to the risk of death, incapacitation, impaired ability to self-rescue unaided, injury, or acute illness. Hazardous atmospheres include flammable gas, vapor, or mist, airborne combustible dust, oxygen concentration below 19.5 percent or above 23.5 percent, concentrations of substances that exceed dose or permissible exposure limits, or other atmospheric condition immediately dangerous to life or health.
Hazardous Condition	A physical condition or circumstance that is a precondition of an accident occurrence.
Hazardous Substance or Material	Refers to any substance which, by reason of being explosive, flammable, poisonous, corrosive, oxidizing, irritating, or otherwise harmful, is likely to cause illness or injury.
Heavy Gear	Diver-worn, deep-sea dress, including helmet, breastplate, dry suit, and weighted shoes.
High Scaling	Manually or mechanically removing, drilling, blasting, rock bolting, grouting, shoring, forming, inspecting, surveying, or testing rock, concrete, or other materials on vertical faces and slopes or inclines steeper than 1:1 or where workers and machinery require external assistance to maintain stability.
High Voltage	Refers to all voltages of 600 volts or greater, unless otherwise defined in the text of this manual.

Hot Line Order	A statement with documentation from the Operations Supervisor to the Job Supervisor that specific work may be done on or near a line or other equipment without requiring that it be disconnected from all sources of energy. The equipment is to be considered energized or "hot" (see FIST Volume 1-1 for application).
Immediately Dangerous to Life and Health (IDLH)	A condition or practice that poses an immediate threat to life and health, or an immediate threat of severe exposure to contaminants, such as toxic or radioactive materials which are likely to have adverse delayed effects on health.
Imminent Danger	Any condition or practice that could reasonably be expected to cause death or serious physical harm before normal abatement actions can be taken.
Incident	For reporting purposes, an unplanned event involving people, equipment, or the environment that could have resulted in an injury, illness, or loss, but did not.
Industrial Hygienist	An individual who, by virtue of education, training, special studies, certification, and experience, has acquired competence in industrial hygiene. He/she is capable of recognizing the environmental factors, toxic chemicals, and stress of work operation; evaluating those factors based on experience and quantitative measurement techniques; and recommends methods to eliminate, control, or reduce such stresses.
Job Hazard Analysis	A study of a job or activity to (1) identify hazards or potential accidents associated with each step or task, and (2) develop solutions that will eliminate, mitigate, or prevent such hazards or accidents. A job hazard analysis should be an integral part of the written procedures for work activities.
Lineman	A payroll classification or title given a craftsperson whose duties include climbing wood poles or steel structures to perform work on electric power transmission and distribution circuits.

Office Head	Unless otherwise indicated, means the Reclamation official responsible for the area or work activity to which the standard applies. Usually, the Area Manager, Project Manager, or Project Construction Engineer; but in some organizations, the Chief, Power Division; Chief, Field Division; or similar official.
O&M Employee	Any person directly involved with the operation and maintenance of facilities or features of a Reclamation power or water system or involved in activities supporting the O&M function.
Onsite Construction Operations	All construction activities performed under Bureau of Reclamation contract which are carried out within the confines of the project or construction site as specified in the contract document. It also includes all activities on offsite property used by the contractor or his subcontractors for the primary purpose of implementing work under the contract (i.e., borrow pits, repair shops, warehousing, equipment fabrication, and assembly sites, etc.).
Performance Inspection and Tests	Inspection and tests to determine if equipment can safely perform its intended functions.
Permit Required Confined Space	A confined space in which one or more of the following conditions may exist: (a) the space contains, or may contain an atmospheric hazard; (b) the space contains an engulfment hazard (i.e., water or other flowable material that may engulf an entrant); (c) the space has a configuration which may trap an entrant; (d) the space has any other serious safety or health hazard. A formal process and documentation (entry permit) which includes entry and work procedures, atmospheric monitoring, hazards, and emergencies, is required.
Personal Protective Equipment (PPE)	The term shall include, but is not limited to, devices designed to be worn by workers for eye, face, head, respiratory, hand, arm, body, leg, foot, and fall protection.
Procedure	A course of action by which work is initiated, performed, controlled, and completed. A procedure establishes what action is required, who is required to act, and when the action is to take place.

Professional Engineer	One possessing a recognized degree from an accredited college and a current engineering registration certificate, and who, by knowledge of appropriate national standards, training, and experience, has successfully demonstrated the ability to design, analyze, and determine proper application of electrical, mechanical, hydraulic, and structural equipment and systems and their proper application.
Prohibited Conditions	A condition within a confined space that indicates that a control measure specified in the permit has become ineffective, or that a hazard exists within the space which was not anticipated and for which no control measure is in place. Immediate evacuation is necessary when a prohibited condition is identified.
Qualified	Refers to one who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training, and experience, has successfully demonstrated ability to solve or resolve problems relating to the subject matter, the work, or the project.
Radiation Specialist	An individual who, by virtue of education, training, certification, or experience, possesses the expertise necessary to develop and implement methods and procedures for the evaluation of radiation hazards to the subject matter, the work, or the project.
Safe	Relatively free from danger or hazard which could cause or result in injury, illness, or damage.
Safety Factor	The ratio of the ultimate braking strength of a member or piece of material or equipment to the actual working stress or safe working load when in use.
Safety and Health Professional	An individual who, by virtue of education, training, certification, and experience, has achieved professional status in the safety field.
Scuba	Am acronym for Self-Contained Underwater Breathing Apparatus, in which the supply of breathing mixture carried by the diver is independent of any other source.

Special Work Permit	A statement that formalizes and documents the preparation and coordination between Reclamation and non-Reclamation personnel for Clearances and Hot Line Orders to facilitate work by non-Reclamation forces on or near Reclamation power facilities.
Supervisor	A person held responsible for the behavior and production of a group of employees.
Surface-Supplied Air (SSA)	A diving mode in which the diver in the water is supplied from the dive location with compressed air for breathing.
Threshold Limit Values	The limit below which the effects of airborne substances cease to be perceptible and dangerous to employees who may be repeatedly exposed, day after day.
Toxic	Of, pertaining to, or caused by poison; poisonous; harmful.
Unsafe Condition	Any physical state that is not acceptable or that presents risks to personal safety, or that has the potential to cause personal injury, illness, and/or damage to property. Also, any physical state that contributes to a reduction in the degree of safety normally present.

Acronyms

ACGIH	American Conference of Governmental Industrial Hygienists
ACI	American Concrete Institute
AGCA	Associated General Contractors of America
ANSI	American National Standards Institute
API	American Petroleum Institute
ASME	American Society of Mechanical Engineers
AWS	American Welding Society
CFR	Code of Federal Regulations
CO	Contracting Officer
COR	Contracting Officer's Representative
DM	Department Manual
DOT	Department of Transportation
EMT	Emergency Medical Technician
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FHA	Federal Highway Administration
FOPS	Falling Object Protection Structure
FR	Flame Resistant
HEW	Health, Education, Welfare
HHA	Health Hazard Analysis
JHA	Job Hazard Analysis
LPG or LP-gas	Liquefied Petroleum Gas
LPN	Licensed Practical Nurse
MSDS	Material Safety Data Sheet

MSHA	Mine Safety and Health Administration
MUTCD	Manual of Uniform Traffic Control Devices
NEC	National Electrical Code
NESC	National Electrical Safety Code
NFPA	National Fire Protection Association
NIOSH	National Institute for Occupational Safety and Health
NRC	Nuclear Regulatory Commission
NRR	Noise Reduction Rating
OSHA	Occupational Safety and Health Administration
PCSA	Power Crane and Shovel Administration
PEL	Permissible Exposure Limits
PFD	Personal Flotation Devices
POL	Petroleum, Oils, and Lubricants
PPE	Personal Protective Equipment
RF	Radio Frequency
RN	Registered Nurse
ROPS	Rollover Protective Structures
SAE	Society of Automotive Engineers
TLV	Threshold Limit Value
TWA	Time Weight Average
UL	Underwriters Laboratories
USC	United States Code
USCG	U.S. Coast Guard

Appendix L

Referenced Material

These references apply unless superseded by more current standards.

American Concrete Institute, Box 19150, Redford Station, 22400 West Seven Mile Road, Detroit MI 48219

Publication SP4, "Formwork for Concrete"

American Conference of Governmental Industrial Hygienists, Box 1937, Cincinnati OH 45201

"Industrial Ventilation"

"Threshold Limit Values for Chemical Substances and Physical Agents in the Work Environment"

American Lumbering Standards Committee, PO Box 210, Germantown MD 20874

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American Lumbering Standards Institute, 1430 Broadway, New York NY 10018

American National Standards Institute: http://www.ansi.org

A10.3, "Safety Requirements for Powder Actuated Fastening System"

A10.4, "Safety Requirements for Personnel Hoists and Employee Elevators for Construction and Demolition Operations"

A10.5, "Safety Requirements for Material Hoists"

A10.6, "Safety Requirements for Demolition"

A10.7, "Safety Requirements for Transportation, Storage, Handling, and Use of Commercial Explosives and Blasting Agents"

A10.8, "Safety Requirements for Construction and Demolition Operations–Scaffolding"

A10.9, "Construction and Demolition Operations–Concrete and Masonry Work"

A10.13, "Safety Requirements for Steel Erection"

A10.14, "Requirements for Safety Belts, Harnesses, Lanyards, and Lifelines for Construction and Demolition Use"

A10.15, "Safety Requirements for Dredging"

A10.22, “Safety Requirements for Rope Guide Non-Guided Worker’s Hoists”

A13.1, “Scheme for the Identification of Piping Systems”

A14.1, “Safety Requirements for Portable Wood Ladders”

A14.2, “Safety Requirements for Portable Metal Ladders”

A14.3, “Safety Requirements for Fixed Ladders”

A14.4, “Safety Requirements for Job-Made Wooden Ladders”

A17.1, “Elevators and Escalators”

A17.2, “Inspector’s Manual for Elevators and Escalators”

A90.1, “Safety Standards for Manlifts”

A92.2, “Vehicle Mounted Elevating and Rotating Aerial Devices”

A120.1, “Safety Code for Powered Platforms for Exterior Building Maintenance”

B7.1, “Safety Code for the Use, Care, and Protection of Abrasive Wheels”

B11.1, “Safety Requirements for Construction, Care, and Use for Machine Tools– Mechanical Power Presses”

B15.1, “Safety Standard for Mechanical Power Transmission Apparatus”

B20.1, “Safety Standard for Conveyors and Related Equipment”

B30.2, “Overhead and Gantry Cranes”

B30.3, “Hammerhead Tower Cranes”

B30.4, “Safety Standard for Portal, Tower, and Pillar Cranes”

B30.5, “Mobile and Locomotive Truck Cranes”

B30.6, “Derricks”

B30.7, “Base Mounted Drum Hoists”

B30.8, “Floating Cranes and Floating Derricks”

B30.9, “Slings”

B30.10, “Hooks”

B30.11, “Monorails and Underhung Cranes”

B30.12, “Handling Loads Suspended from Rotor Craft”

B30.14, “Side Boom Tractors”

B30.16, “Overhead Hoists (Underhung)”

B30.17, “Overhead and Gantry Cranes (Top Running Bridge, Single Girder, Underhung Hoist)”

B30.19, “Cableways”

B30.22, “Articulating Boom Cranes”

B31.1, “Power Piping”

B56.1, “Low Lift and High Lift Trucks”

C2, “National Electrical Safety Code”

C95.2, “Radio Frequency Radiation Hazard Warning Symbol”

D6.1, “Manual on Uniform Traffic Control Devices for Streets and Highways”

HST-6M, “Performance Standards for Air Wire Rope Hoists”

N2.1, “Warning Symbols–Radiation Symbol”

RP7, “Practice for Industrial Lighting”

S1.4, “Specification for Sound Level Meters”

S1.25, “Personnel Noise Specification for Dosimeters”

S3.19, (Formerly 224.22) “Method for the Measurement of Real-Ear Protection of Hearing Protectors and Physical Attenuation of Earmuffs”

S12.6, “Method for the Measurement of the Real-Ear Attenuation of Hearing Protectors”

Z41, “Personal Protection–Protective Footwear”

Z49.1, “Safety in Welding, Cutting, and Allied Processes”

Z87.1, “Practice for Occupational and Educational Eye and Face Protection”

Z88.2, “Practices for Respiratory Protection”

Z89.1, “Protective Headwear for Industrial Workers”

Z136.1, “Safe Use of Lasers”

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Z535.2, “Environmental and Facility Safety Signs”

Z535.3, “Criteria for Safety Symbols”

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Z535.5, “Accident Prevention Tags”

American Petroleum Institute, 2101 L. Street, Washington DC 20037

American Petroleum Institute Standards

American Plywood Association, PO Box 11700, Tacoma WA 98411

Group BB, Group 1, Exterior
(Plywood Products Standard PSI-74)

American Society of Mechanical Engineers, 345 East 47th Street,
New York NY 10017

ASME Boiler and Pressure Code

ASME Boiler and Pressure Code, Sec. VIII, “Unfired Pressure Vessels”

ASME 13.1, “Scheme for the Identification of Piping Systems”

American Welding Society

F4.1, “Recommended Safe Practices for the Preparation of Welding and Cutting of Containers and Piping”

Compressed Gas Association, 1725 Jefferson Davis Highway, Suite 1004,
Arlington VA 22202-4102

G-7.1, “Commodity Specification for Air”

Construction Safety Association of Ontario, 21 Voyager Court South Etobicoke,
Ontario, Canada M9N 5M7

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E. I. du Pont DeNemours & Company (Inc.), Technical Service Section,
Explosives Products Division, Wilmington DE 19898

“Blasters’ Handbook” (16th edition or later)

Factory Mutual Engineering, 1000 Fourth Street, Suite 700, San Rafael CA 94901

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Federal Specifications

QQ-P-416, "Plating, Cadmium (Electrodeposited)"

RR-S-001302, "Safety Equipment, Climbing"

Institute of Makers of Explosives (IME), 420 Lexington Avenue, New York NY 10017

National Electric Manufacturers' Association

EW 1, "Electric Arc Welding Power Sources"

National Fire Protection Association, 470 Atlantic Avenue, Boston MA 02210

NFPA No. 10, "Portable Fire Extinguishers"

NFPA No. 13, "Installation of Sprinkler Systems"

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NFPA No. 31, "Oil Burning Equipment"

NFPA No. 33, "Spray Application Using Flammable and Combustible Materials"

NFPA No. 51B, "Fire Prevention During Welding, Cutting, and Other Hot Work"

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NFPA No. 70E, "Standard for Electrical Safety Requirements for Employee Workplaces"

NFPA No. 101, "Life Safety Code"

NFPA No. 251, "Methods of Fire Tests of Building Construction and Materials"

NFPA No. 385, "Flammable and Combustible Liquid Tank Vehicles"

National Forest Products Association

“National Design Specifications for Wood Construction”

Reclamation, Bureau of

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FIST Volume 3-6, “Storage Battery Principles and Maintenance”

FIST Volume 3-29, “Energized Facility Maintenance”

FIST Volume 4-1, “Maintenance Schedules and Records”

FIST Volume 5-1, “Personal Protective Grounding”

“Record of Inspection and Test – Cranes and Hoisting Equipment”

“Contractor’s Report of Recordable Injury/Illness”

“Brake Performance Test Record – Truck Cranes and Self-Propelled Cranes Mounted on Rubber-Tired Chassis or Frames”

“Brake Performance Test Record – Off-Highway Type Trucks 10,000 Pounds GVW and Over, Truck-Tractor/Trailer Combinations, Transmix Trucks, Dump Trucks, Excavators, and Similar Type Equipment”

“Brake Performance Test Record – Off-Highway Wheel-Type Construction Machines”

“Contractor Monthly Summary of Occupational Injuries/Illnesses Experience”

“General Design Standards, Design Standard No. 1, Chapter 3, "Safety Design Standards”

Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale PA 15096

J101, “Hydraulic Wheel Cylinders for Automotive Drum Brakes”

J115, “Safety Signs”

J167, “Overhead Protection for Agricultural Tractors - Test Procedures and Performance Requirements”

J185, “Access Systems for Off-Road Machines”

J220, “Crane Boomstop”

J321B, “Tire Guards for Protection of Operators of Earthmoving Haulage Machines”

J386, “Operator Restraint System for Off-Road Work Machines”

J682, “Fenders and Mudflaps”

J1029, “Lighting and Markings of Construction, Earthmoving Machinery”

J1040, “Performance Criteria for Rollover Protective Structures (ROPS) for Construction, Earthmoving, Forestry, and Mining Machines”

J1042, “Operator Protection for General Purpose Industrial Equipment”

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J1116, “Categories of Off-Road Self Propelled Work Machines”

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Underwriters Laboratories, Inc., 207 East Ohio Street, Chicago IL 60611

U.S. Department of Labor

Mine Safety and Health Administration

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49 CFR Parts 171-179, "Hazardous Materials Regulations"

49 CFR Part 195, "Transportation of Hazardous Liquids by Pipelines"

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