Sunshine Act Meetings

Federal Register
Vol. 51, No. 133
Friday, July 11, 1986

This section of the FEDERAL REGISTER contains notices of meetings published under the "Government in the Sunshine Act" (Pub. L. 94-409) 5 U.S.C. 552b(e)(3).

CONTENTS

	Item
Federal Deposit Insurance Corporation	1
Federal Reserve System	2
Overseas Private Investment Corporation	3
Securities and Exchange Commission	4

1

FEDERAL DEPOSIT INSURANCE CORPORATION

Pursuant to the provisions of the "Government in the Sunshine Act" (5 U.S.C. 552b), notice is hereby given that at 11:25 a.m. on Tuesday, July 8, 1986, the Board of Directors of the Federal Deposit Insurance Corporation met in closed session, by telephone conference call, to consider a recommendation regarding the Corporation's assistance agreement with an insured bank.

In calling the meeting, the Board determined, on motion of Director C.C. Hope, Jr. (Appointive), seconded by Director Robert L. Clarke (Comptroller of the Currency), that Corporation business required its consideration of the matter on less than seven days' notice to the public; that no earlier notice of the meeting was practicable; that the public interest did not require consideration of the matter in a meeting open to public observation; and that the matter could be considered in a closed meeting pursuant to subsections (c)(4), (c)(8), and (c)(9)(A)(ii) of the "Government in the Sunshine Act" (5 U.S.C. 552b(c)(4), (c)(8), and (c)(9)(A)(ii)).

Dated: July 8, 1986.

Federal Deposit Insurance Corporation.

Hoyle L. Robinson,

Executive Secretary.

[FR Doc. 86-15751 Filed 7-9-86; 12:34 pm]

BILLING CODE 6714-01-M

2

FEDERAL RESERVE SYSTEM BOARD OF GOVERNORS

TIME AND DATE: 11:00 a.m., Wednesday, July 16, 1986.

PLACE: Marriner S. Eccles Federal Reserve Board Building, C Street entrance between 20th and 21st Streets, NW., Washington, DC 20551.

STATUS: Closed.

MATTERS TO BE CONSIDERED:

1. Personnel actions (appointments, promotions, assignments, reassignments, and salary actions) involving individual Federal Reserve System Employees.
2. Any items carried forward from a previously announced meeting.

CONTACT PERSON FOR MORE INFORMATION: Mr. Joseph R. Coyne, Assistant to the Board; (202) 452-3204. You may call (202) 452-3207, beginning at approximately 5 p.m. two business days before this meeting, for a recorded announcement of bank and bank holding company applications scheduled for the meeting.

Dated: July 8, 1986.

James McAfee,

Associate Secretary of the Board.

[FR Doc. 86-15716 Filed 7-8-86; 4:05 pm]

BILLING CODE 6210-01-M

3

OVERSEAS PRIVATE INVESTMENT CORPORATION

TIME AND DATE: 9:00 a.m. (closed portion). 10:00 a.m. (open portion), Tuesday, July 22, 1986.

PLACE: Offices of the Corporation, seventh floor Board Room 1615 M Street, NW., Washington, DC.

STATUS: The first part of the meeting from 9:00 a.m. to 10:00 a.m. will be closed to the public. The open portion of the meeting will start at 10:00 a.m.

MATTERS TO BE CONSIDERED (Closed to the public 9:00 a.m. to 10:00 a.m.):

1. Finance Project in Western Hemisphere Country.
2. Finance Project in Western Hemisphere Country.
3. Finance Project in East Asia Country.
4. OPIC Privatization.
5. Performance Requirements.
6. Public Hearing.
7. Claims Report.
8. Information Report: Finance.
9. Information Report: General.
10. China Projects: Status Report.

FURTHER MATTERS TO BE CONSIDERED (Open to the public 10:00 a.m.):

1. Approval of the Minutes of the Previous Meeting.
2. Approval of Scheduled Board Meetings.
3. Personnel Actions.
4. OPIC Bank Accounts in the Dominican Republic.
5. Policy: Country Limitations.
6. OPIC Budget for FY 1988.
7. Allocation of Retained Earnings.
8. Financial Statements.
9. Information Reports.

CONTACT PERSON FOR INFORMATION: Information with regard to this meeting may be obtained from the Secretary of the Corporation at (202) 457-7015

Elizabeth A. Burton,

Corporate Secretary.

July 10, 1986.

[FR Doc. 86-15787 Filed 7-9-86; 3:44 pm]

BILLING CODE 3210-01-M

4

SECURITIES AND EXCHANGE COMMISSION

"FEDERAL REGISTER" CITATION OF PREVIOUS ANNOUNCEMENT: (To be published).

STATUS: Closed/open meetings.

PLACE: 450 Fifth Street, NW., Washington, DC

DATE PREVIOUSLY ANNOUNCED: Tuesday, July 1, 1986.

CHANGE IN THE MEETING: Additional item/meeting.

The following closed item scheduled for Tuesday, July 8, 1986, following the 1:30 p.m. open meeting, has been rescheduled for Thursday, July 10, 1986, at 11:00 a.m.

Access to investigative files by Federal, State, or Self-Regulatory Authorities.

The following item was considered at a closed meeting scheduled on Tuesday, July 8, 1986, following 1:30 p.m. open meeting.

Regulatory matter hearing enforcement implications.

The following additional items will be considered at a closed meeting scheduled for Thursday, July 10, 1986, at 11:00 a.m.

Formal order of investigation.
Institution of administrative proceeding of enforcement nature.

The following item will be considered at an open meeting scheduled for Thursday, July 10, 1986, at 2:30 p.m.

Consideration of whether to send a letter to the joint House/Senate Conference Committee considering proposed tax reform legislation, concerning the effect on financial reporting of a provision in the current Senate Bill which would impose an alternative minimum tax based on the difference

between income reported in financial statements for financial reporting purposes and tax preference income. For further information, please contact John Heyman at (202) 272–2130.

Commissioner Peters, as duty officer, determined that Commission business required the above changes and that no earlier notice thereof was possible.

At times changes in Commission priorities require alterations in the scheduling of meeting items. For further information and to ascertain what, if any, matters have been added, deleted or postponed, please contact: Douglas Michael at (202) 272–2467.

Jonathan G. Katz,

Secretary.

July 9, 1986.

[FR Doc. 86–15795 Filed 7–9–86; 3:59 pm]

BILLING CODE 8010–01–M

Federal Register

Friday
July 11, 1986

Part II

Department of Labor

Occupational Safety and Health Administration

29 CFR Part 1926

Electrical Standards for Construction; Final Rule

DEPARTMENT OF LABOR

Occupational Safety and Health Administration

29 CFR Part 1926

[Docket S-106]

Electrical Standards for Construction

AGENCY: Occupational Safety and Health Administration (OSHA), Labor.

ACTION: Final rule.

SUMMMARY: OSHA is revising the electrical safety standards for construction in Subpart K of 29 CFR Part 1926. The revision is intended to clarify and update those standards. The final rule will accomplish the following three major objectives:

(1) National Electrical Code (NEC) requirements which directly affect employee safety in construction workplaces have been placed in the text of the OSHA standard, eliminating the need for the NEC to be incorporated by reference.

(2) Relevant requirements in the existing text of Subpart K, which supplemented the NEC, have been integrated into the new format.

(3) The requirements have been written in performance language so that superfluous detailed specifications could be omitted and changes in technology could be accommodated, without compromising safety.

The final standard also provides the clarification that installations made in accordance with the 1984 NEC will be accepted as being in compliance with the installation requirements of Subpart K, except for several provisions.

EFFECTIVE DATE: These revisions become effective on October 9, 1986.

The information collection regulations contained in this regulation, 29 CFR Part 1926, have been approved by the Office of Management and Budget under the provisions of 44 U.S.C. Chapter 35 and have been assigned OMB Control Number 1218-0130.

FOR FURTHER INFORMATION CONTACT: Mr. James F. Foster, U.S. Department of Labor, Occupational Safety and Health Administration, Room N3637, 200 Constitution Avenue, NW., Washington, DC 20210. (202-523-8151).

SUPPLEMENTARY INFORMATION:

I. Background

(A) Safety Problems of Electric Shock

It is well known that the human body will conduct electricity. If direct body contact is made with an electrically energized part while a similar contact is made simultaneously with another conductive surface which is maintained at a different electrical potential, a current will flow. This current will enter the body at one contact point, traversing the body and then exiting at the other contact point, usually the ground.

Each year many workers suffer pain, injuries and death from such electric shocks. The Bureau of Labor Statistics (BLS) reports 830 work-related deaths by all causes for 1980 (960 fatalities in 1979) in construction workplaces with 11 employees or more. In researching causes of these fatalities, BLS has found that about 12 percent were electrocutions. Therefore, for this period, the number of accidental electrocutions for construction firms with more than 10 employees has likely exceeded 100 each year. The overall number of electrocutions in construction is probably higher, since the BLS fatality data presented here do not include deaths in workplaces with 10 or fewer employees.

The effects that electric shock will have on an individual will depend upon the type of circuit; its voltage, resistance, and current; the pathway through the body; and the duration of the contact. For example, electric shocks produced by alternating currents of powerline frequency (normally 60 Hertz) passing through the body from hand to foot for an average adult worker for one second can cause various effects, starting from a condition of being barely perceptible at 1 milliampere to involuntary muscular control from 9 to 25 milliamperes. The passage of still higher currents can produce ventricular fibrillation of the heart (cessation of rhythmic pumping action) from 75 milliamperes to 4 amperes and finally immediate cardiac arrest at over 4 amperes. Nearly instantaneous fatalities from electric shock can result from direct paralysis of the respiratory system (at 20 milliamperes or more), failure of the heart to pump due to ventricular fibrillation (at 75 milliamperes or more), or immediate and complete heart stoppage (at 4 amperes or more). Even if the shocking current does not pass through vital organs or nerve centers, severe injuries such as deep internal burns can still occur. In some cases, injuries caused by electric shock can be a contributory cause of delayed fatalities.

Burns suffered in electrical accidents are of great concern. These burns may be of three basic types: Electrical burns, arc burns, and thermal contact burns. Electrical burns are the result of the electric current flowing in the tissues and may be skin deep or may affect deeper layers (muscles, bones, etc.) or both. Tissue damage is caused by the heat generated from the current flow; if the energy delivered by the electrical shock is high, the body cannot dissipate the heat and the tissue is burned. Typically, such electrical burns are slow to heal. Arc burns, on the other hand, are the result of high temperatures produced by electric arcs or by explosions in close proximity to the body. These burns are similar to burns and blisters produced by any high temperature source. Finally, thermal contact burns are those normally experienced from the skin's contacting hot surfaces of overheated electrical conductors, conduits, or other energized equipment. All types of burns may be produced simultaneously.

Electrical shock currents, even at levels as low as 3 milliamperes, can also cause injuries of an indirect or secondary nature. In this case, the involuntary muscular reaction from the electrical shock can cause bruises, bone fractures, and even death resulting from collisions or falls.

(B) Hazards Associated With Electricity

Most electrical systems use the earth to establish an electrical voltage reference system with respect to ground. This is done by connecting a portion of the circuit to ground. Since these systems use conductors which have voltages to ground, a shock hazard exists for persons who are in electrical contact with the earth and are exposed to the conductors. If a person comes in contact with an ungrounded conductor while he or she is also in contact with the ground, his or her body becomes part of the circuit and current passes through it. Employees on construction sites, because of the environment involved, are likely to be in contact with ground or a grounded conductive surface most of the time. Therefore, the possibility of receiving an electrical shock on a construction site is much greater than for most other workplaces.

In addition to the shock hazard, electricity poses other hazards to employees. For example, when a short circuit occurs or current flow is interrupted, hazards are created from the resultant arcs. If high current is involved, these arcs can cause injury or can start a fire. Fires can also be created by overheating equipment or by conductors carrying too much current. High-energy arcs can damage equipment, causing fragmented metal to fly in many directions. In atmospheres which contain flammable gases or vapors or combustible dusts, even low-energy arcs can cause violent explosions.

(C) Nature of Electrical Accidents

Electrical accidents, when initially studied, often appear to be caused by circumstances which are varied and peculiar to the particular incidents involved. However, further consideration usually reveals the underlying cause to be a combination of three possible factors, i.e., work involving unsafe equipment and installations, workplaces made unsafe by the environment, and unsafe work performance (unsafe acts). For simplicity, the first and second accident-causing situations are sometimes combined and referred to as "unsafe conditions." Thus, electrical accidents can be generally considered as being caused by unsafe conditions, unsafe acts, or, in the usual case, combinations of the two.

A few illustrations may help to clarify these contributory factors. For example, some unsafe conditions involving electrical equipment and installations can often be identified by the presence of faulty insulation, improper grounding, loose connections, defective parts, ground faults in equipment, or unguarded live parts. The environment, particularly the wet and damp conditions at a construction site, can also be a contributory factor to electrical accidents in a number of ways. Other unsafe environments affecting electrical safety would be, for example, atmospheres containing flammable gases or vapors, and areas containing corrosive atmospheres.

Some unsafe acts can be recognized as, typically, the failure to deenergize electrical equipment when it is being repaired or inspected, the intentional use of obviously defective and unsafe tools, or the use of tools or equipment too close to energized parts. It should also be noted that inadequate maintenance can cause equipment or installations, which were originally considered safe, to deteriorate, resulting in an unsafe condition.

Compounding these hazards, the temporary nature of construction increases the probability that a combination of unsafe conditions, unsafe acts, and unsafe environments will result in electrical accidents. For example, the use of tools and cords in poor condition and the use of ungrounded equipment have contributed to construction accidents. Furthermore, the wet and conductive environments common on construction projects increase the likelihood of electric shock when such unsafe conditions are present.

(D) Protective Measures

There are various general ways of protecting employees from the hazards of electric shock, including insulation and guarding of live parts. For example, insulation provides an electrical barrier to the flow of current. To be effective, the insulation must be appropriate for the voltage, and the insulating material must be clean and dry. Another type of protection, guarding, prevents the employee from coming too close to energized parts. Guarding can be in the form of a physical barrier, or it can be provided by installing the live parts out of reach from the working surface. (This technique is known as "guarding by location.")

Grounding is yet another method of protecting employees from electric shock; however, it is normally a secondary protective measure. To keep guards or enclosures (the primary protection) at a common potential with earth, they are connected, by means of a grounding conductor, to ground. If a live part accidentally comes in contact with a grounded enclosure, current flow is directed back to earth, so that circuit protective devices (e.g., fuses and circuit breakers) can interrupt the circuit.

In addition to these protective measures, the use of proper work procedures is necessary for employee protection. When employees are working near or with electrical equipment, they must use safe work practices. Such safety-related employee work practices include keeping a prescribed distance from exposed energized lines, avoiding the use of electrical equipment while one is wet, and locking-out and tagging equipment which is deenergized for maintenance.

Another important safety practice involves electrical protective devices, such as rubber gloves and rubber mats (which are used for insulation against live parts) or liveline tools (which are used for insulation from and actuation of energized parts from a distance). However, to assure the protection of the employee, this equipment must be properly manufactured and maintained. With this equipment, regular maintenance becomes an important consideration in order to keep the equipment from deteriorating and causing an unsafe condition.

(E) Existing Regulations and Reasons for Revision

As noted earlier, electricity has long been recognized as a serious workplace hazard, exposing employees to such dangers as electric shock, electrocution, fires, and explosions. Indeed, the long history of the National Electrical Code attests to this fact. Since the turn of the century, the NEC has represented the continuing efforts of experts in electrical safety to deal with these recognized hazards and to provide for safety in all electrical installations, including construction workplaces.

The regulations presently contained in Subpart K of 29 CFR Part 1926 incorporated the entire 1971 NEC by reference. They also included some additional requirements (for example, those on battery rooms and battery charging, § 1926.403) that are not contained in the NEC. The NEC is the most widely used code for safeguarding people and property from the potential hazards associated with electricity. Today, in addition to its role in the existing OSHA standards, the NEC provides the basis for electrical safety regulations in over 2000 municipalities throughout all 50 States, and it is enforced by over 12,000 governmental electrical inspectors.

OSHA recognizes the important role that the NEC has played over the years in defining basic requirements for safety in electrical installations. The revision of Subpart K will maintain the protection presently afforded to employees by the 1971 NEC, as incorporated by reference in the former standards. While carrying forward NEC provisions which are considered necessary for employee safety, OSHA is providing greater flexibility for compliance with these provisions to the extent that employee safety warrants. OSHA has determined, therefore, that the requirements contained in this revision of Subpart K are reasonably necessary to protect employees from electrical hazards posing significant risks in the workplace.

Since the 1971 NEC was adopted as a national consensus standard, the National Fire Protection Association (NFPA) has revised the NEC four times, the most recent being the 1984 edition. Because of the continual process by the NFPA of updating the Code, any specific edition which OSHA might adopt would likely be outdated within a few years. In addition, since the rulemaking process can become somewhat lengthy, a complete revision of the OSHA electrical safety standards every three years to keep pace with the NEC changes is not practical. To remedy this problem, OSHA has revised Subpart K to make the standards flexible enough to accommodate changes in technology, obviating the need for constant revision. Additionally, where possible, the regulations are written in performance terms in order to allow alternative

installation methods if they provide comparable safety to the employee.

Another difficulty with incorporation of the entire NEC by reference is that the NEC contains many details which are not directly related to employee safety. In this revision of Subpart K, OSHA has tried to carry forward only NEC provisions which are relevant to employee safety in construction workplaces. In addition, OSHA has attempted to simplify those provisions to make the standards easier for employers and employees to use and understand. Furthermore, since the revised standard places all relevant requirements in the text of the regulations, employers will no longer have to refer to the NEC to determine their obligations under OSHA.

In striving for this degree of simplification, the Agency has tried to use an approach which will both allow for and accept new methods of electrical installation which may appear in future NEC revisions. Nonetheless, OSHA also recognizes that while such future editions of the NEC might contain technological advances providing significant improvement in employee safety, the new installations might not be permitted under Subpart K. Should this occur, the new, more protective NEC revisions would merit employer attention at an early date rather than awaiting a further update of Subpart K. OSHA policy under the existing coverage of Subpart K, which will continue under the revised standard, is that employers who elect to follow the latest NEC changes in the interim will incur a de minimis violation of the relevant Subpart K provision. However, due to the performance-oriented nature of the OSHA standard as compared to the NEC, conflicts between the NEC and the OSHA standards in areas affecting employee safety are expected to be infrequent.

The Agency's de minimis policy is set forth in OSHA Instruction CPL 2.45A (Field Operations Manual). As this instruction explains, a de minimis condition exists where an employer's workplace has been updated in accordance with new technology or equipment as a result of revisions to the latest consensus publications from which OSHA standards were derived (such as the NEC), where the updated versions result in a "state of the art" workplace, technically advanced beyond the requirements of the applicable OSHA standard, and where equal or greater safety and health protection is provided.

II. Development of Standard

(A) General Approach

In view of the limitations imposed by the continued incorporation by reference of the 1971 NEC, as previously discussed, OSHA determined that relevant requirements for electrical safety for construction should be placed within the body of Subpart K and that these provisions should be updated and clarified to facilitate their application to construction workplaces. OSHA used selected provisions of Part I of NFPA 70E, "Electrical Safety Requirements for Employee Workplaces," as a base document for developing its proposed revision for construction.

(B) Background

In 1976, NFPA created the "70E Committee" to prepare a consensus standard for possible use by OSHA in developing revisions of the Agency's electrical safety standards. The 70E Committee visualized a standard consisting of four major parts:

Part I—Installation Safety Requirements,
Part II—Safety-Related Work Practices,
Part III—Safety-Related Maintenance Requirements,
Part IV—Safety Requirements for Special Equipment.

The NFPA 70E Committee completed its work on Part I, and NFPA approved it as a national consensus standard in 1979. Part I was derived from the 1978 NEC; however, unlike the NEC, NFPA 70E Part I was not intended to be applied as a comprehensive standard for the design, installation, modification, or construction of an electrical installation or system. Rather, the purpose of NFPA 70E Part I was to provide a compilation of provisions from the NEC which were considered relevant to employee safety from electrical hazards of electric utilization systems in the workplace. Efforts were made to revise and clarify language from the NEC in order to make the requirements more readily understood and implemented by employers.

As a result, OSHA carefully reviewed the work product of the NFPA 70E Committee and determined that its use as a source document for OSHA's design safety standard for electrical utilization systems and equipment was appropriate and offered certain advantages in achieving a more simplified standard. OSHA consequently prepared a notice of proposed rulemaking containing proposed amendments to the electrical safety standards in Subpart S of 29 CFR Part 1910. The proposal was published in the **Federal Register** on September 25, 1979 (44 FR 55274). This was followed by a public hearing (which was held on November 8, 1979), and the final standard was subsequently published on January 16, 1981 (46 FR 4034).

In the process of developing the revision of Subpart K, OSHA reviewed NFPA 70E to examine its suitability as a standard for electrical safety for construction workplaces. Various provisions in NFPA 70E (i.e., sections 2.B(1), 3.A(2)(a), and 3.A(2)(c)(vii)) specifically mention construction. Other sections, while not using the term "construction", clearly cover the types of equipment and operations found in construction work. For example, section 6.A(4) *Tunnel Installations*, refers to the use of mobile shovels, draglines, underground excavators, and the like. This further demonstrates that electrical safety in construction was a consideration in the development of the consensus standard. In reviewing reports of electrical accidents in construction, OSHA also determined that many of the requirements in NFPA 70E were directed at the causes of these accidents, as well as to typical hazards present in the construction industry. For example, NFPA 70E provisions on temporary wiring and on grounding address hazards which contribute to many of the electrocutions and electric shock injuries in construction.

However, OSHA also recognized that NFPA 70E addresses the broad spectrum of occupational electrical hazards and covers many types of installations not generally found in construction. The Agency reviewed NFPA 70E at length to determine which provisions were relevant to construction and to incorporate only those relevant parts into revised Subpart K. For example, parts of NFPA 70E contain requirements pertaining to installations and equipment not generally found in construction, such as data processing systems, electric signs and outline lighting, electrolytic cells, swimming pools, and electrically driven or controlled irrigation machines. Therefore, in order to better effectuate the protection of employees from the hazards of electric shock than that provided by a national consensus standard, the proposed version of Subpart K did not include provisions from NFPA 70E which specifically address these and other types of installations not generally found in construction.

(C) New Format for Subpart K

The major change in the new format of Subpart K is the inclusion of the

relevant NEC provisions within the body of the standard itself, making it unnecessary to continue to incorporate the entire NEC by reference.

An advantage of using this format is indicated by the reduction from the approximately 250,000 words in the National Electrical Code to the approximately 15,000 words in the revised standard.

The new format divides Subpart K into four groups of standards. In addition, a general definitions section covering the entire Subpart is also provided. OSHA believes that the use of this format can provide for the continued effective coverage of hazards and equipment currently addressed, with enough flexibility to accommodate other equipment and protective methods in the future. The revised Subpart K is divided into four major groups as follows:

Installation Safety Requirements: §§ 1926.402—1926.415
Safety-Related Work Practices: §§ 1926.416—1926.430
Safety-Related Maintenance and Environmental Considerations: §§ 1926.431—1926.440
Safety Requirements for Special Equipment: §§ 1926.441—1926.448.

Since each division represents a wide range of diverse equipment, installations and practices, divisions will be further subdivided as appropriate.

In addition, a general definitions section for all of Subpart K is included as § 1926.449.

Various provisions located elsewhere in Part 1926 formerly referenced either the 1971 NEC or specific paragraphs in Subpart K. The final rule changes these references to reflect the appropriate revised provisions of Subpart K.

III. History of the Regulation

As required by section 107 of the Construction Safety Act (83 Stat. 96, 40 U.S.C. 333), a draft of the proposed revision of Subpart K was submitted to the Advisory Committee on Construction Safety and Health (ACCSH) on January 26, 1982, and was discussed at their meeting on March 3, 1982. The committee's recommendation is contained in the transcript of this meeting.

During the meeting, committee members and public participants made suggestions concerning the draft proposal. OSHA thoroughly reviewed and analyzed the ACCSH recommendations, many of which were incorporated into the proposal and this final rule. Careful consideration was given to all of the suggestions. The major issues raised by the Committee were discussed in the preamble to the proposal (48 FR 45877–45878).

On October 7, 1983, OSHA published (48 FR 45872) a proposed revision of its electrical standards for construction. The notice of proposed rulemaking invited interested persons to submit written comments on the proposed standard and to file objections and requests for a public hearing. The original date for the close of the comment period was set for November 21, 1983, but was subsequently extended, at the request of commenters, to December 31, 1983 (48 FR 54652). Thirty-six written comments were received, including two requests for a hearing. These hearing requests identified ten major issues:

1. Whether OSHA should modify the application of Subpart K to cover existing facilities where construction activities are being performed.

2. Whether some industrial transmission and distribution installations should be covered by Subpart K.

3. Whether the NEC should continue to be incorporated by reference and, if not, whether the standard should be based on applicable provisions of NFPA 70E relevant to construction.

4. Whether OSHA should retain the more detailed language of the former standard in paragraphs (d), (e), and (g) of § 1926.401, which deal with specific ground resistance values and bonding techniques, rather than the more performance-oriented language of proposed § 1926.404(f).

5. Whether receptacles in existing installations should be permitted to be grounded by means of grounded metal cold water pipes, as was the case in the former standards, or whether such receptacles should be required to be grounded by a separate equipment grounding conductor connected back to the service.

6. Whether temporary lighting should be required to be installed with "heavy duty" cords rather than with other means, such as multi-conductor cable assemblies or open conductors.

7. Whether the specific language in paragraphs (a)(1), (a)(3), (a)(6), and (a)(8) of former § 1926.402, dealing with design details of attachment plugs and receptacles and with protection of cables from damage, should be retained or whether the objectives of these requirements have been adequately addressed in the proposal.

8. Whether revised § 1926.403(j) should apply to equipment on the supply side of the service conductors.

9. Whether the requirement, in proposed § 1926.404(f)(7)(i), to ground enclosures for conductors should allow exemptions for enclosures used to protect cables from damage and for enclosures added to existing installations of open wiring, knob-and-tube wiring, and nonmetallic-sheathed cable, under certain restrictions.

10. Whether the definitions for Subpart K should be as proposed, or whether they should conform to those either in the 1984 NEC or in the former standard.

In response to these hearing requests, OSHA published a notice of public hearing, listing these issues, on February 9, 1984 (49 FR 4949). In addition to listing the issues, the hearing notice pointed out that, as noted in the proposal, existing § 1926.400(h) on ground-fault protection was being redesignated as § 1926.404(b)(1) and was not being proposed for removal or revision. The notice also made note of an error in the printing of proposed § 1926.404(a)(1) and listed the correct wording as: "A conductor used as an equipment grounding conductor shall be identifiable and distinguishable from all other conductors." One commenter who objected to the proposal mentioned these two concerns in his hearing request (Ex. 2-28). The informal rulemaking hearing was convened by Judge Julius A. Johnson on April 10, 1984, pursuant to section 6(b)(3) of the Act (29 U.S.C. 655(b)(3)) and 29 CFR Part 1911. The hearing included testimony from 14 witnesses. Judge Johnson established a post-hearing period for the submission of additional comments and briefs extending through May 30, 1984.

The entire record, including 27 exhibits and 101 transcript pages, was certified by Judge Johnson on October 25, 1984, in accordance with 29 CFR 1911.17. Copies of materials in the record, as well as an index of the record, may be obtained from the OSHA Docket Office, Room N3670, Frances Perkins Building, 200 Constitution Avenue NW., Washington, DC 20210.

This final standard is based on a full consideration of the entire record of this proceeding including materials discussed or relied on in the proposal, the record of the informal hearing, and all written comments and exhibits received.

IV. Issues

The evidence submitted into the record is summarized and evaluated in the following discussions of the issues. The numbers in brackets refer to specific references in the April 10, 1984, hearing exhibits (Ex.) and hearing transcript page numbers (Tr.).

1. *Whether OSHA should modify the application of Subpart K to cover*

existing facilities where construction activities are being performed.

Proposed § 1926.402(b) stated that the installation safety requirements of Subpart K would apply to "electrical installations on the jobsite, both temporary and permanent." This language, which is the same as that contained in the existing standard, suggested that the permanent wiring of an existing building would be covered by Subpart K any time construction work was being performed.

One hearing participant, the American Iron and Steel Institute (AISI) (Ex. 2–15), was concerned about the possible duplication or overlapping of standards between the electrical standards for general industry, Part 1910, Subpart S, and those for construction, Part 1926, Subpart K. It was argued that an employer could be subject to different standards at the same workplace, depending upon whether construction activities or routine maintenance activities were being performed.

AISI reiterated its concern in its post-hearing brief (Ex. 23), claiming that, without a clarification, the Subpart K requirements could be construed as applying to an existing installation of electric equipment any time construction activities are being performed in a given workplace. They proposed that the electrical standards for general industry, Part 1910, Subpart S, be used as the standard for permanent installations.

One of OSHA's expert witnesses, Mr. Ralph H. Lee, stated his view that when maintenance, modification, or re-construction is being performed in an existing installation, the rules of Subpart S of Part 1910 apply to equipment and wiring forming part of the permanent facilities (Ex. 11). He explained that the wiring and equipment temporarily brought in to perform the construction activities must comply with Subpart K of Part 1926.

OSHA's application of the existing electrical standards for construction has followed the pattern outlined by Mr. Lee. The proposed revision of Subpart K was not intended to change this application.

However, OSHA does recognize that the application of Subpart K to existing facilities where construction activities are taking place should be clarified. Therefore, in order to clarify the scope of new §§ 1926.402 through 1926.408, OSHA has modified the second sentence of § 1926.402(a) in the final rule to read:

> These regulations apply to installations, both temporary and permanent, used on the jobsite; but the regulations do not apply to existing permanent installations that were in place before the construction activity commenced.

This language should make it clear that the permanent wiring of an existing building is not covered by the installation safety requirements in §§ 1926.402 through 1926.408 of Subpart K. Such wiring must comply with Subpart S of Part 1910 if the building is a workplace. If the building is a private residence, the existing permanent wiring of the building would not be covered by any OSHA standards. In this situation, in which the construction employer would have no control over the original installation, that employer would still have the general duty to protect employees from recognized hazards presented by the electrical installation which are likely to cause death or serious physical harm. Additionally, the safety-related work practices contained in §§ 1926.416 and 1926.417 will apply to all construction work, regardless of whether a new or existing electrical installation is involved. Thus, the work-practice requirements will provide protection for construction employees from hazards presented by existing installations, even if an installation itself is not subject to §§ 1926.402 through 1926.408. These sections require the employer to protect employees from contact with energized parts, which is the major and most serious hazard posed to construction workers by an existing permanent installation.

Under the final standard (as under the existing standard), the permanent wiring used to provide power at the jobsite and installed during the construction process would be covered by Subpart K. Any equipment or wiring, such as portable tools or extension cord sets, connected to the permanent wiring would also be covered, whether or not the permanent wiring itself is covered. This protects employees using portable equipment against faults in the permanent wiring.

The language contained in final § 1926.402(a) will maintain OSHA's current policy regarding the application of the electrical standards for construction to permanent wiring. OSHA also believes that the final rule clarifies the scope of Subpart K so that employers and employees can more readily determine which standards are applicable to their workplaces.

2. *Whether some industrial transmission and distribution installations should be covered by Subpart K.*

In their hearing request (Ex. 2–15), AISI recommended that OSHA clearly define and differentiate between electrical utilization equipment and power distribution and transmission equipment. Their suggestion was that OSHA use 15 kV as the demarcation line between the utilization system and the transmission and distribution system. Above 15 kV, equipment would be considered transmission or distribution equipment; below, equipment would be considered as part of the utilization system.

In his hearing statement (Ex. 18), the steel industry witness who raised this issue reiterated his concern with the proposal's "lack of specific discrimination between conventional electrical utilization systems and those of utility-type generation, transmission, and distribution systems." However, he did not reaffirm his support for a 15 kV dividing line. Instead, he suggested that OSHA await the outcome of a study of an NEC subcommittee planned for assignment to review public comments relating to NEC scope applicability (Ex. 18, 21). This procedure is part of NFPA's periodic review process for revising and updating the NEC.

Since the NEC updating cycle includes a multiplicity of steps including formal submittals of both proposals and comments, reviews for consensus, and finally submittal to NFPA membership for approval, no changes in the NEC will be finalized until NFPA formally adopts the 1987 edition of the NEC as a national consensus standard.

The suggestion made to OSHA that some particular voltage, such as 15 kV, be established as a demarcation line between the utilization system and the transmission and distribution system, was questioned by several witnesses at the hearing. One witness representing the Edison Electric Institute (EEI) stated that many power plants and substations which are part of a utility company's generating and distribution facilities, operate at less than 15 kV (Tr. 42). Additionally, one of OSHA's expert witnesses questioned the rationale of such a demarcation line between utilization and distribution systems inasmuch as Subpart K and Subpart V now provide for such separation, and he further testified that Subpart K addresses "600 volt and below circuitry, with most power utilized at 120 volts serving power tools and lighting" (Tr. 28). The other OSHA expert witness made the same point and also noted that Subpart K also covers "utilization uses" over 600 volts (Ex. 11).

In light of this evidence, OSHA does not consider it appropriate to define transmission and distribution systems vis-a-vis utilization in terms of voltage. The voltage of a system is not always an indication of the system's purpose. OSHA believes that a determination of

whether certain equipment is part of the utilization system or part of a transmission or distribution system can only be made on a case-by-case basis.

The representatives of the electric utility industry brought out a related issue, namely, whether the proposed Subpart K would continue the "utility exclusion" contained in the 1971 NEC adopted by reference in the existing standard (Tr. 39–40). As pointed out by the EEI witness, section 90–2(b)(5) of the 1971 NEC states:

90–2. Scope.

* * * * *

(b) *Not covered.* It [the NEC] does not cover:* * *

(5) Installations under the exclusive control of electric utilities for the purpose of communication, metering or for the generation, control, transformation, transmission and distribution of electric energy located in buildings used exclusively by utilities for such purposes or located outdoors on property owned or leased by the utility or on public highways, streets, roads, etc., or outdoors by established rights on private property.

The electric utility industry representatives acknowledged that transmission and distribution lines (covered by Subpart V of the Construction Standards) were clearly not covered by the proposed requirements. However, they were concerned that the revised Subpart K would apply to the temporary and permanent wiring when construction work is performed in "an electric utility workplace, other than transmission and distribution lines" (Tr. 41). They contended that Subpart K should retain the incorporation by reference of the National Electrical Code, along with its "exemption" of certain electric utility facilities (Ex. 22).

Proposed § 1926.402(a), which was consistent with existing § 1926.400(b), provided that the electrical installation requirements only apply to "electrical equipment and installations used to provide electric power and light." It was never intended that the standard cover electrical installations used primarily for the generation, transmission, or distribution of electric power. To make this point absolutely clear in the final rule, OSHA has changed § 1926.402(b) to read as follows:

(b) *Not covered.* Sections 1926.402 through 1926.408 do not cover installations used for the generation, transmission, and distribution of electric energy, including related communication, metering, control, and transformation installations. (However, these regulations do cover portable and vehicle-mounted generators used to provide power for equipment used at the jobsite.) See Subpart V of this Part for the construction of power distribution and transmission lines.

While the exact language of section 90–2(b)(5) of the 1971 NEC has not been used, the installations listed in the OSHA paragraph as not being covered are of the same types as noted in the 1971 NEC. The only difference is that the NEC refers only to such installations under the exclusive control of electric utilities, while OSHA's electrical installation standards for construction have never covered such installations regardless of who controlled them. Although the specific suggestions of the steel and electric utility have not been incorporated into the final rule, it is OSHA's belief that the language added in § 1926.402(b) of the final rule clarifies the application of the standard and responds adequately to their stated concerns.

3. *Whether the NEC should continue to be incorporated by reference and, if not, whether the standard should be based on applicable provisions of NFPA 70E relevant to construction.*

One of the hearing requests (Ex. 2–28) objected to the proposal's elimination of the incorporation by reference of the National Electrical Code. This commenter, representing the International Brotherhood of Electrical Workers (IBEW), suggested that OSHA simply replace the reference to the 1971 NEC with one to the 1984 NEC. To support their view, the IBEW cited evidence from the preamble to the proposal that the NEC is adopted and enforced by many local and State jurisdictions and that it is widely understood and recognized in the construction industry. The IBEW also argued that, since OSHA's standard was based on NEC provisions, each revision of the NEC would necessitate a revision of the OSHA standard.

In support of their position that OSHA should adopt the 1984 NEC, the IBEW presented evidence of the legality of incorporating a national consensus standard by reference (Ex. 16). According to section 552(a)(1) of the Administrative Procedure Act, an incorporation by reference is valid if it is reasonably available to affected persons and if its incorporation is approved by the Director of the **Federal Register**. As noted by one IBEW witness, the NEC is certainly available to all employers and employees (Tr. 75–76). However, this witness also acknowledged that OSHA would have to propose a specific edition of the NEC, describe any substantive revisions to the current standard which would be incorporated therein, and hold a hearing if someone objects to the proposal (Tr. 77).

At the hearing, one IBEW witness restated these objections (Tr. 61–63, 68–69). Additionally, he countered OSHA's claim that the proposal would simplify the standards by noting that those in the construction industry are already familiar with and understand the NEC (Tr. 62). He therefore claimed that OSHA's adoption of requirements which differ from the NEC would lead to confusion rather than simplification (Tr. 68).

IBEW's claims were supported at the hearing by EEI (Tr. 46–49; Ex. 13). One EEI representative noted that there is a "network of training and education concerning the NEC" (Tr. 47). He stated that community colleges, professional associations, and the NFPA itself are involved in this educational effort. As did the IBEW witness, the utility witness argued that confusion would result from OSHA's issuance of a standard which "attempts with different language to imitate a portion of the NEC."

Other evidence and several other commenters generally supported the view that the NEC is widely recognized and understood and that it should be incorporated in some manner into the OSHA standards (Ex. 2–6, 2–13, 2–23, 2–29).

Both of OSHA's expert witnesses supported the proposed removal of the incorporation of the NEC by reference (Ex. 10, 11). Mr. Bernard W. Whittington noted the specification orientation of the NEC and the need for OSHA to enforce a standard which would accept alternative methods of compliance while still protecting employees (Tr. 25–26). Mr. Ralph H. Lee also supported OSHA's proposal, contending that it would simplify the standards and eliminate requirements not directly related to employee safety. The overwhelming majority of the comments also supported OSHA's intention to eliminate the incorporation of the NEC by reference and replace it with a performance-oriented standard (Ex. 2–5, 2–10, 2–18, 2–20, 2–21, 2–30, 2–36, 18, 21, 24, 25, 27).

In developing its proposed Subpart K revision, OSHA drew heavily on its experience with the incorporated 1971 NEC and the problems that had been encountered in recent years. These problems, which were noted in the proposal and are discussed at length later under this issue, would exist with the adoption by reference of any specific edition of the National Electrical Code, and they have been well documented in the rulemaking record (Ex. 19, 20, 21, 24). In summary, there are essentially five major areas of concern:

1. The NEC is revised by NFPA every 3 years. The OSHA public rulemaking effort typically takes more than 3 years from the early draft stage to the

publication of a final rule. (Indeed, this effort to revise Subpart K took 4 years to complete.) Therefore, any specific edition of the NEC which OSHA proposes to adopt will already have been replaced by a more recent edition by the time the final rule will have been published. (For example, had OSHA in late 1981 or early 1982 decided to propose the adoption of the then current 1981 NEC instead of drafting the standard as proposed, the 1984 NEC would have been published by NFPA about the same time as OSHA's proposal on adoption of the 1981 NEC. In light of the number of changes to the NEC from 1981 to 1984, the OSHA standard would likely have needed to be reproposed in order to provide for public notice and comment on those proposed changes.) Without a continual process of revising Subpart K to reflect changes in the NEC, OSHA's electrical standards for construction would quickly become hopelessly out of date.

2. Even if OSHA were to propose adoption of each new edition of the NEC as it became available, public comments received during the rulemaking process could result in the Agency's adoption of many requirements which differ from those in the code.

3. In addition to the official 3-year period for NEC revision, the NEC can be changed anytime within that period by the processing of Tentative Interim Amendments by the National Fire Protection Association. If the amendments were to make substantive changes in the NEC, OSHA would have to go through further rulemaking in order to bring Subpart K into conformity with the code.

4. The NEC contains many installation details which are not directly related to employee safety and which, therefore, are not necessary for inclusion in an OSHA standard. (See Section II of this preamble for discussion of the development of the proposal.)

5. Although the NEC is not intended as a design specification nor an instruction manual for untrained persons, it does contain many detailed equipment or installation requirements which are not amenable to routine inspections for workplace safety.

OSHA does not dispute the legality of adopting a specific edition of the NEC into its regulations. In fact, OSHA has found the current incorporation by reference of the 1971 NEC in the general industry and construction electrical standards to be legal and enforceable. Yet, portions of these standards became outdated upon publication of the 1975 NEC. OSHA has continued to enforce the 1971 NEC even as later editions of the Code have become available. This process has caused the existing standards, though enforceable, to become out of date.

However, OSHA believes that adoption of new editions of the NEC by reference as they become available is not practical. IBEW suggested that OSHA could propose to adopt a future edition of the NEC at the time that a new edition is being proposed by NFPA (Tr. 77). Nevertheless, there are additional burdens placed on OSHA which would preclude such a possibility. Initially, OSHA would have to know exactly what was being proposed in the new NEC. An evaluation would have to be made to determine what substantive differences existed between the 1971 NEC and the NFPA's proposal. OSHA would then justify each difference in terms of employee safety and evaluate the regulatory impacts of these changes. By the time OSHA could publish a proposal, NFPA would likely have already approved the final NEC. If the new NEC were approved by NFPA with additional changes beyond what had been proposed, OSHA's proposal, preamble, and regulatory analysis would all have to be changed to reflect these changes. After publication of OSHA's proposal, the public would have the opportunity to comment and request a hearing. Lastly, OSHA would have to evaluate the rulemaking record and adopt a final rule based on that record. Due to this lengthy process, OSHA does not believe that its regulations could keep pace with the NEC.

Because the NEC is such a widely-used and recognized electrical installation code, the idea of merely incorporating the latest edition of the NEC into the OSHA standards by reference, to replace the 1971 edition, seems attractive at first glance. However, based upon OSHA's experience with its present electrical standards for construction, and its evaluation of the logistics of standards revision and the rulemaking process, the Agency has determined that incorporation of the latest edition of the NEC whenever it becomes available is not a practicable option. As noted previously, this determination centers primarily on the vagaries of the NEC revision process, on the contents of the NEC itself, and on the problems associated with standard-setting under section 6(b) of the OSHAct. The following discussion focuses on each of these limitations at length.

In developing its periodic revisions of the NEC, the National Fire Protection Association (NFPA) relies on twenty code making panels, a correlating committee and various advisory committees and subcommittees. After the code making panels take action to accept, accept-in-principle or reject the proposals, a consensus review of all panel action is conducted by the correlating committee. During the current processing schedule for the coming 1987 NEC, over 3500 proposals have been submitted for action. Following the completion of the code making panel action on these proposal submittals, related public comments are then received by NFPA, and the same cycle of panel action and correlating committee review repeats. When work on the received comments is concluded, final NFPA acceptance or rejection balloting is required before the completed NEC can be released.

The final NEC document which emerges from these deliberations is the result of many judgments and decisions which are not subject to final detailed general public or judicial scrutiny. However, when OSHA receives the new NEC, the Agency is not free simply to adopt it as an OSHA standard *in toto*, without opening it to public notice, comment, and an opportunity for a hearing. This means that all changes from the existing OSHA standard would be the subject of the rulemaking effort and would need to be supportable by substantial evidence on the record as a whole. It would be necessary for the Agency to be totally versed on every aspect of the new NEC in order to provide support for incorporating those provisions in the OSHA standards. It is clear, therefore, that the incorporation of the latest NEC would not necessarily be a straight-forward, *pro forma* exercise. Further, an OSHA rulemaking on the entire NEC would provide parties who had not prevailed with argument at the NFPA level, to raise those arguments anew at the OSHA level. It would be unreasonable to expect OSHA to have the degree of institutional knowledge of the NEC revisions which would be necessary to deal with these arguments. Even more compelling, however, is the problem of consistency: The benefits of incorporating the latest NEC through rulemaking would be achieved only if the entire NEC were to pass through the proceeding unscathed, without OSHA being compelled to make changes in the final rule. Only then would the language in the final standard remain totally consistent with the latest NEC and thus be identical to that being enforced by building and other authorities in this country. Given OSHA's need to develop its standards based upon the public record, one cannot assume that OSHA's proposal would go through rulemaking unchanged or that public input would have no effect upon either the form or

the substance of its final electrical standards. Indeed, even in the performance-oriented final rule being promulgated today, public comment has led the Agency to make various modifications; the many specifications in the NEC would certainly be subject to comparable revision during the rulemaking process.

Yet another complication involves the interrelationship between NFPA's schedule for revising the NEC, and OSHA's timetables for revising its standards under section 6(b) of the OSHAct. Because the development of an OSHA standard can be a lengthy process, it is conceivable that the rulemaking on a new edition of the NEC might well extend past the time when an even newer edition becomes available. This would lead to the incongruous situation of OSHA finalizing a standard which would have to be reopened for further rulemaking almost immediately. The likelihood of such a scenario would be enhanced by the need to evaluate new changes in the NEC in detail in each rulemaking. The Agency does not believe that such efforts would constitute a productive use of Agency resources or the resources of the interested parties that would be participating in the proceedings. OSHA has made a determined effort to develop an electrical standard for construction which is flexible enough to allow for changes in technology and practices over time and which can accommodate revisions in the NEC without itself having to be revised. If this effort is effective, the Agency will be able to concentrate its rulemaking resources in more productive areas.

Even if OSHA were to be able to adopt new editions of the NEC as they were issued, this would not assure uniformity in and of itself, because of another element of the NEC development process. Between editions of the NEC, the NFPA is frequently called upon to issue modifications and interpretations to the most recent code. These issuances are referred to as "Tentative Interim Amendments" and "Formal Interpretations" respectively and are, at least in the former case, precursors of changes to be made in the next edition of the NEC. It is evident that there is no way for OSHA to incorporate these documents into its rulemakings on any comprehensive basis. Further, to the extent that these "Tentative Interim Amendments" and "Formal Interpretations" do not represent OSHA's views, there is the potential for further disagreement between the NEC and the OSHA standards.

In addition, as has been pointed out frequently during this rulemaking, the NEC contains many specifications which are not directly related to employee safety in the workplace. If the entire NEC is to be incorporated by reference in the OSHA standards, the Agency is faced with enforcing standards whose scope is broader than employee protection would necessarily warrant. It was this very problem that led NFPA to convene the 70E committee, with the charge of using the NEC as a source document to develop an electrical safety standard specifically for the workplace. It was the product of that committee's efforts which served as the basis for OSHA's proposed revision of Subpart K. Further, even for details of the NEC which do directly relate to safeguarding employees, the NEC provides many specifications which provide inadequate flexibility for the employer in providing a safe electrical installation. The revised standards are intended to allow for alternative safe methods of installation which are or may be available, and which might not be permissible under a specific edition of the NEC.

In adopting NFPA 70E as a national consensus standard for workplace safety, NFPA recognized that its continuous process of revising the NEC is not compatible with OSHA's need to keep its standards up to date. As noted in section 11(B) of this preamble, NFPA 70E was developed to provide the essential elements of workplace safety covered by the NEC, while obviating the need for frequent revision as new editions of the NEC became available. OSHA has afforded considerable weight to the determinations made by NFPA in this area, particularly in light of their responsibilities in developing the NEC itself and NFPA 70E. Support for OSHA's use of NFPA 70E as a base document in revising its electrical standard for construction was voiced by many commenters and witnesses (Ex. 2–10, 2–30, 2–42, 19, 20, 25, 26, 27). It was generally agreed that NFPA 70E contains basic NEC requirements dealing directly with employee safety, is written in performance terms allowing alternative methods of providing safety, and is written so that it will not need frequent revision (Ex. 2–10, 2–15, 2–34, 2–42, 2–43, 10, 11, 19, 20, 24, 26, 27). For these reasons OSHA has decided to retain the proposal's reliance on NFPA 70E requirements and removal of the incorporation of the NEC by reference. By revising Subpart K in this manner, OSHA expects to be able to protect employees from electrical hazards present in construction workplaces, while reducing the possibility that the standard will become out of date within a short period of time.

At the same time, the record reflects that many electrical contractors and others are familiar with the requirements of the 1984 NEC (Tr. 46–47, 55–57, 62–63) and that there is widespread compliance with those requirements in the construction industry (Ex. 2–13, 2–23; Tr. 55–57). Because of this, OSHA has thoroughly reviewed the 1984 NEC and has determined that the requirements of that Code are at least as effective in protecting employees as revised Subpart K §§ 1926.402–1926.408, except for §§ 1926.404(b)(1) and 1926.405(a)(2)(ii)(E), (F), (G), and (J). These excepted provisions are from the text of the existing Subpart K, and they contain requirements which are not contained in the Code or which differ from requirements in the Code. (For a more complete discussion, see section V of this preamble.) Therefore, OSHA has determined that an installation which complies with the 1984 NEC (excluding all NFPA generated Tentative Interim Amendments) will be accepted as being in compliance with the installation practices contained in the revised Subpart K, except for the specific provisions previously noted.

Although OSHA considers the performance-oriented installation practices contained in the revised Subpart K as the minimum required standard, the Agency will accept, exclusive of any subsequent Tentative Interim Amendments and future NEC revisions, compliance with the specification-type requirements of the 1984 NEC. OSHA cannot accept, in advance, compliance with future editions of the NEC, but will review all future editions to determine their consistency with the performance requirements contained in the revised Subpart K. It is hoped that during this time employers and employees, by employing the less detailed OSHA standard and by understanding how it relates to the NEC, will experience a minimum of confusion from the revised standard.

4. *Whether OSHA should retain the more detailed language of the existing standard in paragraphs (d), (e), and (g) of § 1926.401, which deal with specific ground resistance values and bonding techniques, rather than the more performance-oriented language of proposed § 1926.404(f).*

In their hearing request, IBEW objected to the proposal's revision of former § 1926.401(d) (Ex. 228). Disagreeing with the Distribution Table

in the preamble to the proposal, the IBEW argued that proposed § 1926.404(f)(10) was not equivalent to existing § 1926.401(d).

The existing requirement reads as follows:

(d) *Ground resistance.* Driven rod electrodes shall, where practicable, have a resistance to ground not to exceed 25 ohms. Where the resistance is not as low as 25 ohms, two or more electrodes connected in parallel shall be used.

The proposed revision read as follows:

(10) *Made electrodes.* Where made electrodes are used, they shall be free from nonconductive coatings, such as paint or enamel; and where practicable, they shall be embedded below permanent moisture level. A single electrode consisting of a rod, pipe or plate which has a resistance to ground greater than 25 ohms shall be augmented by one additional electrode installed no closer than 6 feet (1.83 m) to the first electrode.

The language of both of these requirements came from the NEC. Existing § 1926.401(d) is identical to 1971 NEC section 250–84; proposed § 1926.404(f)(10) was derived from 1984 NEC sections 250–83 and 250–84.

At the hearing, the IBEW restated their position with respect to existing § 1926.401(d) that the proposal provided inadequate protection. Their entire argument consisted of the following statement: .

The present section [§ 1926.401(d)] should be retained. It requires, where practical, driven rod electrodes to have a resistance to ground not to exceed 25 ohms. Where this is not practical and the resistance is greater than 25 ohms, it provides for two or more electrodes to be used.

The proposed amendment .405(f)(10) states that a single electrode having a resistance greater than 25 ohms shall be augmented by one additional electrode. This is inadequate protection. (Tr. 65)

The IBEW presented no further evidence on this issue.

This testimony was rebutted by OSHA's expert witness, Mr. Ralph H. Lee, who explained the difficulty of achieving a 25-ohm resistance with made electrodes in some parts of the country (Ex. 11; Tr. 34–35). Mr. Lee also explained that the purpose of this provision is the protection of the employee from hazards resulting from the impression of a higher than normal voltage on the utilization system (Ex. 11). This could happen, for example, through the failure of insulation in a distribution transformer. The connection of the utilization system to ground facilitates the operation of protective devices by providing a path for current resulting from the higher voltage; and this prevents subsequent insulation failure, due to the impression of high voltage on the lower voltage circuit, and possible injury to employees. Because of these facts, Mr. Lee explained, a resistance less than 25 ohms is not of primary importance. No evidence was presented to refute this testimony.

OSHA agrees with the rationale set forth by Mr. Lee and is retaining § 1926.404(f)(10) as proposed. This is consistent with what is required by the 1984 NEC.

With respect to existing § 1926.401(e), the IBEW argued that this provision was essential, and they objected to its removal (Ex. 2–28; Tr. 65). This requirement read as follows:

(e) *Testing of grounds.* Grounding circuits shall be checked to ensure that the circuit between the ground and the grounded power conductor has a resistance which is low enough to permit sufficient current to flow to cause the fuse or circuit breaker to interrupt the current.

Taken literally, this paragraph required employers to check the resistance to ground of the grounding electrode. Both the proposal and the existing standard required this resistance, where practical, to be less than 25 ohms. However, a grounding electrode resistance near this limit is not low enough to cause an overcurrent device to open a circuit due to the existence of a fault to a remote ground. Mr. Ralph H. Lee noted that, on a 277/480-volt system, a 25-ohm ground alone would allow only 11.1 amperes to flow, not enough to operate a 15-ampere protective device (Ex. 2–38, 11). Thus, such an installation would meet existing § 1926.401(b), but the resistance check required by existing § 1926.401(e) would show that the resistance was too high to permit sufficient current to flow to cause the overcurrent device to interrupt the circuit. As noted by Mr. Lee, the grounding of the system protects against the possibility of the impression of high voltage on the system; it is the equipment grounding conductor which protects employees from ground faults in the utilization system itself (Ex. 2–38, 11). Therefore, a grounding electrode with a 25-ohm resistance to ground would not pose a hazard to employees.

At best, it is incongruous for the requirement directly addressing the resistance to ground of the grounding electrode to allow a higher resistance than the requirement to check the resistance allows. Additionally, as noted in the discussion of the previous issue, the resistance of the grounding electrode is not of primary importance to employee safety. The most common and most hazardous ground fault is a fault from a "hot" conductor to the metal frame of an electric tool, which is required to be grounded. The equipment grounding conductor returns current to the source of voltage, and this "short circuit" causes the overcurrent device to open the circuit. Since the impedance of the grounding electrode is not a part of the circuit conducting the fault current, the value of this impedance has no effect on the amount of fault current flowing or on whether or not the overcurrent device opens the circuit upon occurrence of this type of ground fault. Therefore, OSHA has determined that a requirement to check the resistance of the grounding electrode is not necessary for employee safety.

The IBEW also claimed that the proposed removal of existing § 1926.401(g) would seriously weaken the provisions concerning bonding by limiting their application (Ex. 2–28; Tr. 65). In the Distribution Table in the preamble to the proposal, OSHA stated that the requirements of existing § 1926.401(g) dealing with bonding for static electricity control were already covered in §§ 1926.151(a)(5) and 1926.152(e)(2). The IBEW noted that the referenced provisions relate only to bonding in connection with hazardous concentrations of flammable gases, vapors, or liquids (Ex. 2–28). Their objections claimed that these rules do not address the subject of attaching and detaching bonding clamps or clips (Ex. 2–28; Tr. 66).

Paragraph (g) of former § 1926.401 reads as follows:

(g) *Bonding.* (1) Conductors used for bonding and grounding stationary and movable equipment shall be of ample size to carry the anticipated current.

(2) When attaching bonding and grounding clamps or clips, a secure and positive metal-to-metal contact shall be made. Such attachments shall be made before closures are opened and material movements are started and shall not be broken until after material movements are stopped and closures are made.

There was no requirement in this paragraph to provide bonding conductors; this paragraph applied if bonding conductors were provided. In paragraphs (f)(8)(ii) and (f)(9) of § 1926.404, the proposal carried forward the requirements of existing § 1926.401(g)(1). The proposed provisions read as follows:

(f) * * *

(8) * * *

(ii) A conductor used for grounding fixed or movable equipment shall have capacity to conduct safely any fault current which may be imposed on it.

* * * * *

(9) *Bonding.* Where bonding conductors are used to assure electrical continuity they shall

have the capacity to conduct any fault current which may be imposed.

The language used in these paragraphs is nearly identical to that used in paragraph (g)(1) of the existing standard. In this case, the requirements in the proposal and in the existing regulation are the same. Therefore, the final rule incorporates the provisions of existing § 1926.401(g)(1) in paragraphs (f)(8)(ii) and (f)(9) of revised § 1926.404, as proposed.

Paragraph (g)(2) of existing § 1926.401 did not relate to equipment or installations covered by Subpart K. Rather, this provision addressed bonding jumpers used to control static electricity during the transfer of materials from one enclosure to another. These bonding jumpers are not a part of the electrical installation used to provide power and light; therefore, coverage of these jumpers does not belong within Subpart K, which only covers that installation.

However, the use of such bonding conductors is covered in Subpart F of Part 1926. Paragraph (a)(5) of § 1926.151 addresses bonding for tanks and vessels containing hazardous concentrations of flammable gases or vapors and reads as follows:

(5) The nozzle of air, inert gas, and steam lines or hoses, when used in the cleaning or ventilation of tanks and vessels that contain hazardous concentrations of flammable gases or vapors, shall be bonded to the tank or vessel shell. Bonding devices shall not be attached or detached in hazardous concentrations of flammable gases or vapors.

Paragraph (e)(2) of § 1926.152 addresses bonding for containers of flammable liquids and reads as follows:

(2) Transfer of flammable liquids from one container to another shall be done only when containers are electrically interconnected (bonded).

Both of these provisions set forth the conditions under which bonding is required, including when the bonding must be in place. Existing § 1926.401(g)(2) does not go beyond what is already required by the Subpart F regulations. Since existing § 1926.401(g)(2) would be out of place in Subpart K and since the hazards it addressed are still covered elsewhere in the construction standards, OSHA has decided to remove this provision from the electrical standards for construction.

5. *Whether receptacles in existing installations should be permitted to be grounded by means of grounded metal cold water pipes, as is the case in the existing standards, or whether such receptacles should be required to be grounded by a separate equipment grounding conductor connected back to the service.*

For branch circuit extensions, the existing standard, as stated in 1971 NEC section 250–50, Exception, allows the grounding conductor of a grounding type receptacle to be grounded to a nearby cold water pipe if the original branch circuit does not have an equipment grounding conductor. The draft proposal reviewed by ACCSH continued to allow this practice and was intended to be consistent with the NEC.

Some of the ACCSH members raised concerns regarding the use of a water pipe as a ground, pointing out the hazards involved. In particular, the committee cited the widespread use of plastic pipe as evidence that many piping systems would not provide a continuous electrical conductor. Additionally, it was noted that the use of a water pipe as a grounding conductor can introduce hazards to plumbers working on the piping. If the pipe is carrying leakage current, it poses a shock hazard to anyone interrupting its continuity.

OSHA agrees that the expanded use of plastic water pipe can cause problems with the reliability of a water pipe as a ground and recognizes the increased shock hazard to those working on the pipes. Also, the types of old, ungrounded branch circuits addressed by this provision of the NEC are not generally encountered in construction. For these reasons, OSHA's proposal would not have allowed the grounding of receptacles by means of grounded water pipes. The proposal would have required them to be grounded by means of an equipment grounding conductor which runs with or encloses the circuit conductors (proposed § 1926.404(f)(9)). Since the proposal differed from the NEC on this point, OSHA solicited comments regarding any problems which could result from this conflict of standards.

In their objections, the IBEW argued that OSHA's standard should follow the NEC (Ex. 2–28). After noting that OSHA's standard prohibited the grounding of receptacles by means of grounded metal cold water pipes, the IBEW claimed that NEC provisions on grounding are adequate and more clearly address the relevant hazard than OSHA's proposal (Ex. 2–28; Tr. 64). In support of their position, they quoted NEC requirements for including an underground metal water pipe as part of the grounding electrode system and for supplementing the water pipe with an additional electrode (Ex. 2–28).

OSHA's expert witness, Mr. Ralph Lee, noted the hazards arising from the practice of grounding a receptacle by means of a metal water pipe near the receptacle (Ex. 11; Tr. 35). He suggested the elimination of this practice.

One commenter argued that provisions relating to existing installations were not relevant to an electrical construction standard (Ex. 2–40).

After considering this issue, OSHA agrees with this last comment. As explained in § 1926.402(a), the electrical installation standards do not apply to existing installations in place before the construction activity began. Thus, any requirements dealing with the existing wiring of a building would be beyond the scope of the standard; and the issue of grounding to cold water pipes deals exclusively with existing installations. OSHA has decided, therefore, that the standard should be silent on this issue. The revised standard specifies which equipment is to be grounded, but does not cover methods used in existing installations to ground this equipment. Thus, the employee using the equipment is protected, but the method used to provide the protection is determined by the employer.

OSHA realizes that employees working on plumbing systems may face hazards resulting from the practice of using metal pipes to ground equipment. These hazards will be addressed in future rulemaking activities.

6. *Whether temporary lighting should be required to be installed with "heavy duty" cords rather than with other means, such as multiconductor cable assemblies or open conductors.*

In the existing standard, § 1926.401(j)(2) contained the requirement:

Temporary lights shall be equipped with heavy duty electric cords with connections and insulation maintained in safe condition.

In § 1926.405(a)(2)(ii)(B), the proposed standard would have allowed methods of wiring temporary lights in addition to cords, including open conductors, cables suitable for the environment, and conduit. In this area, the proposal was consistent with the 1971 and 1981 NEC, which allow but do not require temporary lights to be wired with cord. The NEC recognizes that, when properly installed, any of these wiring methods can provide safety as effectively as heavy duty electric cord can. Since it was thought that proposed § 1926.405(a)(2)(ii)(B) would adequately protect employees from the hazards of temporary lighting wiring methods, the language of existing § 1926.401(j)(2) was not included in the proposal. This approach was consistent with OSHA Instruction STD 3–9.1, which interpreted

the former standard as allowing methods of wiring portable lights other than by means of heavy duty cords, provided the installation complied with the 1971 NEC.

Several ACCSH members objected to the proposed removal of this requirement. The representative of the International Brotherhood of Electrical Workers felt that OSHA's proposal did not provide the minimum protection of the existing standard. However, no one presented data or information demonstrating that other temporary lighting wiring methods allowed by the existing standard (as interpreted under OSHA Instruction STD 3-9.1) have caused injury or exposed employees to unnecessary hazards. Subsequently, OSHA formally proposed the elimination of existing § 1926.401(j)(2), while inviting comments on this issue.

After publication of the proposal, the IBEW again objected to the proposed elimination of existing § 1926.401(j)(2). They also took this opportunity to urge OSHA to rescind OSHA Instruction STD 3-9.1. They based their objections on the claim that former § 1926.401(j)(2) was "clearly worded, self-contained, and substantively essential" (Ex. 2-28). At the hearing, the IBEW witness noted that cords used for temporary lighting on construction sites are subject to various kinds of damage from workers, equipment, and the weather (Tr. 66).

Support for OSHA's proposed removal of this requirement was expressed in the comments and at the hearing (Ex. 2-15, 2-34, 2-42, 2-43; Tr. 30). These comments noted the lack of evidence that wiring temporary lights by means other than "heavy duty" flexible cord is hazardous. A hearing exhibit submitted by Mr. Ralph H. Lee stated that "heavy duty" cords owe their "heavy duty" capability to the heavy jacket surrounding the cord's conductors (Ex. 11). This exhibit went on to claim that the conductors within the jacket are rather fragile (due to their being stranded) and that these conductors form the strength element for the festooned lighting common in construction. (In festoon lighting, the lights are suspended as pendants from the supply conductors.) This exhibit also claimed that open conductors, because they are generally solid conductors, are stronger and more suitable for this type of wiring.

After considering all the evidence on this issue, OSHA has determined that many methods of wiring temporary lights can be installed so as to provide safety to employees. The final rule requires open conductors to be located so that they will not be exposed to damage (§ 1926.405(a)(2)(ii)(B)). Other types of wiring methods protect the conductors between lights by means of jackets or metal or nonmetallic raceways. As required by the standard, these wiring methods are fixed in place for weeks or months at a time, and they are not as exposed to likely damage as is portable equipment.

The only time a "heavy duty" cord would be necessary is when the temporary lighting is portable rather than fastened in place. In such cases, the flexibility provided by the cord would be needed to prevent the conductors from being damaged by the constant flexion, and a heavy jacket would protect the conductors from the abrasion and abuse they receive when being moved around a jobsite. Additionally, if flexible cord is used for the installation of fixed temporary lighting, the cord used must be of a type that is suitable for hard use so that it can withstand the abuse it faces on a construction site.

Therefore, the final rule allows various means of installing temporary lights, but is more specific than the proposal in its requirements for portable equipment. Final § 1926.405(a)(2)(ii)(B) requires temporary branch circuits, including those for lighting, to be run as multiconductor cord or cable assemblies, within raceways, or as open conductors. Open conductors may be installed only where not subject to damage. To deal with the problem of portable lighting and to continue the requirement for "heavy duty" cord for this equipment, OSHA has amended § 1926.405(a)(2)(ii)(J) in the final rule to require cords used for portable and temporary lights to be designed for hard or extra-hard usage. The proposal had required this only of extension cords. (See also further discussion of this requirement in Section V of this preamble.)

7. Whether the specific language in paragraphs (a)(1), (a)(3), (a)(6), and (a)(8) of existing § 1926.402, dealing with design details of attachment plugs and receptacles and with protection of cables from damage, should be retained or whether the objectives of these requirements have been adequately addressed in the proposal.

Paragraphs (a)(1) and (a)(3) of existing § 1926.402 contains specific design requirements for receptacles, plugs, and connectors. Paragraphs (a)(6) and (a)(8) of existing § 1926.402 contains requirements for protecting cables from physical damage. These four paragraphs read as follows:

(a) *Flexible cable and cords.* (1) Receptacles for attachment plugs shall be of approved, concealed contact type with a contact for extending ground continuity and shall be so designed and constructed that the plug may be pulled out without leaving any live parts exposed to accidental contact.

* * * * *

(3) Attachment plugs or other connectors supplying equipment at more than 300 volts shall be of the skirted type or otherwise so designed that arcs will be confined.

* * * * *

(6) Trailing cables shall be protected from damage.

* * * * *

(8) Cable passing through work areas shall be covered or elevated to protect it from damage which would create a hazard to employees.

OSHA proposed to remove these paragraphs from Subpart K. As noted in the Distribution Table contained in the preamble to the proposal, various provisions which were included in the proposed standard addressed the hazard dealt with by these existing regulations. In particular, the following table describes how these existing paragraphs were covered in the proposal:

DISTRIBUTION TABLE FOR PARAGRAPHS (a)(1), (a)(3), (a)(6), AND (a)(8) OF EXISTING § 1926.402

Old paragraph	Area addressed	Proposed new section
(a)(1)	Approval of receptacles.	§ 1926.403(a)—Requires all equipment to be approved.
(a)(1)	Receptacles—Concealed contact and guarding of live parts.	§ 1926.403(i)(2)—Requires all live parts to be guarded from employee contact.
(a)(1)	Receptacles to be grounding type.	§ 1926.404(f)—Contains general requirements on grounding. § 1926.405(a)(2)(ii)(C)—Requires receptacles on temporary wiring to be grounding type.
(a)(3)	Attachment plugs and connectors over 300 volts to be skirted type.	§ 1926.403(a)—Requires approval of § 1926.403(c)—Requires equipment to be capable of safely interrupting current.
(a)(6)	Trailing cables to be protected from damage.	§ 1926.405(a)(2)(ii)(I)—Requires flexible cords and cables to be protected from damage.
(a)(8)	Cable passing through areas to be covered or elevated.	§ 1926.405(a)(2)(ii)(B)—Requires branch-circuit conductors to be elevated. (Usual application is to cables run as temporary wiring.) § 1926.405(a)(2)(ii)(I)—Requires flexible cords and cables to be protected from damage.

As can be seen from this table, the proposal contained requirements written in performance language addressing the same hazards as the existing standard. However, in raising this issue, the IBEW objected to the elimination of the specific language contained in the existing standard (Ex. 2-28). They

claimed that the simple language of the existing standard was being replaced by a maze of regulations in the proposal (Ex. 2–28). They also argued that the general provisions of the proposal do not adequately address the hazards covered by the existing standard (Ex. 2–28). For example, the IBEW stated that paragraphs (a), (b), and (c) of proposed § 1926.403 do not deal with the hazard of attachment plugs or other connectors supplying equipment at more than 300 volts.

On the other hand, Mr. Bernard W. Whittington, an OSHA expert witness, contended that the proposed regulations noted in the Distribution Table did, in fact, cover the same hazards as those in the existing standard (Ex. 10; TR. 30–31). In support of OSHA's proposal, Mr. Whittington, who (through his membership on the NFPA 70E Committee) helped draft NFPA 70E, argued that the performance-oriented approach proposed for Subpart K is appropriate and provides equivalent or better safety compared to the existing Subpart K (Tr. 27, 31).

OSHA has determined that properly written performance-oriented standards can protect employees as well as specification standards, while providing employers with the opportunity to protect their employees in the most efficient manner. The concerns raised with respect to this issue are demonstrative of this point. For example, existing § 1926.402(a)(3) required plugs and connectors used at 300 volts or more to be the skirted type. This skirting is one means of protecting employees separating the connectors under load conditions from the arcing caused by this separation. In the final standard, § 1926.403(a) does not specify skirting but does require these plugs and connectors to be approved; the qualified testing laboratory "approving" these devices would determine their safety, including provisions for protection from arcing. Additionally, final § 1926.403(b) requires them to be free of serious hazards and states that arcing effects are one consideration involved. Also, final § 1926.403(c) requires equipment to be rated to interrupt the current which is to be broken. Equipment which could not safely interrupt high current would not be rated for this service and may not be used in this manner. Thus, the final standard requires employee protection equivalent to that provided by the existing standard while allowing greater flexibility in compliance.

8. *Whether revised § 1926.403(j) should apply to equipment on the supply side of the service conductors.*

Paragraph (j)(1) of proposed § 1926.403 read as follows:

(j) *Over 600 volts, nominal*—(1) *General.* Conductors and equipment used on circuits exceeding 600 volts, nominal, shall comply with all applicable provisions of paragraphs (a) through (g) of this section and with the following provisions which supplement or modify those requirements. The provisions of paragraphs (j) (2), (3), and (4) of this section do not apply to equipment on the supply side of the service conductors.

Proposed paragraphs (j)(2), (j)(3), and (j)(4) dealt with guarding of live parts, working space about equipment, and access to workspace for installations over 600 volts. The last sentence of proposed paragraph (j)(1) stated the simple fact that equipment on the *supply side* of the service conductors was not addressed. Such equipment would be part of a distribution network and, thus, not covered by the proposed installation provisions anyway. (See discussion of Issue 2. Neither the proposal nor the final installation rules apply to distribution lines or equipment.) The equipment addressed by final § 1926.403(j), and covered by the standard, would be the service conductors and equipment on the load side of these conductors.

In their objections to the proposal, the IBEW claimed that there was no good reason for excluding those provisions from applying to equipment on the supply side of the service conductors (Ex. 2–28). To support their objection, they noted that the voltages mentioned in § 1926.403(j) are those normally associated with supply-side equipment (Ex. 2–28).

Installations on the supply side of the service conductors are outside the scope of Subpart K, which only covers utilization systems (Ex. 11, 13). Therefore, OSHA has decided to retain § 1926.403(j)(1) as proposed, to cover only service conductors over 600 volts and equipment over 600 volts on the load side of the service conductors.

9. *Whether the requirement, in proposed § 1926.404(f)(7)(i), to ground metal enclosures for conductors should allow exemptions for enclosures used to protect cables from damage and for enclosures added to existing installations of open wiring, knob-and-tube wiring, and nonmetallic sheathed cable, under certain restrictions.*

Paragraph (f)(7)(i) of proposed § 1926.404 contained a requirement similar to one in the 1971 NEC that enclosures for conductors be grounded. OSHA proposed two exceptions to this rule: one for enclosures used to protect cable assemblies from damage, the other for enclosures used for conductors run as extensions of existing circuits. These exceptions were also contained in the 1971 NEC. Proposed § 1926.404(f)(7)(i) read as follows:

(7) *Supports, enclosures, and equipment to be grounded*—(1) *Supports and enclosures for conductors.* Metal cable trays, metal raceways, and metal enclosures for conductors shall be grounded, except that:

(A) Metal enclosures such as sleeves that are used to protect cable assemblies from physical damage need not be grounded; and

(B) Metal enclosures for conductors added to existing installations of open wire, knob-and-tube wiring, and nonmetallic-sheathed cable need not be grounded if all of the following conditions are met: (1) Runs are less than 25 feet (7.62 m); (2) enclosures are free from probable contact with ground, grounded metal, metal laths, or other conductive materials; and (3) enclosures are guarded against employee contact.

The IBEW objected to the exceptions to the proposed requirement to ground metal enclosures for conductors (Ex. 2–28). Claiming that both exceptions were inappropriate and would promote electrical hazards, they stated that any metal should be grounded "if there is a possibility of [its] becoming energized and being touched by a person in contact with the ground" (Tr. 65).

This proposed requirement was equivalent to 1971 NEC Section 25033, which was adopted by reference in existing § 1926.400(a). The first proposed exception (taken from the NEC) recognized the fact that the conductors within a cable assembly are protected against insulation failure by an outer jacket over the conductor insulation. The metal enclosure is normally provided in areas where the cable's jacket must be protected. Being isolated sections, these enclosures have no ready access to a grounding means. Since an insulation failure leading to contact of the conductor with the metal enclosure is very unlikely and since a means of grounding these enclosures is not readily available, the enclosures were not required to be grounded. OSHA proposed to continue this exception.

The second exception, also taken from the 1971 NEC, applied to metal enclosures for conductors added to existing installations of open wiring, knob-and-tube wiring, and nonmetallic-sheathed cable. In this case, the exception was limited to situations in which the possibility of insulation failure is low, due to the limitation on the length of the run of the conductors. Also, the exception limited the likelihood of employee contact with the ungrounded metal enclosure.

Support was expressed for OSHA's proposal, with commenters stating that paragraphs (f)(7)(i) (A) and (B) of proposed § 1926.404 posed no electrical hazard to employees (Ex. 2–38, 2–47, 2–

43). One of OSHA's expert witnesses noted that metal enclosures which were not required to be grounded would normally be inaccessible to employees (Ex. 11).

OSHA has determined that installations which meet the conditions set forth in the exceptions to proposed § 1926.404(f)(7) do not compromise employee safety. Therefore, these exceptions have been retained in the final rule.

10. *Whether the definitions for Subpart K should be as proposed, or whether they should conform to those either in the 1984 NEC or in the existing standard.*

The definitions contained in § 1926.449 of proposed Subpart K were derived from and were consistent with those in the National Electrical Code. In some cases, certain minor differences resulted from NEC changes over the years. Also, as explained in the preamble to the proposal (48 FR 45877), definitions related to "approval" were proposed to be modified to remove references to specific testing laboratories. The specific definitions at issue were proposed to read as follows:

Acceptable. An installation or equipment is acceptable to the Assistant Secretary of Labor, and approved within the meaning of this Subpart K:

(i) If it is accepted, or certified, or listed, or labeled, or otherwise determined to be safe by a qualified testing laboratory capable of determining the suitability of materials and equipment for installation and use in accordance with this standard; or

(ii) With respect to an installation or equipment of a kind which no qualified testing laboratory accepts, certifies, lists, labels, or determines to be safe, if it is inspected or tested by another Federal agency, or by a State, municipal, or other local authority responsible for enforcing occupational safety provisions of, and found in compliance with, the National Electrical Code; or

(iii) With respect to custom-made equipment or related installations which are designed, fabricated for, and intended for use by a particular customer, if it is determined to be safe for its intended use by its manufacturer on the basis of test data which the employer keeps and makes available for inspection to the Assistant Secretary and his authorized representatives.

Accessible. (As applied to wiring methods.) Capable of being removed or exposed without damaging the building structure or finish, or not permanently closed in by the structure or finish of the building. (See "concealed" and "exposed.")

Accessible. (As applied to equipment.) Permitting close approach; not guarded by locked doors, elevation, or other effective means. (See "Readily accessible.")

Ampacity. Current-carrying capacity of electric conductors expressed in amperes.

Approved. Acceptable to the authority enforcing this subpart. The authority enforcing this subpart is the Assistant Secretary of Labor for Occupational Safety and Health. The definition of "acceptable" indicates what is acceptable to the Assistant Secretary of Labor, and therefore approved within the meaning of this subpart.

Automatic. Self-acting, operating by its own mechanism when actuated by some influence, such as a change in current strength, pressure, temperature, or mechanical configuration.

Guarded. Covered, shielded, fenced, enclosed, or otherwise protected by means of suitable covers, casings, barriers, rails, screens, mats, or platforms to remove the likelihood of approach to a point of danger or contact by persons or objects.

Identified (As applied to equipment). Recognized as suitable for the specific purpose, function, use, environment, application, etc. where described as a requirement in this standard. Suitability of equipment for a specific purpose, environment, or application is determined by a qualified testing laboratory where such identification includes labeling or listing.

Labeled. Equipment or materials to which has been attached a label, symbol or other identifying mark of a qualified testing laboratory which indicates compliance with appropriate standards or performance in a specified manner.

Listed. Equipment or materials included in a list published by a qualified testing laboratory whose listing states either that the equipment or material meets appropriate standards or has been tested and found suitable for use in a specified manner.

Qualified person. One familiar with the construction and operation of the equipment and the hazards involved.

Qualified testing laboratory. A properly equipped and staffed testing laboratory recognized by the Assistant Secretary of Labor which has capabilities for and provides the following services: (a) experimental testing for safety of specified items of equipment and materials referred to in this standard to determine compliance with appropriate test standards or performance in a specified manner; (b) inspecting the run of such items of equipment and materials at factories for product evaluation to assure compliance with the test standards; (c) service-value determinations through field inspections to monitor the proper use of labels on products and with authority for recall in the event a hazardous product is installed; (d) employing a controlled procedure for identifying the listed and/or labeled equipment or materials tested; and (e) rendering creditable reports or findings that are objective and without bias of the tests and test methods employed.

The IBEW objected to these proposed definitions—to some because they are not consistent with the 1984 NEC, to those related to "approval" because they are "inappropriate and unenforceable." They claimed that the NEC definitions are recognized throughout the industry and are adequate for the purpose of Subpart K (Tr. 67). They argued that "editorial changes to language in the National Electrical Code will serve only to confuse employers and employees and render enforcement more difficult" (Tr. 67). Additionally, the IBEW objected to OSHA's proposed definition of "qualified person," since it differed from the generic Construction Standards definition of "qualified" in § 1926.32(l) (Ex. 2–28). Lastly, arguing that the proposal's definition of "approved" was inappropriate and unenforceable, they suggested that the definition in existing § 1926.405(a) be retained.

With respect to the definition of "accessible (as applied to wiring methods)", OSHA has determined that the proposed definition is the same as that given in the 1984 NEC. Therefore, IBEW's concern regarding this definition has been met, and there is no change in the final rule.

Although identical in intent to the NEC definitions, the meanings of "accessible (as applied to equipment)," "ampacity," and "automatic" given in the proposal differed slightly in language or punctuation. To promote consistency with the NEC, OSHA has decided to use the 1984 NEC definitions of these terms.

Despite the fact that the proposed definition of "guarded" is not identical to that given in the 1984 NEC, OSHA's definition agrees with the NEC and is a grammatical improvement. Therefore, OSHA has retained the proposal's definition of "guarded."

In the case of "qualified person," the proposed definition was the same as the 1984 NEC, because the requirements contained in the proposal were largely based on the Code. This definition differs from that in § 1926.32(l), which applies generally throughout the construction standards and which reads as follows:

"Qualified" means one who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training, and experience, has successfully demonstrated his ability to solve or resolve problems relating to the subject matter, the work, or the project.

The proposal incorporated a definition of "qualified person" directly from the 1984 NEC. The use of the term "qualified person" in the NEC and in OSHA's proposal is heavily dependent upon the restrictions imposed by that definition. In comparing the proposed definition with the general definition of "qualified" in § 1926.32(l) of the construction standards, the Agency has determined that the general definition does not provide sufficient specificity as to the qualifications of a "qualified person." Although the use of the general definition would provide some added degree of consistency throughout the

construction standards, it does not adequately reflect the uniqueness of the electrical hazards covered by Subpart K. For example, revised § 1926.405(a)(2)(iii) prohibits access of other than qualified persons to temporary installations of equipment over 600 volts. It is clear from the proposed definition of "qualified person" that an individual would need to be familiar with the construction and operation of those installations, and with the associated hazards, in order to be allowed access to them. This would not necessarily require a person with an advanced degree or certificate; indeed, the mere fact that a person possessed such a degree or certificate would not automatically make him or her "qualified" in a particular situation under Subpart K. Based on the proposed definition, an electrical engineer who was not familiar with the installation would not be considered qualified for the purposes of § 1926.405(a)(2)(iii), despite having an engineering degree. However, under the general definition of "qualified" in § 1926.32(l), such an individual might be considered to meet the definition by virtue of the phrase "has successfully demonstrated his ability to solve or resolve problems relating to the *subject matter, the work, or the project*" (emphasis added). For the purposes of Subpart K, knowledge of the installation in question is necessary before a person can be considered "qualified;" such specific knowledge is not an absolute requirement under the general construction definition. For these reasons, OSHA believes that, to retain the original intent of the "qualified person" requirements within Subpart K, the proposed definition of "qualified person" is more appropriate than the general definition of "qualified" in § 1926.32(l). Therefore, the final standard carries forward the definition as originally proposed.

The remaining definitions of concern to the IBEW relate to the suitability of equipment or materials as determined by a qualified testing laboratory. The existing standard, in § 1926.405(a), simply referenced the general industry electrical standard, while the proposal placed the relevant portions of the general industry definitions, amended to conform to the 1981 NEC, in the text of Subpart K. The existing definitions relating to approval referred to a nationally recognized testing laboratory, such as, but not limited to, Underwriters Laboratories, Inc. (UL) and Factory Mutual Engineering Corp. (FM). However, in accordance with the 1981 NEC, all references to "a nationally recognized testing laboratory" were changed to "qualified testing laboratory." Additionally, the proposal defined "qualified testing laboratory" in terms which parallel the description of such laboratories in Section 90–6 of the 1981 NEC. The proposed definition did not include references to the two specific laboratories mentioned in the existing definitions but set forth criteria for laboratories to meet and would have required "recognition" by the Assistant Secretary. These provisions are discussed more fully below. In the proposed Subpart K, terms related to approval were applied in the same manner as in the existing regulations.

In contrast to IBEW's position, several comments expressed support for OSHA's proposed definitions (Ex. 2–4, 2–20, 2–40, 2–41). The proposed definitions are nearly the same as the definitions of similar terms in the 1984 NEC. The only significant difference is that, whenever the NEC mentions "acceptable to the authority having jurisdiction," OSHA (being that authority) has specified what is acceptable. For example, the 1984 NEC, as did previous NEC editions, defines "approved" as being acceptable to the authority having jurisdiction. In the proposal as in the existing standards, OSHA retained the NEC language and added a sentence explaining that the Assistant Secretary is the authority having jurisdiction for Subpart K. OSHA further proposed, consistent with the former standard, a definition of "acceptable", which is not defined in the NEC. In a format similar to that used in Subpart S of the General Industry Standards, OSHA proposed various criteria to indicate what the Agency would consider to be "acceptable" for the purposes of Subpart K.

The definition of "approved" contained in the proposal was also generally consistent with the existing standard, except for the removal of references to specific testing organizations. Because the proposal removed mention of UL and FM from the existing standard and was more specific than the NEC in illustrating what is acceptable, OSHA has determined that the proposed definitions of terms related to approval are consistent with the NEC and are more appropriate for the Agency's purposes than the existing definitions.

In the final rule, OSHA has revised its proposed definition of "qualified testing laboratory" by deleting the words "recognized by the Assistant Secretary of Labor." However, all of the criteria contained in the definition have been retained as originally proposed. The definition thus sets forth the elements which a laboratory must meet in order to be considered a "qualified testing laboratory" for the purposes of Subpart K but does not incorporate a requirement for such a laboratory to receive "recognition" from OSHA. There is currently no operative mechanism for OSHA to provide the "recognition" envisioned by the proposed definition. OSHA is presently evaluating the many issues related to the use of testing laboratories (including OSHA's role in recognizing such laboratories) in the context of its general industry standards. As was noted in the Subpart K proposal, OSHA published a notice of proposed rulemaking (49 FR 8326) on March 6, 1984, on the safety testing or certification of certain workplace equipment and materials involving the use of accredited testing laboratories. Although the testing and certification proposal is not applicable to the construction industry and would not directly affect Subpart K of Part 1926, it does incorporate many of the definitions that are found in Subpart K, including a term that is analogous to the Subpart K term "qualified testing laboratory" (called "qualified electrical testing laboratory" in the general industry proposal). OSHA therefore recognizes that, in the interest of consistency, the outcome of the general industry rulemaking on safety testing and certification may possibly lead the Agency to reevaluate the use of the terms and definitions that are found in Subpart K of Part 1926. When that rulemaking has been completed, appropriate changes will be proposed for the regulations in Subpart K, if necessary, as well as for other OSHA regulations which deal with product approval and testing laboratories.

11. Other objections.

In their hearing request, the IBEW raised two other issues—one resulted from a misunderstanding of the proposal, the other from a mistake in the printing of the proposal (Ex. 2–28). The IBEW objected to the removal of former § 1926.400(h), dealing with ground-fault protection. However, as noted in the proposal (48 FR 45876, 45881), OSHA did not propose this paragraph for removal, but indicated that the ground-fault protection provisions would be redesignated in the revised Subpart K as paragraph (b)(1) of § 1926.404, without change. Accordingly, the entire text of redesignated § 1926.404(b)(1) [existing § 1926.400(h)] has been included for publication in the final rule. This should eliminate any misunderstandings.

The other issue raised was of the omission of the word "grounding" from proposed § 1926.404(a)(1). As noted in

the hearing notice, the correct wording of the second sentence of this paragraph is: "A conductor used as an equipment grounding conductor shall be identifiable and distinguishable from all other conductors." This correction has been made in the final rule.

V. Summary and Explanation of the Final Standard

The final standard revising 29 CFR Part 1926, Subpart K, follows the language and format of the proposal with some changes. Most of the changes are editorial in nature. However, those that are substantive are discussed in detail in the following discussion. Where changes have been made concerning areas of the proposal which were major issues at the hearing, reference is made to the discussion of such issues in section IV of this preamble.

The resulting final standard, which is based on the record considered as a whole, simplifies and clarifies the existing Subpart K. The significance of this simplification is indicated by the reduction from the approximately 250,000 words in the National Electrical Code to the approximately 15,000 words in this final standard. As a consequence, the 1971 NEC (NFPA–70) will no longer be incorporated by reference in the OSHA Construction Standards.

Subpart K of Part 1926, as revised, provides a systematic format to satisfy present requirements and to accommodate future growth. Subpart K contains four major parts covering not only the design safety standards for electrical systems (Part I), but also safety-related work practices (Part II), safety-related maintenance and environmental conditions (Part III), and safety requirements for special equipment (Part IV).

As previously mentioned, the existing Subpart K incorporated by reference the entire 1971 National Electrical Code. Additionally, the existing standard set forth other requirements addressing unique hazards present in the construction industry. Some of these additional requirements were equivalent to or duplicated requirements in the 1971 NEC. For example, existing § 1926.402(a)(2) prohibited the interchangeability of receptacles used on circuits of different voltages, frequencies, or types of current. A paragraph in section 210–21 of the 1971 NEC contained the same prohibition.

Other regulations in existing Subpart K were derived from different sources and supplemented the requirements of the NEC. An example of this type is existing § 1926.402(a)(10), which prohibits the use of worn or frayed cables. While no such requirement is explicitly stated in the 1971 NEC, this prohibition is implied throughout various sections of the code, such as sections 100–17, 230–46, 305–2, and 410–23.

The revision of Subpart K will accomplish the following three major objectives:

(1) NEC requirements which directly affect employee safety in construction workplaces have been placed in the text of the OSHA standard, eliminating the need for the NEC to be incorporated by reference.

(2) Relevant requirements from the existing text of Subpart K which supplemented the NEC have been integrated into the new format.

(3) The requirements have been written in performance language so that unnecessary detailed specifications can be omitted and changes in technology can be accommodated, without compromising safety.

As a result, the final standard should be easier to use and understand and should not become technologically obsolete in the near future. Since it has been written in performance-oriented terms, Subpart K should remain a viable electrical safety standard, even though the detailed specifications of the NEC change as the Code is revised every three years. Therefore, when the NEC is periodically revised by NFPA, Subpart K should not be out-of-date to the extent that revision of the OSHA standard would be necessary.

The final rule contains several new provisions, which are not found either in the 1971 NEC or elsewhere in the existing Subpart K. These few additional requirements reflect safety requirements appearing in the 1981 NEC (on which the proposal was based) and carried forward in the most recent revision (1984) of the NEC. At the time the proposal was published, OSHA determined that most construction employers were generally complying with the 1981 NEC and that the few new rules contained in that edition of the code were already being met. Since the 1984 NEC versions of these rules contained no substantive changes, employers should still be in compliance with these new rules, if they are now complying with the 1984 NEC. Therefore, as set forth in OSHA's regulatory analysis, the final standard should create no new burdens on employers, nor should it reduce employee safety.

Some parts of the existing §§ 1926.400 through 1926.405 have been deleted or modified and incorporated into new sections. Other parts of these sections have been incorporated into new sections without substantive change. As an aid for following these changes, OSHA has developed the following distribution table:

DISTRIBUTION TABLE

Old section	New section
1926.400(a)	Removed. The old paragraph adopted the 1971 NEC by reference. The final rule places the relevant NEC requirements into the text of the regulation.
1926.400(b)	1926.402.
1926.400(c)	1926.416(a).
1926.400(d)	1926.416(b)(1).
1926.400(e)	1926.403(i)(1) [low voltage]; and 1926.403(j)(3) [high voltage]—requirements are consistent with the 1984 NEC.* Minimum clear working space has been increased from 2½ feet to 3 feet.
1926.400(f)	1926.416(c); reference to NEC has been removed.
1926.400(g)	1926.417.
1926.400(h)	1926.404(b)(1).
1926.401(a)	1926.404(f)(7)(iv); requirement has been reworded to be consistent with the 1984 NEC.* Requirement now lists specific conditions requiring the grounding of portable equipment.
1926.401(b)	1926.404(f)(7) (iii) and (v); requirement has been reworded to be consistent with the 1984 NEC.* Requirements now list specific conditions requiring the grounding of fixed equipment.
1926.401(c)	1926.404(f)(6); requirements relating to impedance and ampacity of grounding conductor have been removed to be consistent with 29 CFR Part 1910, Subpart S. Briefly, these requirements have been removed because the parameters cannot be accurately measured in operational workplaces. Further discussion of OSHA's rationale for removing these requirements can be found in the preamble to the Subpart S final rule document (January 16, 1981, 46 FR 4044, Column 3, Discussion of Issue No. 5).
1926.401(d)	Ground resistance of driven rod electrodes is covered by 1926.404(f)(10).
1926.401(e)	Removed. Requirement is ambiguous in that it implies that the resistance between the ground and the grounded power conductor is a controlling factor in circuit overcurrent protection. Clarifying the ambiguity would result in a requirement for measuring the actual equipment grounding conductor impedance under fault conditions. The practicality of such measurements have been questioned and currently no such requirement exists in the National Electrical Code. See discussion of issue No. 4.
1926.401(f)	1926.405(a)(2)(ii)(J).
1926.401(g)(1)	Conductor ampacity is covered by 1926.404(f)(8)(ii) for grounding and by 1926.404(f)(9) for bonding.
1026.401(g)(2)	Bonding as it relates to static electricity control for material handling is covered in Subpart F (Fire Protection and Prevention) of Part 1926 instead of Subpart K. Bonding for this purpose is addressed in 1926.151(a)(5) and 1926.152(e)(2).
1926.401(h)	Temporary wiring is covered in 1926.405 (a)(2). Reference to the NEC has been removed.
1926.401(i)	Covered by 1926.403(i)(2) and 1926.405(a)(2)(ii)(B).
1926.401(j)(1)	1926.405(a)(2)(ii)(E).
1926.401(j)(2)	First sentence removed. Hard usage cords are required by 1926.405(a)(2)(ii)(J). Second sentence is 1926.405(a)(2)(ii)(F). Third sentence is covered by 1926.403(e) for conductors and 1926.405(g)(2)(iii) for hard service flexible cords.
1926.401(j)(3)	1926.416(b)(2).
1926.401(j)(4)	1926.405(a)(2)(ii)(G); amended to allow greater flexibility.
1926.402(a)(1)	Covered by 1926.403(a), 1926.403(i)(2), 1926.404(f) and 1926.405(a)(2)(ii)(C).
1926.402(a)(2)	1926.405(j)(2)(i).

DISTRIBUTION TABLE—Continued

Old section	New section
1926.402(a)(3)	Covered by 1926.403 (a), (b) and (c).
1926.402(a)(4)	Covered by 1926.403(b) and 1926.405(g)(2)(iv).
1926.402(a)(5)	1926.405(g)(2)(iii); amended to be consistent with the 1984 NEC.* Splices are now permitted for hard service cords No. 12 and larger only.
1926.402(a)(6)	1926.405(a)(2)(ii)(1) and 1926.408(a)(4)(ii).
1926.402(a)(7)	Covered by 1926.403(e) and 1926.405(g)(2)(iii).
1926.402(a)(8)	Covered by 1926.405(a)(2)(ii) (B) and (I).
1926.402(a)(9)	1926.405(j)(1)(iii); amended to conform to 1984 NEC.* Editorial changes only.
1926.402(a)(10)	1926.416(e)(1).
1926.402(a)(11)	1926.405(a)(2)(ii)(I); amended to conform to the 1984 NEC.* Editorial changes only.
1926.402(a)(12)	1926.416(e)(2).
1926.402(b)(1)	1926.404(e)(1)(i); amended to simplify requirement.
1926.402(b)(2)	1926.404(e)(1)(ii); amended to conform to 1984 NEC.* Editorial changes only.
1926.402(b)(3)	1926.416(d).
1926.402(c)(1)	1926.403(h); reworded for clarification.
1926.402(c)(2)	Covered by 1926.403(f) and 1926.404(e)(1)(v).
1926.402(c)(3)	Covered by 1926.403(d)(1) and 1926.405(b)(2).
1926.402(c)(4)	1926.405(e); amended to be consistent with the 1984 NEC.* Editorial changes only.
1926.402(d)	Covered by 1926.403 (i)(2) and (j)(2) and by 1926.405(j)(5).
1926.402(e)	Covered by Subparts F and J of Part 1926.
1926.403	1926.441, with minor editorial changes.
1926.404(a)	Placed in 1926.449 and amended to conform to 29 CFR Part 1910, Subpart S.
1926.404(b)	1926.407(b); amended to conform to 29 CFR Part 1910, Subpart S.
1926.404(c)	Covered by 1926.407 (b)(2) and (d).
1926.404(d)	1926.432.
1926.405	1926.449; amended to include more definitions and to be consistent with the 1984 NEC.* Editorial changes only.

*Note: OSHA is using language comparable to the 1984 NEC version of these rules. See text for additional explanation.

As can be seen from the Distribution Table, some of the final revisions are 1984 NEC versions of former requirements set forth in Subpart K. For example, final § 1926.404(f)(7)(iv), which addresses grounding of cord- and plug-connected equipment, is derived from 1984 NEC section 250–45. This regulation replaces existing § 1926.401(a), which required portable and plug-connected equipment other than double-insulated equipment to be grounded.

In contrast, the final rule lists specific conditions which warrant the grounding of equipment connected by cord and plug. If the listed conditions are not present, grounding is not necessary for employee safety. In developing revisions to the existing requirements of Subpart K, OSHA relied on corresponding requirements contained in the NEC. The reasons for this are threefold. First, the NEC is widely recognized and understood in the construction industry. The use of language consistent with (and in many cases identical to) that used in the 1984 NEC will promote greater understanding of OSHA's standard within the industry. Second, as clearly demonstrated in the Regulatory Analysis, a majority of contractors have become familiar with and are already complying with the provisions of the latest NEC in effect (four NEC revisions by NFPA since 1971). This ensures wide acceptance of and compliance with OSHA's revised standard. Third, OSHA's final rule is consistent with the regulations of many state and local authorities, which base their rules on the latest edition of the NEC. This reduces the possibility that employers will be required to follow conflicting or inconsistent standards.

Parts of the standard not listed in the distribution table have been derived from requirements in the 1984 National Electrical Code and NFPA 70E. The following section discusses the final rule's principal substantive deletions from the existing standard. Principal additions are discussed in the sections explaining and describing the final rule.

Principal deletions. In the 1971 NEC, incorporated by the existing Subpart K, Chapters 3 and 4 deal with wiring methods and materials (Chapter 3) and equipment for general use (Chapter 4) and include extensive design-type data. In the final rule, however, the tables containing various specialized technical information, such as are contained in those chapters, have not been included. Typical topics of these deleted parts include insulation characteristics, allowable ampacities, electrical box sizes, and flexible cord and motor full load currents. This type of information has not been included in the final standard because it deals with items not directly related to electrical hazards. For example, requirements on the composition of insulation on a conductor have been deleted; however, the actual requirement that the conductor be insulated and that the insulation be approved for its intended purpose has been retained. These changes result in a standard which is more performance oriented, but which does not reduce the level of safety provided by Subpart K.

Chapter 6 of the 1971 NEC describes special equipment requirements. Requirements from this chapter dealing with electrically operated organs and the installation of equipment and wiring used for sound recording and reproduction have not been included in the final rule because electrical safety for employees in construction is not directly affected by these items. This type of equipment is not normally found in construction.

Chapter 7 of the 1971 NEC deals with special conditions. Requirements from this chapter involving stand-by power generation systems and emergency systems have not been included. In these situations, primary electrical hazards to the worker are minimal since the effects of power outage are generally limited to work stoppage. Additionally, such systems are not commonly used for construction purposes, and the general installation requirements of Subpart K would provide protection in the few cases in which these systems would be present.

Chapter 9 of the 1971 NEC provides a collection of tables containing technical data, together with a number of sample computations. This entire chapter is not included in the revised standard because it is solely an instructive guide for the design of certain electrical systems and is not a necessary component of OSHA electrical safety regulations.

Section 1926.402 Applicability.

Paragraph (a) of this section states that revised §§ 1926.402 through 1926.408 apply to electrical installations used to provide power and light at the construction jobsite. However, these regulations do not apply to existing electrical installations which were wired before the construction work started. Equipment (for example, extension cord sets and electric tools) connected to an existing installation during the construction process would be covered by §§ 1926.402 through 1926.408. For a more detailed discussion, see Issue I of Section IV of this preamble.

The note to paragraph (a) states that OSHA will consider an employer's compliance with the 1984 NEC to be the same as compliance with most of the requirements of revised § § 1926.403 through 1926.408. For employers who comply with the 1984 NEC, this paragraph then lists the additional provisions contained within § § 1926.402 through 1926.408 with which those employers must also comply. After thoroughly reviewing the final standard, OSHA determined that these provisions were not derived directly from the NEC and that they contained substantively different requirements supplementing the provisions of the 1984 Code. These different requirements were then listed in the note to paragraph (a). For a further discussion of this paragraph, see Issue 3 in section IV of the preamble. An explanation of why the particular provisions listed in this paragraph were chosen is provided in the discussion of each paragraph in this section of the preamble.

Paragraph (b) states that revised § § 1926.402 through 1926.408 do not apply to electrical installations for the generation, transmission, and distribution of electric energy. Such installations are not covered by the

NEC. However, this non-coverage or so called "exemption" does not extend to portable or vehicle-mounted generators providing power for utilization equipment at the construction site. This equipment is not considered electric-utility-type generating equipment and is covered by the NEC. For example, in the case of grounding requirements, portable or vehicle-mounted generators are covered by section 250–6 in the 1984 NEC. OSHA considers these types of generators to be part of the utilization system, since they are general of low capacity and are connected directly to the utilization equipment. This contrasts with the much larger generators supplying transmission and distribution networks. Also, the final standard contains provisions dealing directly with these types of small generators (§ 1926.404(f)(3)). For a more detailed discussion of this paragraph, see Issue I of Section IV of this preamble.

Section 1926.403 General requirements.

This section contains general requirements for electrical installations. These requirements address approval and use of equipment, splices, marking and identification, working clearances, and guarding of live parts.

Paragraph (a) requires all electric equipment and conductors to be approved. One commenter suggested removing the word "approved" from other places throughout Subpart K (Ex. 2–20). It was argued that the presence of other requirements for "approved" equipment weakened the general requirement for approval of all equipment. This recommendation has been accepted, and the unnecessary use of the word "approved" has been discontinued elsewhere in Subpart K.

Paragraph (b)(1) restates the general duty clause of the OSHAct, with respect to electrical equipment. Employers are required to provide a workplace free from recognized hazards. This paragraph supplements the general duty by including criteria for judging the safety and acceptability of electrical equipment and installations.

Paragraph (b)(2) requires equipment to be used and installed in accordance with necessary safety instructions. The proposed requirement read as follows:

(2) Listed or labeled equipment shall be used and installed in accordance with any instructions included in the listing or labeling.

One commenter suggested that this paragraph also refer to certified equipment, to be consistent with OSHA's definition of "acceptable" (Ex. 2–20). (The definition refers to equipment that is "certified, or listed, or labeled" by a qualified testing laboratory.) This comment has been accepted, and the final rule reads as follows:

(2) Listed, labeled, or certified equipment shall be installed and used in accordance with instructions included in the listing, labeling, or certification.

Paragraph (c) requires equipment that must interrupt current to be capable of doing so safely. Paragraph (d) addresses the mounting of equipment and contains provisions allowing for the safe dissipation of heat.

Paragraph (e) requires splices to be suitably made and insulated. Parts of electric equipment that produce arcs, sparks, or molten metal are required to be appropriately guarded by § 1926.403(f).

Marking and identification are covered in § 1926.403 (g) and (h). In paragraph (g), electric equipment is required to be marked to identify the manufacturer and to identify the relevant electrical ratings. Paragraph (h) requires branch circuits, feeders, services, and disconnecting means for equipment to be identified.

Paragraphs (i) and (j) set forth requirements pertaining to the guarding of and working clearances around live parts of electric equipment. Regulations applying to equipment 600 volts or less can be found in § 1926.403(i), while paragraph (j) applies over 600 volts.

Section 1926.404 Wiring design and protection.

This section covers the design requirements for wiring systems from the service conductors to the branch circuit conductors. It also covers requirements for the protection of electric conductors from overcurrent and physical hazards.

Paragraph (a) requires that the grounded circuit conductor and the equipment grounding conductor be identifiable and distinguishable from other conductors. These regulations have been written in more performance-oriented terms than the existing requirements (contained in Article 200 of the 1971 NEC, originally incorporated by reference in Subpart K) which required that those conductors be identified in a specific manner.

Paragraph (b)(1), redesignated from § 1926.400(h) of the existing standard, addresses ground-fault protection for employees. The public rulemaking on revised Subpart K did not invite comment on this provision, as it has already been the subject of a comprehensive public rulemaking effort (41 FR 55696; December 21, 1976). Therefore, the requirements read the same as the old regulations, except for editorial changes necessitated both by its new location and by the new format for Subpart K.

Briefly, paragraph (b)(1) requires employers to provide one of two methods of ground-fault protection—either ground-fault circuit interrupters (GFCI) or an assured equipment grounding conductor program—to protect employees on construction sites. If the employer chooses the GFCI option, then 120-volt, 15- and 20-ampere receptacles which are not part of the permanent wiring must have ground-fault circuit interrupter protection. (The GFCI is a device which continuously monitors current and detects current leaking to ground outside the path of the circuit conductors. When the leakage to ground exceeds the trip level, the circuit is interrupted quickly enough to prevent electrocution.) If the assured equipment grounding conductor program is chosen, then the employer must maintain equipment grounding conductors through daily inspections and periodic tests. (Thus, the ground-fault protection provided by the equipment grounding conductor is maintained.)

Paragraph (b)(1) of final § 1926.404 is included in the aforementioned list of provisions in the note to final § 1926.402(a). Thus, OSHA is requiring employers to comply with final § 1926.404(b)(1) regardless of whether they comply with the 1984 NEC, which contains a somewhat similar provision in section 305–4. The OSHA regulation is different from the NEC in several respects. The primary difference is that OSHA's GFCI option applies to receptacle outlets which are not part of the permanent wiring, while the NEC requirement only applies to temporary wiring. For example, under the OSHA regulation for GFCIs, protection must be provided for the receptacle outlets on the end of extension cord sets even if the extension cords are supplied by permanent wiring. Under the NEC, GFCI protection is only required when temporary wiring is used and all the requirements for running temporary wiring (Article 305 of the 1984 NEC) are met. Other significant differences exist between the OSHA and NEC requirements for the assured equipment grounding conductor program. Since the OSHA regulation provides greater employee protection, compliance with analogous 1984 NEC provisions alone will not be acceptable under Subpart K.

Paragraph (b)(2) contains requirements for outlet devices. For this particular requirement, the proposal contained several specifications, in addition to the general performance

requirement that outlet devices have a rating not less than the load to be served. Two comments suggested that these specifications were overly detailed and unnecessary (Ex. 2–34, 2–37). Proposed § 1926.404(b)(2) read as follows:

(2) *Outlet devices.* Outlet devices shall have an ampere rating not less than the load to be served and shall comply with the following:

(i) *Lampholders.* Where connected to a branch circuit having a rating in excess of 20 amperes, lampholders shall be of the heavy-duty type. A heavy-duty lampholder shall have a rating of not less than 660 watts if of the admedium type and not less than 750 watts if of any other type.

(ii) *Receptacles.*

(A) A single receptacle installed on an individual branch circuit shall have an ampere rating of not less than that of the branch circuit.

(B) Where connected to a branch circuit supplying two or more receptacles or outlets, receptacle ratings shall conform to the values listed in Table K–4.

(C) The rating of an attachment plug or receptacle used for cord- and plug-connection of a motor to a branch circuit shall not exceed 15 amperes at 125 volts or 10 amperes at 250 volts if individual overload protection is omitted.

TABLE K–4. RECEPTACLE RATINGS FOR VARIOUS SIZE CIRCUITS

Circuit rating, ampere	Receptacle rating amperes
15	Not over 15.
20	15 or 20.
30	30.
40	40 or 50.
50	50.

The introduction to proposed paragraph (b)(2) required outlet devices to be able to carry the current demanded by the load. Proposed paragraph (e)(1)(i) of the same section required equipment (including outlet devices) to be protected against overcurrent. These two requirements determined, in terms of performance, the maximum and minimum ratings of outlet devices on any particular branch circuit. Therefore, proposed paragraphs (b)(2)(i) and (b)(2)(ii) were redundant in setting forth these ratings by specification.

OSHA agrees that proposed § 1926.404(b)(2)(i), regarding lampholders, is unnecessary for the protection of employees, as the hazard it addressed is already covered under the general requirement of paragraph (b)(2) and under the performance language of paragraph (e)(1)(i). Therefore, proposed paragraph (b)(2)(i) does not appear in the final rule.

However, in contrast to proposed paragraph (b)(2)(i), the specifications for receptacles contained in proposed § 1926.404(b)(2)(ii) are necessary for employee protection, because the relevant hazards are not addressed by the general requirement. A degree of specificity is needed in these requirements to prevent employers from avoiding the ground-fault protection regulations simply by installing plugs and receptacles of ratings above 20 amperes on 15- and 20-ampere equipment and circuits. (See discussion of final § 1926.404(b)(1) in this section of the preamble.) Although this practice is technically prohibited by the performance language of paragraphs (b)(2) and (e)(1)(i), OSHA believes that specifications are needed to provide adequate criteria for interpretation and enforcement of these two paragraphs and paragraph (b)(1). Therefore, proposed § 1926.404(b)(2)(ii) has been retained and renumbered as paragraphs (b)(2) (i), (ii), and (iii) in the final rule.

Paragraph (c) contains requirements on the location and clearance of low voltage (600 volts or less) conductors and of outside lamps. Again, two commenters argued that this paragraph contained provisions (viz., paragraphs (c)(1)(i) and (c)(2)) that are overly detailed and not directed towards employee safety (Ex. 2–34, 2–37). The requirements of concern to these commenters related to the minimum size of overhead conductors.

Many requirements in the NEC (for example, 1984 NEC sections 230–23, 230–31, 250–94, and 400–12) specify the minimum size of conductors. Generally, throughout the revised standard, OSHA has not retained such requirements because the use of performance language has been determined to provide comparable safety. In reviewing proposed paragraphs (c)(1)(i) and (c)(2), OSHA has determined that the hazards addressed by these paragraphs are adequately covered by two other provisions of the final standard: § 1926.403(b)(1)(iii), governing mechanical strength and durability, and § 1926.404(e)(1)(i), requiring suitable overcurrent protection. Therefore, OSHA has accepted the recommendation of the two comments on these proposed requirements, and paragraphs (c)(1)(i) and (c)(2) of proposed § 1926.404 do not appear in the final rule.

Reflecting existing requirements for the installation of outside service, feeder, and branch-circuit conductors of 600 volts or less, 1971 NEC sections 230–24(b) and 730–18 read as follows:

230–24 (b). *Clearance from Ground.* Service-drop conductors when not in excess of 600 volts, shall have the following minimum clearance from ground:

10 feet—above finished grade, sidewalks or from any platform or projection from which they might be reached;

12 feet—over residential driveways and commercial areas such as parking lots and drive-in establishments not subject to truck traffic;

15 feet—over commercial areas, parking lots, agricultural or other areas subject to truck traffic;

18 feet—over public streets, alleys, roads and driveways on other than residential property.

730–18. *Clearance from Ground.* [Outside *feeders and branch circuits.*] Open conductors of not over 600 volts shall conform to the following:

10 feet—above finished grade, sidewalks or from any platform or projection from which they might be reached;

12 feet—over residential driveways and commercial areas such as parking lots and drive-in establishments not subject to truck traffic;

15 feet—over commercial areas, parking lots, agricultural or other areas subject to truck traffic;

18 feet—over public streets, alleys, roads, and driveways on other than residential property.

Instead of relying on the NFPA 70E requirement which is comparable to these NEC provisions and which presents the identical distances for each category, OSHA proposed to update the requirement so that it would be comparable to the equivalent 1981 NEC provisions which revised thc categories for the four different clearance distances. This proposed update was contained in § 1926.404(c)(1)(iii), which read as follows:

(c) *Outside conductors and lamps—(1) 600 volts, nominal, or less.* Paragraphs (c)(1) (i) through (v) of this section apply to branch circuit, feeder, and service conductors rated 600 volts, nominal, or less and run outdoors as open conductors.

* * * * *

(iii) *Clearance from ground.* Open conductors shall conform to the following minimum clearances:

(A) 10 feet (3.05 m)—above finished grade, sidewalks, or from any platform or projection from which they might be reached where the supply conductors are limited to 150 volts to ground and accessible only to employees on foot.

(B) 12 feet— (3.66 m)—Over driveways and other similar areas, such as parking lots, not subject to truck traffic where the supply conductors are limited to 300 volts to ground.

(C) 15 feet (4.57 m)—above finished grade where the supply conductors have a nominal voltage greater than 300 volts to ground and accessible only to employees on foot.

(D) 18 feet (5.49 m)—over streets, alleys, roads, driveways and other areas subject to truck traffic.

In effect, OSHA's proposed revision would have increased the clearance distance for non-public areas subject to truck traffic from 15 feet to 18 feet. In this regard, it should be noted that the 1984 NEC does not incorporate this approach, but reverts to the clearances that had been established in pre-1981 editions of the code, with some minor changes in clearance categories. Because of the varying NEC position on this issue, OSHA has reevaluated the clearances contained in the proposal. For reasons to be discussed subsequently, the Agency has determined that § 1926.404(c)(1)(iii) should not be promulgated as proposed, and that the existing clearance provision should be carried forward unchanged in the final rule.

One commenter (Ex. 2–27) claimed that the proposal was too complex in this area and suggested that OSHA base the vertical clearance distances solely on voltage, except where truck traffic is involved. In areas subject to truck traffic, 18 feet was suggested as the required clearance from ground. This approach is similar to that presented in the 1984 NEC.

In analyzing this comment, OSHA has discovered that there is an unnecessary inconsistency between Subpart S of the General Industry Standards and the proposed revision of Subpart K of the Construction Standards. Section 1910.304(c)(2) of Subpart S reads as follows:

(c) *Outside conductors, 600 volts, nominal, or less.* Paragraph (c)(1), (c)(2), (c)(3), and (c)(4) of this section apply to branch circuit, feeder, and service conductors rated 600 volts, nominal, or less and run outdoors as open conductors. Paragraph (c)(5) applies to lamps installed under such conductors.

* * * * *

(2) *Clearance from ground.* Open conductors shall conform to the following minimum clearances:

(i) 10 feet—above finished grade, sidewalks, or from any platform or projection from which they might be reached.

(ii) 12—feet over areas subject to vehicular traffic other than truck traffic.

(iii) 15 feet—over areas other than those specified in paragraph (c)(2)(iv) of this section that are subject to truck traffic.

(iv) 18 feet—over public streets, alleys, roads, and driveways.

This general industry requirement is equivalent to the comparable provisions (Sections 230–24(b) and 730–18) in the 1971 NEC adopted by the existing Subpart K of Part 1926.

OSHA's Regulatory Analysis of the proposed revision to Subpart K identified proposed § 1926.404(c)(1)(iii) as one revised provision which would impose additional compliance obligations over those imposed by the existing provisions. However, the available data indicated that the reported accidents which were related to inadequate clearances would have been prevented by compliance with either the current rule or the proposed rule. In brief, the Regulatory Analysis concluded that all reported accidents attributable to non-compliance with the proposed rule also involved a failure to comply with the existing standard. The Agency believes that under these circumstances, particularly in light of the changes made from the 1981 to 1984 editions of the NEC, adoption of the proposed revision of the clearances provision is not warranted. Therefore, OSHA has decided to retain the existing requirements for vertical clearance from ground for outside service, feeder, and branch-circuit conductors. The final requirement, which is now contained in § 1926.404(c)(1)(ii), reads as follows:

(ii) *Clearance from ground.* Open conductors shall conform to the following minimum clearances:

(A) 10 feet (3.05 m)— above finished grade, sidewalks, or from any platform or projection from which they might be reached.

(B) 12 feet (3.66 m)— over areas subject to vehicular traffic other than truck traffic.

(C) 15 feet (4.57 m)—over areas other than those specified in paragraph (c)(1)(ii)(D) of this section that are subject to truck traffic.

(D) 18 feet (5.49 m)—over public streets, alleys, roads, and driveways.

By carrying forward the existing requirements in Subpart K, the final OSHA § 1926.404(c)(1)(ii) will be consistent with Subpart S of the General Industry Standards and will minimize unnecessary burdens on the part of employers while maintaining the current level of safety for employees. Of course, as provided in the note to final § 1926.402(a), if an installation is in compliance with the 1984 NEC, OSHA will also consider it to be in compliance with revised § 1926.404(c)(1)(ii).

Paragraph (d) requires that a disconnecting means be provided for the service entrance conductors. It also contains the location, marking, and operational requirements for that disconnect.

Paragraph (e) contains overcurrent protection requirements for low voltage and high voltage conductors. One comment was received concerning proposed paragraph (e)(1)(iii) (Ex. 2–10). In the proposal the first sentence of this paragraph read as follows:

Except for service fuses, all cartridge fuses which are accessible to other than qualified persons and all fuses and thermal cutouts on circuits over 150 volts to ground shall be provided with disconnecting means.

Referring to the exception for service fuses, the comment suggested that OSHA's requirement be modified in accordance with the 1984 NEC provision upon which it was based. Section 240–40, with Exception No. 1, of the 1984 NEC reads as follows:

240–40. *Disconnecting Means for Fuses and Thermal Cutouts.* Disconnecting means shall be provided on the supply side of all fuses or thermal cutouts in circuits of over 150 volts to ground and cartridge fuses in circuits of any voltage, where accessible to other than qualified persons, so that each individual circuit containing fuses or thermal cutouts can be independently disconnected from the source of electric energy.

Exception No. 1: A device provided for current limiting on the supply side of the service disconnecting means as permitted by Section 230–82.

OSHA agrees that inconsistency with the NEC should be avoided if possible. Therefore, in § 1926.404(e)(1)(iii) of the final rule, the words "Except for service fuses" have been replaced with language contained in Exception No. 1 to section 240–40 of the 1984 NEC. The relevant sentence in the final rule reads as follows:

Except for devices provided for current limiting on the supply side of the service disconnecting means, all cartridge fuses which are accessible to other than qualified persons and all fuses and thermal cutouts on circuits over 150 volts to ground shall be provided with disconnecting means.

Grounding and bonding requirements for electric systems are contained in paragraph (f). This paragraph is subdivided into eleven categories as follows:

(1) Systems to be grounded.

(2) Separately derived systems.

(3) Portable and vehicle-mounted generators.

(4) Conductors to be grounded.

(5) Grounding connections.

(6) Grounding path.

(7) Supports, enclosures, and equipment to be grounded.

(8) Methods of grounding equipment.

(9) Bonding.

(10) Made electrodes.

(11) Grounding of systems and circuits of 1,000 volts and over (high voltage).

As was proposed, paragraph (f)(3) of final § 1926.404 contains new regulations pertaining to the grounding of portable and vehicle-mounted generators. To prevent hazardous voltages from being impressed on the system and to ensure the proper operation of overcurrent protective devices, the existing standard, 1971 NEC section 445–8, required grounding the frames of

generators operating at over 150 volts to ground. Lower voltage generators were to have their frames grounded or permanently and effectively insulated from ground. Recognizing the uncertain availability of a dependable ground for portable and vehicle-mounted generators, the final rule does not require the frames of such generators to be grounded, if certain conditions are met. These conditions, in § 1926.404(f)(3), have been taken from the 1984 NEC; and, in general, they require the generator to provide power only to equipment and receptacles on the generator and require the equipment grounding conductor to be connected to the generator frame. While permitting the frame of the generator to serve as the grounding electrode for the system supplied by the generator, the final rule continues to ensure the proper operation of protective devices.

The major issues raised concerning grounding and bonding are discussed in section IV of this preamble, under Issues 4, 5, and 9.

Section 1926.405 Wiring methods, components, and equipment for general use.

Paragraph (a) deals with wiring methods. General wiring requirements are the subject of § 1926.405(a)(1). In this paragraph, continuity of metal raceways and enclosures is required, and wiring in certain ducts is prohibited.

Paragraph (a)(2) gives requirements on temporary wiring, which is commonly used in construction when permanent wiring is not available. In general, temporary wiring is permitted to be of a class less than permanent wiring but must follow the rules for permanent installations, except as otherwise noted.

Some comments were received suggesting that the entire set of electrical installation requirements in Subpart K be limited to the provisions on temporary wiring, use of flexible cords and cables, and the use of portable electric equipment (Ex. 2–14, 2–30, 2–34; Tr. 56). These commenters suggested that all other wiring be required to comply with the electrical standards for general industry (29 CFR Part 1910, Subpart S). They argued that the remaining provisions were mostly irrelevant and unnecessary and would add confusion to the use of the standards.

OSHA disagrees with this point of view to the extent that it draws an artificial distinction between temporary and permanent wiring installation requirements. As noted in paragraph (a)(2)(i) of final § 1926.405, most of the installation requirements found throughout Subpart K are applicable to temporary wiring as well as to the permanent wiring which is both installed and used during the construction process. For example, the guarding requirements ofparagraphs (i) and (j) of final § 1926.403, the overcurrent protection requirements of § 1926.404(e), and the grounding requirements of § 1926.404(f) are all as vital to the safe installation of a temporary electrical system as they would be to a permanent installation. For these reasons, OSHA believes it is appropriate to include all applicable electrical standards for construction within Part 1926, and OSHA believes it is important to avoid the need to refer to the General Industry Standards for requirements which are so integral to construction. Therefore, OSHA has decided to retain the proposed format of having the temporary wiring provisions a separate paragraph among the other installation requirements, rather than limit Subpart K to temporary wiring alone.

The existing provisions on temporary wiring, § 1926.400(a) and 1926.401(h), incorporated Article 305 of the 1971 NEC by reference. Final § 1926.405(a)(2) carries forward the substance of these requirements, updated to the 1984 NEC, and supplements them with several new provisions, as proposed. The first of these, paragraph (a)(2)(ii)(C) of § 1926.405, prohibits the installation of receptacles on temporary lighting circuits. Derived from 1984 NEC section 305–(2)(d), this requirement is necessary to prevent construction areas from experiencing a loss of temporary lighting, which could occur if cord- and plug-connected equipment at the receptacle were to trip a circuit breaker or ground-fault circuit interrupter protecting the lighting circuit. Paragraph (a)(2)(ii)(H) is also new and has been taken from 1984 NEC Section 305–2(g). However, it does not add a requirement; it merely explains the extent to which provisions of the existing standard which address the need for junction boxs (1971 NEC sections 300–15 and 300–16) apply to temporary wiring (1971 NEC section 305–1). The final rule clarifies that junction boxes are required where a change is made from one wiring method to another and one of the wiring methods is a raceway system or a metal-clad or metal-sheathed cable system.

Paragraphs (a)(2)(ii) (E) and (F) of final § 1926.405 have been listed in the note to final § 1926.402(a) as requirements which must be met regardless of whether the employer follows the 1984 NEC. Although there are provisions in the 1984 NEC which are similar (NEC Sections 305–2(f) and 410–27, respectively), OSHA has determined that the provisions in the final rule are more effective in providing employee safety.

Existing § 1926.401(j)(1) addresses the protection of lamps for temporary lighting and reads as follows:

> Temporary lights shall be equipped with guards to prevent accidental contact with the bulb, except that guards are not required when the construction of the reflector is such that the bulb is deeply recessed.

The 1984 NEC also has a provision addressing the protection of lamps for temporary lighting. This requirement, which was not contained in the 1971 NEC, is contained in 1984 NEC section 305–2(f) and reads as follows:

> All lamps for general illumination shall be protected from accidental contact or breakage. Protection shall be provided by elevation of at least 7 feet (2.13 m) from normal working surface or by a suitable fixture or lampholder with a guard.
>
> Brass shell, paperlined sockets, or other metal-cased sockets shall not be used unless the shell is grounded.

The 1984 NEC provision allows installations of the lamps at a height of 7 feet (2.13 m) or more in lieu of a physical guard. Existing § 1926.401(j)(1) requires a guard for the lamp, regardless of height, unless the lamp is deeply recessed. In construction workplaces, these guards protect lamps from damage caused by the commonplace movement of ladders, long pipes, and similar material, whereas merely installing the lights at a height of more than 7 feet will not provide such protection. Therefore, in § 1926.405(a)(2)(ii)(E), OSHA proposed a requirement which combined the existing Subpart K regulation with the new provision from the NEC. As proposed, this requirement read as follows:

> All lamps for general illumination shall be protected from accidental contact or breakage. Temporary lights shall be equipped with guards to prevent accidental contact with the bulb, except that guards are not required when the construction of the reflector is such that the bulb is deeply recessed. Metal-case sockets shall be grounded.

One commenter noted that the proposed language, which was specific in nature, did not recognize that lamps could be safely guarded by location (Ex. 2–34). Although OSHA does not believe that installation of lamps at a height of 7 feet, as permitted by the 1984 NEC, sufficiently protects employees in construction areas, the Agency does recognize the possibility that there may be ways of guarding lamps by location (or, perhaps, by other means as well). Since the first sentence states the

requirement for lamps to be protected in terms of performance, the second sentence, which states a similar provision in specification language, is unnecessary for employee safety. Therefore, OSHA has not carried the second sentence of proposed § 1926.405(a)(2)(ii)(E) forward into the final rule. However, because OSHA does not believe that 1984 NEC section 305–2(f) provides sufficient safety to employees, final § 1926.405(a)(2)(ii)(E) is listed as a requirement that must be met regardless of an employer's compliance with the 1984 NEC.

Existing § 1926.401(j)(2) requires suspended lights and their cords to be designed for the use. Section 410–27 of the 1984 NEC addresses pendant conductors for lampholders. However, the NEC provision does not specifically cover cords or the lampholders themselves as does the paragraph in the existing Subpart K. Therefore, the final standard retains the equivalent requirement (§ 1926.404(a)(2)(ii)(F)) as one which must be met regardless of an employer's compliance with the 1984 NEC.

Paragraph (a)(2)(ii)(G) of final § 1926.405 is taken from existing § 1926.401(j)(4), which required portable electric lighting used in moist and/or other similarly hazardous locations to be operated at a maximum of 12 volts. As proposed, OSHA is amending this provision to allow the use of 120-volt lights if they are protected by ground-fault circuit interrupters. OSHA believes that either method can protect employees from the hazard of accidental electrocution due to lamp breakage in highly conductive locations. No opposition to this proposed exception was expressed during the rulemaking proceeding. Since final § 1926.405(a)(2)(ii)(G) has no counterpart in the NEC, it has been listed in final § 1926.402(c) as one of the requirements which must be followed in addition to the 1984 NEC.

Several comments were received concerning the proposed requirement (§ 1926.405(a)(2)(ii)(J)) for extension cord sets to be designed for hard or extrahard usage (Ex. 2–10, 2–28, 2–31, 2–32). In the proposal, this provision read as follows:

> (J) Extension cords used with portable electric tools and appliances shall be of three-wire type and shall be designed for hard [or] extrahard usage.

One comment noted the omission of the word "or", which occurred in the printing of the proposal and was later corrected (Ex. 2–10).

Two commenters argued that OSHA was using an undefined descriptive term ("hard or extra-hard usage") rather than explicitly specifying what is required (Ex. 2–31, 2–32). Noting that Table 400–4 of the NEC does use this terminology, one of these commenters claimed that further clarification was needed. OSHA agrees that this provision should be more explicit, but it should not be written so as to restrict unnecessarily the types of cords to be used. To satisfy both needs, OSHA has added a clarifying note to final paragraph (a)(2)(ii)(J) referencing NEC Table 400–4. Additionally, the note lists specific examples of types of flexible cords that are designed for hard or extra-hard usage. This should give employers guidance as to what types of cords will meet the requirement, but the rule will still accept new types of hard or extra-hard usage cords in the future.

The IBEW also commented on this provision in relation to their previously discussed issue concerning the former requirement for heavy-duty cords on temporary lights (existing § 1926.401(j)(2)) (Ex. 2–28). The IBEW correctly noted that proposed § 1926.405(a)(2)(ii)(J) would not apply to cords for temporary lights, though the preamble to the proposal incorrectly indicated that it did (Distribution Table, 48 FR 45875). On construction sites, they argued, cords used for temporary lighting are subjected to various kinds of damage, from workers, equipment, and the weather. Therefore, they claimed that "heavy duty" cords should be required.

OSHA agrees with the IBEW on this matter. As the IBEW noted, flexible cords (not just those used with temporary lights) are highly subject to damage in construction workplaces. The proposal did address this problem, though somewhat vaguely, in § 1926.405(g)(1)(i), requiring flexible cords to be "approved for conditions of use and locations." To eliminate any possible confusion as to what types of cords are required for temporary lights in construction, OSHA has added a sentence to final § 1926.405(a)(2)(ii)(J) requiring cords for temporary and portable lights to be suitable for hard or extra-hard usage.

Lastly, OSHA has changed the term "extension cords" to "extension cord sets" for consistency with final § 1926.404(b)(1)(iii). "Extension cord", "extension cord set", and "cord set" are synonymous (though "cord set" is the term used in Article 305 (Temporary Wiring) of the NEC). With the aforementioned changes, final § 1926.405(a)(2)(ii)(J) reads as follows:

> (J) Extension cord sets used with portable electric tools and appliances shall be three-wire type and shall be designed for hard or extra-hard usage. Flexible cords used with temporary and portable lights shall be designed for hard or extra-hard usage.
>
> Note.—The National Electrical Code, ANSI/NFPA 70, in Article 400, Table 400–4, lists various types of flexible cords, some of which are noted as being designed for hard or extra-hard usage. Examples of these types of flexible cords include hard service cord (types S, ST, SO, STO) and junior hard service cord (types SJ, SJO, SJT, SJTO).

Since there is no NEC provision comparable to paragraph (a)(2)(ii)(J) of final § 1926.405, this paragraph has been listed in § 1926.403(c) as one of the additional requirements in Subpart K which must be followed by employers who are complying with the 1984 NEC.

Paragraph (b) of final § 1926.405 requires cabinets, boxes, and fittings to provide a complete enclosure for conductors and to have only smooth surfaces in contact with conductors.

Paragraphs (c) and (d) relate to switches, switchboards, and panelboards, and these provisions require protection from live parts.

Weatherproof enclosures are required for wet locations in paragraph (e). Paragraph (f) requires conductors to have suitable insulation.

Paragraph (g) covers the use of flexible cords. Uses which are permitted and not permitted are listed in paragraph (g)(1), while paragraph (g)(2) details requirements for identification, splices, and termination of flexible cords.

Requirements applicable to portable cables for use over 600 volts are contained in paragraph (h).

Fixture wires are addressed in § 1926.405(i). This paragraph gives permitted uses for fixture wires and does not allow their use for general branch circuit wiring.

Paragraph (j) contains requirements for wiring of equipment for general use. Paragraphs (j) (1) and (2) cover lighting equipment, plugs, and receptacles. Marking, guarding, and disconnection requirements for appliances are given in paragraph (j)(3).

Requirements for motors are contained in paragraph (j)(4). Motors are required to have suitable overcurrent protection and disconnection means. Guarding requirements are also provided in this paragraph.

Paragraph (j)(5) gives safeguarding requirements for transformer installations. Depending on their rating, some transformers must be in a vault. Stated in performance language, § 1926.405(j)(5)(vi) requires such vaults to be able to contain fires and combustible liquids. Although no specific fire rating is given, any vault constructed in accordance with NEC

specifications in Article 450 would be acceptable.

Capacitor switching and charge drainage are addressed in paragraph (j)(6).

Section 1926.406 Specific purpose equipment and installations.

Paragraph (a) covers cranes and hoists and includes requirements for disconnects, control switches, required working clearance, and grounding. In § 1926.406(a)(1)(iii), the proposal contained a detailed specification related to the rating of a switch or circuit breaker used as a disconnecting means for a crane or hoist. This provision was intended to ensure that the disconnecting means had an adequate rating and stated the requirement in specifications. One commenter claimed that this requirement was unnecessarily specific and not directly related to employee safety (Ex. 2–37). OSHA agrees and notes that the hazard addressed by this requirement is covered in final § 1926.403(c), which requires disconnecting means to be of ample rating and which states the requirement in performance-oriented terms. Therefore, proposed § 1926.406(a)(1)(iii) has not been carried forward.

Paragraph (b) includes specific requirements for disconnects and location of control panels associated with elevators, dumbwaiters, escalators, and moving walks.

Specific requirements relating to disconnecting means, controls, guarding, grounding and labeling for electric welders and X-ray equipment are included in paragraphs (c) and (d).

Section 1926.407 Hazardous (classified) locations.

Paragraph (a) gives the scope of this section and designates the classes and divisions of hazardous (classified) locations.

Paragraph (b) contains the basic requirement that equipment, wiring methods, and installations be intrinsically safe or approved for the hazardous location or safe for the hazardous location.

Guidelines for determining what equipment and installations are "safe for the hazardous location" and thus meet § 1926.407(b)(3) of the final standard are contained in Chapter 5 of the National Electrical Code (NFPA 70). However, these guidelines are not the only means of complying with the standard. Any equipment or installation which is shown by the employer to provide protection from the hazards involved will be acceptable. This performance-oriented approach will allow the employer maximum flexibility in providing safety for employees.

Paragraph (c) requires conduits used in hazardous locations to be threaded and installed wrench tight.

Section 1926.408 Special Systems.

Paragraph (a) addresses electrical systems over 600 volts, nominal. Requirements are given for wiring methods, interrupting and isolating devices, mobile and portable equipment, and tunnel installations.

Requirements for remote control, signaling, and power-limited circuits are contained in paragraph (b). Depending on the voltage, current, and power limitation, these circuits have been designated as Class 1, Class 2, or Class 3.

Paragraph (c) applies to communications systems and contains provisions on protective devices, conductor and equipment locations, and grounding.

Safety-Related Work Practices

Section 1926.416 General requirements.

As noted in the Distribution Table, this section in the final rule has combined several requirements of existing Subpart K, without significant change. Paragraph (a) gives general requirements for the protection of employees from contact with energized power lines. In response to a suggestion from a commenter, paragraph (a)(3) has been modified so that action must be taken to determine the location of and to protect employees from *energized* circuits (Ex. 2–15). Although proposed paragraph (a)(3) (also existing § 1926.400(c)(2)) was intended to apply only to energized circuits, it could have been interpreted as requiring employers to determine the location of and post warning signs for deenergized circuits. The final rule should clarify this regulation.

Paragraph (b) gives requirements for keeping passageways and open spaces clear of electrical hazards. Paragraph (c) prohibits increasing the rating of fuses or circuit breakers in existing circuits, while paragraph (d) requires special tools for removing and installing fuses in energized circuits. Paragraph (e) deals with the use of cords and cables.

Section 1926.417 Lockout and tagging of circuits.

This section requires the tagging of controls, the locking and tagging of disconnects, and the identification of equipment whenever equipment or circuits are deenergized for work. These provisions have been taken, without substantive change, from § 1926.400(g) of the existing standard. Two commenters argued that proposed § 1926.417 was inadequate, and they suggested that the section be changed to require positive lockout (Ex. 2–3, 2–37).

Although, at this time, the Agency has not determined that existing § 1926.400(g) is inadequate, OSHA is currently reviewing the entire issue of lockout and tagging and is developing proposals for general industry which deal with this subject matter (i.e., hazardous energy control and electrical safety-related work practices). The Agency believes that a comprehensive approach to this problem is desirable and is reviewing the available data with regard to construction as well. Until the other proposals are further developed, OSHA believes that proposed § 1926.417 (existing § 1926.400(g)) should not be changed at this time and that revision of this section should await the receipt of further data and information in the related rulemakings for general industry.

Safety-Related Maintenance and Environmental Considerations

Section 1926.431 Maintenance of equipment—Equipment in hazardous locations.

Taken from existing § 1926.404(d), this provision requires the employer to maintain the integrity of equipment installed in hazardous locations.

Section 1926.432 Environmental deterioration of equipment.

Paragraph (a) requires equipment used under conditions which may cause deterioration to be identified for such use. Paragraph (b) requires corrosion protection for wiring elements and hardware, such as metal raceways, cable armor, boxes, fittings, and supports.

Safety Requirements for Special Equipment

Section 1926.441 Batteries and battery charging.

Taken, without substantive change, from existing § 1926.403, this section sets forth requirements for batteries and battery charging. Paragraph (a) contains provisions for ventilation, acid resistant floors, trays, and racks, and acid protection for employees. Paragraph (b) contains rules for battery charging installations.

Definitions

Section 1926.449 Definitions applicable to this subpart.

The definitions in existing § 1926.405 have been carried forward in § 1926.449

of the final rule. Some have been editorially modified to conform to their counterparts in the 1984 NEC and Subpart S of Part 1910. However, since the terms "hazard" and "shock hazard" are not used in the final rule or in the former standard, OSHA has removed the definitions for these terms. To supplement the definitions in existing § 1926.405, OSHA has defined additional terms used in the final standard. These additions have been taken from the 1984 NEC.

A definition of "intrinsically safe equipment and associated wiring" is being included to clarify the requirements in final § 1926.407 (existing requirement: 1971 NEC Article 500) pertaining to such equipment. The definition has been derived from the National Fire Protection Association Standard for Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1 Hazardous Locations, NFPA 493–1978. Although section 500–1 of the 1971 NEC describes intrinsically safe equipment, it does not contain a definition of the term. The definition adopted by OSHA is consistent with the descriptive language set out in the 1971 NEC and is identical to that given in the proposal, to which there was no objection.

Some of the proposed definitions were raised as issues at the public hearing. These definitions have previously been discussed in Issue 10 of Section IV of this preamble.

Miscellaneous Changes to Other Subparts

In addition to revising Subpart K, OSHA has made several miscellaneous changes to other subparts of Part 1926. All but one of these revisions eliminate references to the NEC or existing provisions of Subpart K and replace them with references to the corresponding provisions of revised Subpart K.

OSHA had also proposed to correct a reference in § 1926.600(a)(6). This correction has already been made in the Code of Federal Regulations, so it does not appear in this final rule.

VI. Regulatory Impact Analysis

(A) Final Regulatory Impact Analysis

The following Final Regulatory Impact and Regulatory Flexibility Analysis (RIA) of the final standard revising 29 CFR Part 1926, Subpart K (Electrical Construction) has been prepared in accordance with the requirements of Executive Order 12291 and the Regulatory Flexibility Act of 1980 (Pub. L. 96–353, 94 Stat. 1164 [5 U.S.C. 601] et seq.). The annual incremental savings resulting from this rule are estimated to be $29.3 million; since there is no increased cost the standard does not constitute a major rule under Executive Order 12291.

(1) Overview of the Construction Industry

The Electrical Construction standard covers all workers involved in construction activities. Construction establishments covered by the proposed standard include Standard Industrial Classification (SIC) Codes 15, 16, and 17. In 1982, there were 386,091 establishments in construction that had employees (*County Business Patterns*). The number of workers employed at that time was about 3,940,770. In addition, Workers' Compensation claims indicate that workers in all types of construction jobs are exposed to electrical hazards. In 1979, electrical work was associated with the highest single percentage of total claims (30.7 percent).

(2) Overview of the Effectiveness of Alternative Standards

Site visits performed by OSHA's contractor, the JACA Corporation, indicate that construction projects of all sizes have some degree of noncompliance with the existing Subpart K. OSHA estimates that the total electrical injuries in construction projects were 1,857 in 1981 and 1,738 in 1982, which included 241 and 226 fatalities in each year, respectively. Risk and electrical injuries averted by full compliance with the current standard are estimated to be 1,077 injuries, including 140 fatalities (1982). The major justification for this action is the greater degree of flexibility provided by the revised standard, with no reduction of employee safety, and a corresponding reduction in compliance costs, when compared to the current requirements. In addition, there are two new provisions in the final standard that are expected to increase employee safety. These are §§ 1926.403(i)(1) and 1926.405(a)(2)(ii)(C). The first provision increases the required distances for clearances and the other prohibits the use of receptacles on temporary lighting circuits. OSHA estimates that full compliance with these provisions will prevent an additional 84 lost workday injuries annually.

(3) Technological and Economic Feasibility

A comparison of the existing and final versions of the OSHA electrical construction standards reveals that the revisions introduced do not pose technological changes that would require major cost outlays for construction firms. The revisions having cost implications relative to the existing standard are presented in JACA Corporation's *Final Report* (January 1983, pp. 1–6 to 1–7). The final revised standard contains no additional cost implications from those presented for the proposed revisions. Several of the changes could reduce compliance costs for firms, because the final standard recognizes lower cost alternatives for compliance. Thus, no technological or economic constraints are envisioned.

(4) Overview of Compliance Costs of Final Standard

An important effect of the final standard is the expected cost savings from achieving full compliance with the revised standard compared to achieving full compliance with the existing standard. Savings will be achieved because the revised provisions of the standard allow greater flexibility in achieving compliance. Furthermore, a cost savings will be achieved because the employer will not have to review two standards (i.e., Subpart K and the National Electrical Code [NEC]) in order to determine OSHA compliance requirements. An itemization of the estimated industrywide compliance costs and savings is presented in Table 1. It is estimated that the annual industrywide cost of going from current practices to full compliance with the revised Subpart would be $47.9 million. By comparison, the annual cost of going from current practices to full compliance with the existing Subpart would be $78.5 million. The difference between these two costs ($30.6 million) would be the compliance cost savings realized from the recognition of lower cost of compliance options provided by the revised standard.

TABLE 1.—ESTIMATED AGGREGATE INDUSTRY COMPLIANCE COSTS

[1982 dollars]

Changes in level of compliance	Cost or savings
Current Practices to Full Compliance with Existing Subpart	78,545,826
Current Practices to Full Compliance with Proposed Subpart	47,968,059
Full Compliance with Existing Subpart to Full Compliance with Proposed Subpart	(30,577,769)
• Cost due to more stringent requirements	600,400
• Saving estimated from model projects	(31,360,435)
• Cost estimated from model projects	182,266

Source: U.S. Department of Labor, OSHA, Office of Regulatory Analysis.

(5) Overview of Alternatives Considered

OSHA examined five alternative courses of action under Executive Order

12291. The first of these was to take no action at all and leave the existing standard in force. This action, however, would not address the language in the existing Subpart K, which requires clarification and simplification as outlined earlier. The next two alternatives considered were to issue program directives to clarify the application of the existing rule or to issue hazard alerts to inform employers of specific electrical hazards. In fact, directives and instructions already issued by OSHA in an effort to update and clarify the regulation have not served that purpose and, in fact, have made the existing standard more complicated. As for hazard alerts, which are generally issued to deal with hazards that are currently not covered by standards, the use of these alerts to address hazards which are clearly covered by existing regulations would not be appropriate. Moreover, the use of alerts in the absence of a regulation might not improve safety, as hazard alerts do not impose mandatory requirements. The fourth alternative was to modify the existing Subpart K to adopt the entire 1984 NEC and to clarify some of the provisions of that code. As with the other alternatives this approach also would not address the unnecessary burden of requiring employers to refer to two sets of published documents (Subpart K and the NEC), nor would it solve the problem of the large amount of technical detail in the NEC that is unrelated to construction worker safety.

Yet another alternative would be to eliminate the existing standard. The injuries discussed above, however, have resulted primarily from noncompliance with the current regulation. This suggests that neither market incentives nor NEC regulations have provided the desired level of safety. Given the nature of the construction industry—the ease of entry for firms, temporary conditions at worksites, and workers who have a variety of educational, occupational and skill backgrounds—it is very likely that without the OSHA standard, electrical safety would be undersupplied by the private market.

(B) Regulatory Flexibility Analysis and Certification

The Regulatory Flexibility Act of 1980 (Pub. L. 96–353, 94 Stat. 1164 [U.S.C. 601] et seq.) requires that special consideration be given to the economic impact of a proposed regulation on small entities. Most of the construction firms subject to Subpart K are small businesses.

If annual receipts of $350,000 are used as the cutoff for defining small firms, nearly 89 percent of the electrical contracting firms would be in the "small" category. For the construction industry as a whole (i.e., SIC groups 15, 16 and 17), assuming the same cutoff, the proportion of small firms would be approximately 90 percent.

The potential impact of compliance on individual construction firms was evaluated by developing large-, medium- and small-sized financial models of electrical contracting firms. Electrical contracting firms were usd as a model because the electrical contractor is responsible for most of the electrical work on the construction site and, consequently, would bear most of the costs of compliance with the final Subpart K. The analysis found that in the case of the large- and medium-sized models, the effects on profitability and capital availability would be negligible, even if compliance costs were fully absorbed by the electrical contractor.

The potential impact of achieving full compliance on the small model firm may not be negligible; however, the net effect of the revision is a savings. Using the midpoint of the range of estimated compliance costs for the small firms, for example, reveals that the revisions would result in a savings of $233 per firm (i.e., $798 to achieve compliance with the existing Subpart compared with $565 to achieve compliance with the final Subpart). In the worst-case scenario, which assumes full absorption of compliance costs, the decline in return on assets and profit margin for the small firm to achieve compliance with the final Subpart would be 8.6 and 8.7 percent, respectively; whereas, achieving compliance with the existing Subpart would imply declines of 12.1 and 12.0 percent, respectively. This worst-case scenario is not likely to apply, however, for the following reasons. First, public procurement rules allow the passthrough of the compliance costs of government regulations (i.e., special clauses in Federal Procurement Regulations). Second, in private markets, small firms are usually specialized and are therefore able to pass through increased costs to the customer over the long run. OSHA anticipates, therefore, that most small firms will not be significantly affected.

The relatively greater burden of compliance for small firms vis-a-vis larger firms arises not because of the provisions of the Subpart itself, but because the JACA survey indicates that small firms are farther from full compliance with the existing standard than their larger competitors. On the other hand, the greater flexibility in achieving compliance allowed by the final standard and the arrangement of one set of regulations, as opposed to two (i.e., existing Subpart plus the 1971 NEC), yield even greater benefits to small firms than to large firms. Thus, on balance, the standard leaves small firms in a much better position than they hold under the existing standard. For these reasons, the Assistant Secretary for OSHA certifies that for the purpose of the Regulatory Flexibility Act, the revision of Subpart K of Part 1926 will not have a significant impact on a substantial number of small entities.

The above discussion summarizes the key findings of the Final RIA of the revised Subpart K, Part 1926, as prepared by the Office of Regulatory Analysis of the Occupational Safety and Health Administration. The RIA includes assessments of estimated compliance costs, estimated benefits, risk, small business impacts, alternative regulatory and nonregulatory options, and a profile of the industry. The data in the RIA are based on contract work performed for OSHA by the JACA Corporation. The JACA report, *Economic Analysis of Proposed Revisions to Subpart K, Part 1926, Final Report, January 1983*, and OSHA's Final RIA are available to the public in Docket S106. (Ex. 5, 3).

VII. Effective Date

This revision of Subpart K, along with the other miscellaneous changes being made elsewhere in Part 1926, becomes effective on October 9, 1986.

VIII. State Standards

The 25 States with their own OSHA-approved occupational safety and health plans must revise their existing standard within six months or show OSHA why there is no need for action, e.g., because an existing State standard covering this area is already "at least as effective" as the revised Federal standard. These States are: Alaska, Arizona, California, Connecticut*, Hawaii, Indiana, Iowa, Kentucky, Maryland, Michigan, Minnesota, Nevada, New Mexico, New York*, North Carolina, Oregon, Puerto Rico, South Carolina, Tennessee, Utah, Vermont, Virginia, Virgin Islands, Washington, Wyoming.

IX. List of Index Terms

List of Subjects in 29 CFR Part 1926

Construction safety, Electric power, Fire prevention, Flammable materials, Hazardous materials, Occupational safety and health, Safety, Signs and symbols, Tools.

* Plan covers only State and local government employees.

X. Authority

This document was prepared under the direction of John A. Pendergrass, Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor, 200 Constitution Avenue, NW., Washington, DC 20210.

The information collection regulations contained in this regulation, 29 CFR Part 1926, have been approved by the Office of Management and Budget under the provisions of 44 U.S.C. Chapter 35 and have been assigned OMB Control Number 1218–0130.

Accordingly, pursuant to sections 6(b) and 8 of the Occupational Safety and Health Act of 1970 (84 Stat. 1593, 1599; 29 U.S.C. 655, 657), section 107 of the Contract Work Hours and Safety Standards Act (83 Stat. 96, 40 U.S.C. 333), Secretary of Labor's Order No. 983 (48 FR 35736), and 29 CFR Part 1911, 29 CFR Part 1926 is amended as set forth below.

Signed at Washington, DC this 2nd day of July, 1986.

John A. Pendergrass,

Assistant Secretary of Labor.

PART 1926—[AMENDED]

Part 1926 of Title 29 of the Code of Federal Regulations is amended as follows:

§ 1926.151 [Amended]

1. By amending paragraph (a)(1) of § 1926.151 to remove the words "the requirements of the National Electrical Code, NFPA 70–1971; ANSI Cl–1971 (Rev. of 1968), and".

2. By revising paragraph (b)(4)(v) of § 1926.152 to read as follows:

§ 1926.152 Flammable and combustible liquids.

* * * * *

(b) * * *

(4) * * *

(v) Electrical wiring and equipment located in inside storage rooms shall be approved for Class I, Division 1, Hazardous Locations. For definition of Class I, Division 1, Hazardous Locations, see § 1926.449.

* * * * *

3. By revising paragraph (d)(5) of § 1926.351 to read as follows:

§ 1926.351 Arc welding and cutting.

* * * * *

(d) * * *

(5) See § 1926.406(c) for additional requirements.

* * * * *

4. By revising paragraph (j)(3) of § 1926.803 to read as follows:

§ 1926.803 Compressed air.

* * * * *

(j) * * *

(3) All electrical equipment and wiring for light and power circuits shall comply with the requirements of Subpart K of this Part for use in damp, hazardous, high temperature, and compressed air environments.

* * * * *

5. By adding an authority citation for Subpart K of Part 1926 to read as follows:

Authority: Secs. 6 and 8, Occupational Safety and Health Act (29 U.S.C. 655, 657); Sec. 107, Contract Work Hours and Safety Standards Act (40 U.S.C. 333); Secretary of Labor's Order No. 9–83 (48 FR 35736); 29 CFR Part 1911.

6. By revising Subpart K of 29 CFR Part 1926 to read as follows:

Subpart K—Electrical

General

Sec.
1926.400—Introduction.
1926.401—[Reserved]

Installation Safety Requirements

1926.402—Applicability.
1926.403—General requirements.
1926.404—Wiring design and protection.
1926.405—Wiring methods, components, and equipment for general use.
1926.406—Specific purpose equipment and installations.
1926.407—Hazardous (classified) locations.
1926.408—Special systems.
1926.409—1926.415—[Reserved]

Safety-Related Work Practices

1926.416—General requirements.
1926.417—Lockout and tagging of circuits.
1926.418—1926.430—[Reserved]

Safety-Related Maintenance and Environmental Considerations

1926.431—Maintenance of equipment.
1926.432—Environmental deterioration of equipment.
1926.433—1926.440—[Reserved]

Safety Requirements for Special Equipment

1926.441—Battery locations and battery charging.
1926.442—1926.448—[Reserved]

Definitions

1926.449—Definitions applicable to this subpart.

Subpart K—Electrical

General

§ 1926.400 Introduction.

This subpart addresses electrical safety requirements that are necessary for the practical safeguarding of employees involved in construction work and is divided into four major divisions and applicable definitions as follows:

(a) *Installation safety requirements.* Installation safety requirements are contained in §§ 1926.402 through 1926.408. Included in this category are electric equipment and installations used to provide electric power and light on jobsites.

(b) *Safety-related work practices.* Safety-related work practices are contained in §§ 1926.416 and 1926.417. In addition to covering the hazards arising from the use of electricity at jobsites, these regulations also cover the hazards arising from the accidental contact, direct or indirect, by employees with all energized lines, above or below ground, passing through or near the jobsite.

(c) *Safety-related maintenance and environmental considerations.* Safety-related maintenance and environmental considerations are contained in §§ 1926.431 and 1926.432.

(d) *Safety requirements for special equipment.* Safety requirements for special equipment are contained in § 1926.441.

(e) *Definitions.* Definitions applicable to this Subpart are contained in § 1926.449.

§ 1926.401 [Reserved]

Installation Safety Requirements

§ 1926.402 Applicability.

(a) *Covered.* Sections 1926.402 through 1926.408 contain installation safety requirements for electrical equipment and installations used to provide electric power and light at the jobsite. These sections apply to installations, both temporary and permanent, used on the jobsite; but these sections do not apply to existing permanent installations that were in place before the construction activity commenced.

Note.—If the electrical installation is made in accordance with the National Electrical Code ANSI/NFPA 70–1984, exclusive of Formal Interpretations and Tentative Interim Amendments, it will be deemed to be in compliance with §§ 1926.403 through 1926.408, except for §§ 1926.404(b)(1) and 1926.405(a)(2)(ii) (E), (F), (G), and (J).

(b) *Not covered.* Sections 1926.402 through 1926.408 do not cover installations used for the generation, transmission, and distribution of electric energy, including related communication, metering, control, and transformation installations. (However, these regulations do cover portable and vehicle-mounted generators used to provide power for equipment used at the jobsite.) See Subpart V of this Part for the construction of power distribution and transmission lines.

§ 1926.403 General requirements.

(a) *Approval.* All electrical conductors and equipment shall be approved.

(b) *Examination, installation, and use of equipment*—(1) *Examination.* The employer shall ensure that electrical equipment is free from recognized hazards that are likely to cause death or serious physical harm to employees. Safety of equipment shall be determined on the basis of the following considerations:

(i) Suitability for installation and use in conformity with the provisions of this subpart. Suitability of equipment for an identified purpose may be evidenced by listing, labeling, or certification for that identified purpose.

(ii) Mechanical strength and durability, including, for parts designed to enclose and protect other equipment, the adequacy of the protection thus provided.

(iii) Electrical insulation.

(iv) Heating effects under conditions of use.

(v) Arcing effects.

(vi) Classification by type, size, voltage, current capacity, specific use.

(vii) Other factors which contribute to the practical safeguarding of employees using or likely to come in contact with the equipment.

(2) *Installation and use.* Listed, labeled, or certified equipment shall be installed and used in accordance with instructions included in the listing, labeling, or certification.

(c) *Interrupting rating.* Equipment intended to break current shall have an interrupting rating at system voltage sufficient for the current that must be interrupted.

(d) *Mounting and cooling of equipment*—(1) *Mounting.* Electric equipment shall be firmly secured to the surface on which it is mounted. Wooden plugs driven into holes in masonry, concrete, plaster, or similar materials shall not be used.

(2) *Cooling.* Electrical equipment which depends upon the natural circulation of air and convection principles for cooling of exposed surfaces shall be installed so that room air flow over such surfaces is not prevented by walls or by adjacent installed equipment. For equipment designed for floor mounting, clearance between top surfaces and adjacent surfaces shall be provided to dissipate rising warm air. Electrical equipment provided with ventilating openings shall be installed so that walls or other obstructions do not prevent the free circulation of air through the equipment.

(e) *Splices.* Conductors shall be spliced or joined with splicing devices designed for the use or by brazing, welding, or soldering with a fusible metal or alloy. Soldered splices shall first be so spliced or joined as to be mechanically and electrically secure without solder and then soldered. All splices and joints and the free ends of conductors shall be covered with an insulation equivalent to that of the conductors or with an insulating device designed for the purpose.

(f) *Arcing parts.* Parts of electric equipment which in ordinary operation produce arcs, sparks, flames, or molten metal shall be enclosed or separated and isolated from all combustible material.

(g) *Marking.* Electrical equipment shall not be used unless the manufacturer's name, trademark, or other descriptive marking by which the organization responsible for the product may be identified is placed on the equipment and unless other markings are provided giving voltage, current, wattage, or other ratings as necessary. The marking shall be of sufficient durability to withstand the environment involved.

(h) *Identification of disconnecting means and circuits.* Each disconnecting means required by this subpart for motors and appliances shall be legibly marked to indicate its purpose, unless located and arranged so the purpose is evident. Each service, feeder, and branch circuit, at its disconnecting means or overcurrent device, shall be legibly marked to indicate its purpose, unless located and arranged so the purpose is evident. These markings shall be of sufficient durability to withstand the environment involved.

(i) *600 Volts, nominal, or less.* This paragraph applies to equipment operating at 600 volts, nominal, or less.

(1) *Working space about electric equipment.* Sufficient access and working space shall be provided and maintained about all electric equipment to permit ready and safe operation and maintenance of such equipment.

(i) *Working clearances.* Except as required or permitted elsewhere in this subpart, the dimension of the working space in the direction of access to live parts operating at 600 volts or less and likely to require examination, adjustment, servicing, or maintenance while alive shall not be less than indicated in Table K–1. In addition to the dimensions shown in Table K–1, workspace shall not be less than 30 inches (762 mm) wide in front of the electric equipment. Distances shall be measured from the live parts if they are exposed, or from the enclosure front or opening if the live parts are enclosed. Walls constructed of concrete, brick, or tile are considered to be grounded. Working space is not required in back of assemblies such as dead-front switchboards or motor control centers where there are no renewable or adjustable parts such as fuses or switches on the back and where all connections are accessible from locations other than the back.

TABLE K–1—WORKING CLEARANCES

Nominal voltage to ground	Minimum clear distance for conditions[1]		
	(a)	(b)	(c)
	Feet[2]	Feet[2]	Feet[2]
0–150	3	3	3
151–600	3	3½	4

[1] Conditions (a), (b), and (c) are as follows: (a) Exposed live parts on one side and no live or grounded parts on the other side of the working space, or exposed live parts on both sides effectively guarded by insulating material. Insulated wire or insulated busbars operating at not over 300 volts are not considered live parts. (b) Exposed live parts on one side and grounded parts on the other side. (c) Exposed live parts on both sides of the workspace [not guarded as provided in Condition (a)] with the operator between.

[2] Note.—For International System of Units (SI): one foot = 0.3048m.

(ii) *Clear spaces.* Working space required by this subpart shall not be used for storage. When normally enclosed live parts are exposed for inspection or servicing, the working space, if in a passageway or general open space, shall be guarded.

(iii) *Access and entrance to working space.* At least one entrance shall be provided to give access to the working space about electric equipment.

(iv) *Front working space.* Where there are live parts normally exposed on the front of switchboards or motor control centers, the working space in front of such equipment shall not be less than 3 feet (914 mm).

(v) *Headroom.* The minimum headroom of working spaces about service equipment, switchboards, panelboards, or motor control centers shall be 6 feet 3 inches (1.91 m).

(2) *Guarding of live parts.* (i) Except as required or permitted elsewhere in this subpart, live parts of electric equipment operating at 50 volts or more shall be guarded against accidental contact by cabinets or other forms of enclosures, or by any of the following means:

(A) By location in a room, vault, or similar enclosure that is accessible only to qualified persons.

(B) By partitions or screens so arranged that only qualified persons will have access to the space within reach of the live parts. Any openings in such partitions or screens shall be so sized and located that persons are not likely to come into accidental contact with the live parts or to bring conducting objects into contact with them.

(C) By location on a balcony, gallery, or platform so elevated and arranged as to exclude unqualified persons.

(D) By elevation of 8 feet (2.44 m) or more above the floor or other working surface and so installed as to exclude unqualified persons.

(ii) In locations where electric equipment would be exposed to physical damage, enclosures or guards shall be so arranged and of such strength as to prevent such damage.

(iii) Entrances to rooms and other guarded locations containing exposed live parts shall be marked with conspicuous warning signs forbidding unqualified persons to enter.

(j) *Over 600 volts, nominal.* (1) *General.* Conductors and equipment used on circuits exceeding 600 volts, nominal, shall comply with all applicable provisions of paragraphs (a) through (g) of this section and with the following provisions which supplement or modify those requirements. The provisions of paragraphs (j)(2), (j)(3), and (j)(4) of this section do not apply to equipment on the supply side of the service conductors.

(2) *Enclosure for electrical installations.* Electrical installations in a vault, room, closet or in an area surrounded by a wall, screen, or fence, access to which is controlled by lock and key or other equivalent means, are considered to be accessible to qualified persons only. A wall, screen, or fence less than 8 feet (2.44 m) in height is not considered adequate to prevent access unless it has other features that provide a degree of isolation equivalent to an 8-foot (2.44-m) fence. The entrances to all buildings, rooms or enclosures containing exposed live parts or exposed conductors operating at over 600 volts, nominal, shall be kept locked or shall be under the observation of a qualified person at all times.

(i) *Installations accessible to qualified persons only.* Electrical installations having exposed live parts shall be accessible to qualified persons only and shall comply with the applicable provisions of paragraph (j)(3) of this section.

(ii) *Installations accessible to unqualified persons.* Electrical installations that are open to unqualified persons shall be made with metal-enclosed equipment or shall be enclosed in a vault or in an area, access to which is controlled by a lock. Metal-enclosed switchgear, unit substations, transformers, pull boxes, connection boxes, and other similar associated equipment shall be marked with appropriate caution signs. If equipment is exposed to physical damage from vehicular traffic, guards shall be provided to prevent such damage. Ventilating or similar openings in metal-enclosed equipment shall be designed so that foreign objects inserted through these openings will be deflected from energized parts.

(3) *Workspace about equipment.* Sufficient space shall be provided and maintained about electric equipment to permit ready and safe operation and maintenance of such equipment. Where energized parts are exposed, the minimum clear workspace shall not be less than 6 feet 6 inches (1.98 m) high (measured vertically from the floor or platform), or less than 3 feet (914 mm) wide (measured parallel to the equipment). The depth shall be as required in Table K–2. The workspace shall be adequate to permit at least a 90-degree opening of doors or hinged panels.

(i) *Working space.* The minimum clear working space in front of electric equipment such as switchboards, control panels, switches, circuit breakers, motor controllers, relays, and similar equipment shall not be less than specified in Table K–2 unless otherwise specified in this subpart. Distances shall be measured from the live parts if they are exposed, or from the enclosure front or opening if the live parts are enclosed. However, working space is not required in back of equipment such as deadfront switchboards or control assemblies where there are no renewable or adjustable parts (such as fuses or switches) on the back and where all connections are accessible from locations other than the back. Where rear access is required to work on de-energized parts on the back of enclosed equipment, a minimum working space of 30 inches (762 mm) horizontally shall be provided.

TABLE K-2—MINIMUM DEPTH OF CLEAR WORKING SPACE IN FRONT OF ELECTRIC EQUIPMENT

Nominal voltage to ground	Conditions[1]		
	(a)	(b)	(c)
	Feet[2]	Feet[2]	Feet[2]
601 to 2,500	3	4	5
2,501 to 9,000	4	5	6
9,001 to 25,000	5	6	9
25,001 to 75 kV	6	8	10
Above 75kV	8	10	12

[1] Conditions (a), (b), and (c) are as follows: (a) Exposed live parts on one side and no live or grounded parts on the other side of the working space, or exposed live parts on both sides effectively guarded by insulating materials. Insulated wire or insulated busbars operating at not over 300 volts are not considered live parts. (b) Exposed live parts on one side and grounded parts on the other side. Walls constructed of concrete, brick, or tile are considered to be grounded surfaces. (c) Exposed live parts on both sides of the workspace [not guarded as provided in Condition (a)] with the operator between.

[2] NOTE.—For SI units: one foot=0.3048 m.

(ii) *Lighting outlets and points of control.* The lighting outlets shall be so arranged that persons changing lamps or making repairs on the lighting system will not be endangered by live parts or other equipment. The points of control shall be so located that persons are not likely to come in contact with any live part or moving part of the equipment while turning on the lights.

(iii) *Elevation of unguarded live parts.* Unguarded live parts above working space shall be maintained at elevations not less than specified in Table K–3.

TABLE K–3—ELEVATION OF UNGUARDED ENERGIZED PARTS ABOVE WORKING SPACE

Nominal voltage between phases	Minimum elevation
601–7,500	8 feet 6 inches.[1]
7,501–35,000	9 feet.
Over 35kV	9 feet + 0.37 inches per kV above 35kV.

[1] NOTE.—For SI units: one inch=25.4 mm; one foot=0.3048 m.

(4) *Entrance and access to workspace.* At least one entrance not less than 24 inches (610 mm) wide and 6 feet 6 inches (1.98 m) high shall be provided to give access to the working space about electric equipment. On switchboard and control panels exceeding 48 inches (1.22 m) in width, there shall be one entrance at each end of such board where practicable. Where bare energized parts at any voltage or insulated energized parts above 600 volts are located adjacent to such entrance, they shall be guarded.

(Information collection requirements contained in paragraphs (g) and (h) were approved by the Office of Management and Budget under control number 1218–0130)

§ 1926.404 Wiring design and protection.

(a) *Use and identification of grounded and grounding conductors*—(1) *Identification of conductors.* A conductor used as a grounded conductor shall be identifiable and distinguishable from all other conductors. A conductor used as an equipment grounding conductor shall be identifiable and distinguishable from all other conductors.

(2) *Polarity of connections.* No grounded conductor shall be attached to any terminal or lead so as to reverse designated polarity.

(3) *Use of grounding terminals and devices.* A grounding terminal or grounding-type device on a receptacle, cord connector, or attachment plug shall not be used for purposes other than grounding.

(b) *Branch circuits*—(1) *Ground-fault protection*—(i) *General.* The employer shall use either ground fault circuit interrupters as specified in paragraph (b)(1)(ii) of this section or an assured equipment grounding conductor program as specified in paragraph (b)(1)(iii) of

this section to protect employees on construction sites. These requirements are in addition to any other requirements for equipment grounding conductors.

(ii) *Ground-fault circuit interrupters.* All 120-volt, single-phase, 15- and 20-ampere receptacle outlets on construction sites, which are not a part of the permanent wiring of the building or structure and which are in use by employees, shall have approved ground-fault circuit interrupters for personnel protection. Receptacles on a two-wire, single-phase portable or vehicle-mounted generator rated not more than 5kW, where the circuit conductors of the generator are insulated from the generator frame and all other grounded surfaces, need not be protected with ground-fault circuit interrupters.

(iii) *Assured equipment grounding conductor program.* The employer shall establish and implement an assured equipment grounding conductor program on construction sites covering all cord sets, receptacles which are not a part of the building or structure, and equipment connected by cord and plug which are available for use or used by employees. This program shall comply with the following minimum requirements:

(A) A written description of the program, including the specific procedures adopted by the employer, shall be available at the jobsite for inspection and copying by the Assistant Secretary and any affected employee.

(B) The employer shall designate one or more competent persons (as defined in § 1926.32(f)) to implement the program.

(C) Each cord set, attachment cap, plug and receptacle of cord sets, and any equipment connected by cord and plug, except cord sets and receptacles which are fixed and not exposed to damage, shall be visually inspected before each day's use for external defects, such as deformed or missing pins or insulation damage, and for indications of possible internal damage. Equipment found damaged or defective shall not be used until repaired.

(D) The following tests shall be performed on all cord sets, receptacles which are not a part of the permanent wiring of the building or structure, and cord- and plug-connected equipment required to be grounded:

(*1*) All equipment grounding conductors shall be tested for continuity and shall be electrically continuous.

(*2*) Each receptacle and attachment cap or plug shall be tested for correct attachment of the equipment grounding conductor. The equipment grounding conductor shall be connected to its proper terminal.

(E) All required tests shall be performed:

(*1*) Before first use;

(*2*) Before equipment is returned to service following any repairs;

(*3*) Before equipment is used after any incident which can be reasonably suspected to have caused damage (for example, when a cord set is run over); and

(*4*) At intervals not to exceed 3 months, except that cord sets and receptacles which are fixed and not exposed to damage shall be tested at intervals not exceeding 6 months.

(F) The employer shall not make available or permit the use by employees of any equipment which has not met the requirements of this paragraph (b)(1)(iii) of this section.

(G) Tests performed as required in this paragraph shall be recorded. This test record shall identify each receptacle, cord set, and cord- and plug-connected equipment that passed the test and shall indicate the last date it was tested or the interval for which it was tested. This record shall be kept by means of logs, color coding, or other effective means and shall be maintained until replaced by a more current record. The record shall be made available on the jobsite for inspection by the Assistant Secretary and any affected employee.

(2) *Outlet devices.* Outlet devices shall have an ampere rating not less than the load to be served and shall comply with the following:

(i) *Single receptacles.* A single receptacle installed on an individual branch circuit shall have an ampere rating of not less than that of the branch circuit.

(ii) *Two or more receptacles.* Where connected to a branch circuit supplying two or more receptacles or outlets, receptacle ratings shall conform to the values listed in Table K–4.

(iii) *Receptacles used for the connection of motors.* The rating of an attachment plug or receptacle used for cord- and plug-connection of a motor to a branch circuit shall not exceed 15 amperes at 125 volts or 10 amperes at 250 volts if individual overload protection is omitted.

TABLE K–4—RECEPTACLE RATINGS FOR VARIOUS SIZE CIRCUITS

Circuit rating amperes	Receptacle rating amperes
15	Not over 15.
20	15 or 20.
30	30.
40	40 or 50.
50	50.

(c) *Outside conductors and lamps*—(1) *600 volts, nominal, or less.* Paragraphs (c)(1)(i) through (c)(1)(iv) of this section apply to branch circuit, feeder, and service conductors rated 600 volts, nominal, or less and run outdoors as open conductors.

(i) *Conductors on poles.* Conductors supported on poles shall provide a horizontal climbing space not less than the following:

(A) Power conductors below communication conductors—30 inches (762 mm).

(B) Power conductors alone or above communication conductors: 300 volts or less—24 inches (610 mm); more than 300 volts—30 inches (762 mm).

(C) Communication conductors below power conductors: with power conductors 300 volts or less—24 inches (610 mm); more than 300 volts—30 inches (762 mm).

(ii) *Clearance from ground.* Open conductors shall conform to the following minimum clearances:

(A) 10 feet (3.05 m)—above finished grade, sidewalks, or from any platform or projection from which they might be reached.

(B) 12 feet (3.66 m)—over areas subject to vehicular traffic other than truck traffic.

(C) 15 feet (4.57 m)—over areas other than those specified in paragraph (c)(1)(ii)(D) of this section that are subject to truck traffic.

(D) 18 feet (5.49 m)—over public streets, alleys, roads, and driveways.

(iii) *Clearance from building openings.* Conductors shall have a clearance of at least 3 feet (914 mm) from windows, doors, fire escapes, or similar locations. Conductors run above the top level of a window are considered to be out of reach from that window and, therefore, do not have to be 3 feet (914 mm) away.

(iv) *Clearance over roofs.* Conductors above roof space accessible to employees on foot shall have a clearance from the highest point of the roof surface of not less than 8 feet (2.44 m) vertical clearance for insulated conductors, not less than 10 feet (3.05 m) vertical or diagonal clearance for covered conductors, and not less than 15 feet (4.57 m) for bare conductors, except that:

(A) Where the roof space is also accessible to vehicular traffic, the vertical clearance shall not be less than 18 feet (5.49 m), or

(B) Where the roof space is not normally accessible to employees on foot, fully insulated conductors shall have a vertical or diagonal clearance of not less than 3 feet (914 mm), or

(C) Where the voltage between conductors is 300 volts or less and the roof has a slope of not less than 4 inches (102 mm) in 12 inches (305 mm), the clearance from roofs shall be at least 3 feet (914 mm), or

(D) Where the voltage between conductors is 300 volts or less and the conductors do not pass over more than 4 feet (1.22 m) of the overhang portion of the roof and they are terminated at a through-the-roof raceway or support, the clearance from roofs shall be at least 18 inches (457 mm).

(2) *Location of outdoor lamps.* Lamps for outdoor lighting shall be located below all live conductors, transformers, or other electric equipment, unless such equipment is controlled by a disconnecting means that can be locked in the open position or unless adequate clearances or other safeguards are provided for relamping operations.

(d) *Services*—(1) *Disconnecting means*—(i) *General.* Means shall be provided to disconnect all conductors in a building or other structure from the service-entrance conductors. The disconnecting means shall plainly indicate whether it is in the open or closed position and shall be installed at a readily accessible location nearest the point of entrance of the service-entrance conductors.

(ii) *Simultaneous opening of poles.* Each service disconnecting means shall simultaneously disconnect all ungrounded conductors.

(2) *Services over 600 volts, nominal.* The following additional requirements apply to services over 600 volts, nominal.

(i) *Guarding.* Service-entrance conductors installed as open wires shall be guarded to make them accessible only to qualified persons.

(ii) *Warning signs.* Signs warning of high voltage shall be posted where unauthorized employees might come in contact with live parts.

(e) *Overcurrent protection*—(1) *600 volts, nominal, or less.* The following requirements apply to overcurrent protection of circuits rated 600 volts, nominal, or less.

(i) *Protection of conductors and equipment.* Conductors and equipment shall be protected from overcurrent in accordance with their ability to safely conduct current. Conductors shall have sufficient ampacity to carry the load.

(ii) *Grounded conductors.* Except for motor-running overload protection, overcurrent devices shall not interrupt the continuity of the grounded conductor unless all conductors of the circuit are opened simultaneously.

(iii) *Disconnection of fuses and thermal cutouts.* Except for devices provided for current-limiting on the supply side of the service disconnecting means, all cartridge fuses which are accessible to other than qualified persons and all fuses and thermal cutouts on circuits over 150 volts to ground shall be provided with disconnecting means. This disconnecting means shall be installed so that the fuse or thermal cutout can be disconnected from its supply without disrupting service to equipment and circuits unrelated to those protected by the overcurrent device.

(iv) *Location in or on premises.* Overcurrent devices shall be readily accessible. Overcurrent devices shall not be located where they could create an employee safety hazard by being exposed to physical damage or located in the vicinity of easily ignitible material.

(v) *Arcing or suddenly moving parts.* Fuses and circuit breakers shall be so located or shielded that employees will not be burned or otherwise injured by their operation.

(vi) *Circuit breakers*—(A) Circuit breakers shall clearly indicate whether they are in the open (off) or closed (on) position.

(B) Where circuit breaker handles on switchboards are operated vertically rather than horizontally or rotationally, the up position of the handle shall be the closed (on) position.

(C) If used as switches in 120-volt, fluorescent lighting circuits, circuit breakers shall be marked "SWD."

(2) *Over 600 volts, nominal.* Feeders and branch circuits over 600 volts, nominal, shall have short-circuit protection.

(f) *Grounding.* Paragraphs (f)(1) through (f)(11) of this section contain grounding requirements for systems, circuits, and equipment.

(1) *Systems to be grounded.* The following systems which supply premises wiring shall be grounded:

(i) *Three-wire DC systems.* All 3-wire DC systems shall have their neutral conductor grounded.

(ii) *Two-wire DC systems.* Two-wire DC systems operating at over 50 volts through 300 volts between conductors shall be grounded unless they are rectifier-derived from an AC system complying with paragraphs (f)(1)(iii), (f)(1)(iv), and (f)(1)(v) of this section.

(iii) *AC circuits, less than 50 volts.* AC circuits of less than 50 volts shall be grounded if they are installed as overhead conductors outside of buildings or if they are supplied by transformers and the transformer primary supply system is ungrounded or exceeds 150 volts to ground.

(iv) *AC systems, 50 volts to 1000 volts.* AC systems of 50 volts to 1000 volts shall be grounded under any of the following conditions, unless exempted by paragraph (f)(1)(v) of this section:

(A) If the system can be so grounded that the maximum voltage to ground on the ungrounded conductors does not exceed 150 volts;

(B) If the system is nominally rated 480Y/277 volt, 3-phase, 4-wire in which the neutral is used as a circuit conductor;

(C) If the system is nominally rated 240/120 volt, 3-phase, 4-wire in which the midpoint of one phase is used as a circuit conductor; or

(D) If a service conductor is uninsulated.

(v) *Exceptions.* AC systems of 50 volts to 1000 volts are not required to be grounded if the system is separately derived and is supplied by a transformer that has a primary voltage rating less than 1000 volts, provided all of the following conditions are met:

(A) The system is used exclusively for control circuits,

(B) The conditions of maintenance and supervision assure that only qualified persons will service the installation,

(C) Continuity of control power is required, and

(D) Ground detectors are installed on the control system.

(2) *Separately derived systems.* Where paragraph (f)(1) of this section requires grounding of wiring systems whose power is derived from generator, transformer, or converter windings and has no direct electrical connection, including a solidly connected grounded circuit conductor, to supply conductors originating in another system, paragraph (f)(5) of this section shall also apply.

(3) *Portable and vehicle-mounted generators*—(i) *Portable generators.* Under the following conditions, the frame of a portable generator need not be grounded and may serve as the grounding electrode for a system supplied by the generator:

(A) The generator supplies only equipment mounted on the generator and/or cord- and plug-connected equipment through receptacles mounted on the generator, and

(B) The noncurrent-carrying metal parts of equipment and the equipment grounding conductor terminals of the receptacles are bonded to the generator frame.

(ii) *Vehicle-mounted generators.* Under the following conditions the frame of a vehicle may serve as the grounding electrode for a system

supplied by a generator located on the vehicle:

(A) The frame of the generator is bonded to the vehicle frame, and

(B) The generator supplies only equipment located on the vehicle and/or cord- and plug-connected equipment through receptacles mounted on the vehicle or on the generator, and

(C) The noncurrent-carrying metal parts of equipment and the equipment grounding conductor terminals of the receptacles are bonded to the generator frame, and

(D) The system complies with all other provisions of this section.

(iii) *Neutral conductor bonding.* A neutral conductor shall be bonded to the generator frame if the generator is a component of a separately derived system. No other conductor need be bonded to the generator frame.

(4) *Conductors to be grounded.* For AC premises wiring systems the identified conductor shall be grounded.

(5) *Grounding connections*—(i) *Grounded system.* For a grounded system, a grounding electrode conductor shall be used to connect both the equipment grounding conductor and the grounded circuit conductor to the grounding electrode. Both the equipment grounding conductor and the grounding electrode conductor shall be connected to the grounded circuit conductor on the supply side of the service disconnecting means, or on the supply side of the system disconnecting means or overcurrent devices if the system is separately derived.

(ii) *Ungrounded systems.* For an ungrounded service-supplied system, the equipment grounding conductor shall be connected to the grounding electrode conductor at the service equipment. For an ungrounded separately derived system, the equipment grounding conductor shall be connected to the grounding electrode conductor at, or ahead of, the system disconnecting means or overcurrent devices.

(6) *Grounding path.* The path to ground from circuits, equipment, and enclosures shall be permanent and continuous.

(7) *Supports, enclosures, and equipment to be grounded*—(i) *Supports and enclosures for conductors.* Metal cable trays, metal raceways, and metal enclosures for conductors shall be grounded, except that:

(A) Metal enclosures such as sleeves that are used to protect cable assemblies from physical damage need not be grounded; and

(B) Metal enclosures for conductors added to existing installations of open wire, knob-and-tube wiring, and nonmetallic-sheathed cable need not be grounded if all of the following conditions are met:

(*1*) Runs are less than 25 feet (7.62 m);

(*2*) Enclosures are free from probable contact with ground, grounded metal, metal laths, or other conductive materials; and

(*3*) Enclosures are guarded against employee contact.

(ii) *Service equipment enclosures.* Metal enclosures for service equipment shall be grounded.

(iii) *Fixed equipment.* Exposed noncurrent-carrying metal parts of fixed equipment which may become energized shall be grounded under any of the following conditions:

(A) If within 8 feet (2.44 m) vertically or 5 feet (1.52 m) horizontally of ground or grounded metal objects and subject to employee contact.

(B) If located in a wet or damp location and subject to employee contact.

(C) If in electrical contact with metal.

(D) If in a hazardous (classified) location.

(E) If supplied by a metal-clad, metal-sheathed, or grounded metal raceway wiring method.

(F) If equipment operates with any terminal at over 150 volts to ground; however, the following need not be grounded:

(*1*) Enclosures for switches or circuit breakers used for other than service equipment and accessible to qualified persons only;

(*2*) Metal frames of electrically heated appliances which are permanently and effectively insulated from ground; and

(*3*) The cases of distribution apparatus such as transformers and capacitors mounted on wooden poles at a height exceeding 8 feet (2.44 m) above ground or grade level.

(iv) *Equipment connected by cord and plug.* Under any of the conditions described in paragraphs (f)(7)(iv)(A) through (f)(7)(iv)(C) of this section, exposed noncurrent-carrying metal parts of cord- and plug-connected equipment which may become energized shall be grounded:

(A) If in a hazardous (classified) location (see § 1926.407).

(B) If operated at over 150 volts to ground, except for guarded motors and metal frames of electrically heated appliances if the appliance frames are permanently and effectively insulated from ground.

(C) If the equipment is one of the types listed in paragraphs (f)(7)(iv)(C)(*1*) through (f)(7)(iv)(C)(*5*) of this section. However, even though the equipment may be one of these types, it need not be grounded if it is exempted by paragraph (f)(7)(iv)(C)(*6*).

(*1*) Hand held motor-operated tools;

(*2*) Cord- and plug-connected equipment used in damp or wet locations or by employees standing on the ground or on metal floors or working inside of metal tanks or boilers;

(*3*) Portable and mobile X-ray and associated equipment;

(*4*) Tools likely to be used in wet and/or conductive locations; and

(*5*) Portable hand lamps.

(*6*) Tools likely to be used in wet and/or conductive locations need not be grounded if supplied through an isolating transformer with an ungrounded secondary of not over 50 volts. Listed or labeled portable tools and appliances protected by a system of double insulation, or its equivalent, need not be grounded. If such a system is employed, the equipment shall be distinctively marked to indicate that the tool or appliance utilizes a system of double insulation.

(v) *Nonelectrical equipment.* The metal parts of the following nonelectrical equipment shall be grounded: Frames and tracks of electrically operated cranes; frames of nonelectrically driven elevator cars to which electric conductors are attached; hand-operated metal shifting ropes or cables of electric elevators, and metal partitions, grill work, and similar metal enclosures around equipment of over 1kV between conductors.

(8) *Methods of grounding equipment*—(i) *With circuit conductors.* Noncurrent-carrying metal parts of fixed equipment, if required to be grounded by this subpart, shall be grounded by an equipment grounding conductor which is contained within the same raceway, cable, or cord, or runs with or encloses the circuit conductors. For DC circuits only, the equipment grounding conductor may be run separately from the circuit conductors.

(ii) *Grounding conductor.* A conductor used for grounding fixed or movable equipment shall have capacity to conduct safely any fault current which may be imposed on it.

(iii) *Equipment considered effectively grounded.* Electric equipment is considered to be effectively grounded if it is secured to, and in electrical contact with, a metal rack or structure that is provided for its support and the metal rack or structure is grounded by the method specified for the noncurrent-carrying metal parts of fixed equipment in paragraph (f)(8)(i) of this section. Metal car frames supported by metal hoisting cables attached to or running over metal sheaves or drums of grounded elevator machines are also considered to be effectively grounded.

(9) *Bonding.* If bonding conductors are used to assure electrical continuity, they shall have the capacity to conduct any fault current which may be imposed.

(10) *Made electrodes.* If made electrodes are used, they shall be free from nonconductive coatings, such as paint or enamel; and, if practicable, they shall be embedded below permanent moisture level. A single electrode consisting of a rod, pipe or plate which has a resistance to ground greater than 25 ohms shall be augmented by one additional electrode installed no closer than 6 feet (1.83 m) to the first electrode.

(11) *Grounding of systems and circuits of 1000 volts and over (high voltage)*—(i) *General.* If high voltage systems are grounded, they shall comply with all applicable provisions of paragraphs (f)(1) through (f)(10) of this section as supplemented and modified by this paragraph (f)(11).

(ii) *Grounding of systems supplying portable or mobile equipment.* Systems supplying portable or mobile high voltage equipment, other than substations installed on a temporary basis, shall comply with the following:

(A) Portable and mobile high voltage equipment shall be supplied from a system having its neutral grounded through an impedance. If a delta-connected high voltage system is used to supply the equipment, a system neutral shall be derived.

(B) Exposed noncurrent-carrying metal parts of portable and mobile equipment shall be connected by an equipment grounding conductor to the point at which the system neutral impedance is grounded.

(C) Ground-fault detection and relaying shall be provided to automatically de-energize any high voltage system component which has developed a ground fault. The continuity of the equipment grounding conductor shall be continuously monitored so as to de-energize automatically the high voltage feeder to the portable equipment upon loss of continuity of the equipment grounding conductor.

(D) The grounding electrode to which the portable or mobile equipment system neutral impedance is connected shall be isolated from and separated in the ground by at least 20 feet (6.1 m) from any other system or equipment grounding electrode, and there shall be no direct connection between the grounding electrodes, such as buried pipe, fence or like objects.

(iii) *Grounding of equipment.* All noncurrent-carrying metal parts of portable equipment and fixed equipment including their associated fences, housings, enclosures, and supporting structures shall be grounded. However, equipment which is guarded by location and isolated from ground need not be grounded. Additionally, pole-mounted distribution apparatus at a height exceeding 8 feet (2.44 m) above ground or grade level need not be grounded.

(Information collection requirements contained in paragraphs (b)(1)(iii)(A) and (b)(1)(iii)(G) were approved by the Office of Management and Budget under control number 1218-0062; information collection requirements contained in paragraph (f)(7)(iv)(C)(6) were approved by the Office of Management and Budget under control number: 1218-0130)

§ 1926.405 Wiring methods, components, and equipment for general use.

(a) *Wiring methods.* The provisions of this paragraph do not apply to conductors which form an integral part of equipment such as motors, controllers, motor control centers and like equipment.

(1) *General requirements*—(i) *Electrical continuity of metal raceways and enclosures.* Metal raceways, cable armor, and other metal enclosures for conductors shall be metallically joined together into a continuous electric conductor and shall be so connected to all boxes, fittings, and cabinets as to provide effective electrical continuity.

(ii) *Wiring in ducts.* No wiring systems of any type shall be installed in ducts used to transport dust, loose stock or flammable vapors. No wiring system of any type shall be installed in any duct used for vapor removal or in any shaft containing only such ducts.

(2) *Temporary wiring*—(i) *Scope.* The provisions of paragraph (a)(2) of this section apply to temporary electrical power and lighting wiring methods which may be of a class less than would be required for a permanent installation. Except as specifically modified in paragraph (a)(2) of this section, all other requirements of this subpart for permanent wiring shall apply to temporary wiring installations. Temporary wiring shall be removed immediately upon completion of construction or the purpose for which the wiring was installed.

(ii) *General requirements for temporary wiring.*—(A) Feeders shall originate in a distribution center. The conductors shall be run as multiconductor cord or cable assemblies or within raceways; or, where not subject to physical damage, they may be run as open conductors on insulators not more than 10 feet (3.05 m) apart.

(B) Branch circuits shall originate in a power outlet or panelboard. Conductors shall be run as multiconductor cord or cable assemblies or open conductors, or shall be run in raceways. All conductors shall be protected by overcurrent devices at their ampacity. Runs of open conductors shall be located where the conductors will not be subject to physical damage, and the conductors shall be fastened at intervals not exceeding 10 feet (3.05 m). No branch-circuit conductors shall be laid on the floor. Each branch circuit that supplies receptacles or fixed equipment shall contain a separate equipment grounding conductor if the branch circuit is run as open conductors.

(C) Receptacles shall be of the grounding type. Unless installed in a complete metallic raceway, each branch circuit shall contain a separate equipment grounding conductor, and all receptacles shall be electrically connected to the grounding conductor. Receptacles for uses other than temporary lighting shall not be installed on branch circuits which supply temporary lighting. Receptacles shall not be connected to the same ungrounded conductor of multiwire circuits which supply temporary lighting.

(D) Disconnecting switches or plug connectors shall be installed to permit the disconnection of all ungrounded conductors of each temporary circuit.

(E) All lamps for general illumination shall be protected from accidental contact or breakage. Metal-case sockets shall be grounded.

(F) Temporary lights shall not be suspended by their electric cords unless cords and lights are designed for this means of suspension.

(G) Portable electric lighting used in wet and/or other conductive locations, as for example, drums, tanks, and vessels, shall be operated at 12 volts or less. However, 120-volt lights may be used if protected by a ground-fault circuit interrupter.

(H) A box shall be used wherever a change is made to a raceway system or a cable system which is metal clad or metal sheathed.

(I) Flexible cords and cables shall be protected from damage. Sharp corners and projections shall be avoided. Flexible cords and cables may pass through doorways or other pinch points, if protection is provided to avoid damage.

(J) Extension cord sets used with portable electric tools and appliances shall be of three-wire type and shall be designed for hard or extra-hard usage. Flexible cords used with temporary and portable lights shall be designed for hard or extra-hard usage.

Note.—The National Electrical Code, ANSI/NFPA 70, in Article 400, Table 400–4, lists various types of flexible cords, some of which are noted as being designed for hard or

extra-hard usage. Examples of these types of flexible cords include hard service cord (types S, ST, SO, STO) and junior hard service cord (types SJ, SJO, SJT, SJTO).

(iii) *Guarding.* For temporary wiring over 600 volts, nominal, fencing, barriers, or other effective means shall be provided to prevent access of other than authorized and qualified personnel.

(b) *Cabinets, boxes, and fittings.* (1) *Conductors entering boxes, cabinets, or fittings.* Conductors entering boxes, cabinets, or fittings shall be protected from abrasion, and openings through which conductors enter shall be effectively closed. Unused openings in cabinets, boxes, and fittings shall also be effectively closed.

(2) *Covers and canopies.* All pull boxes, junction boxes, and fittings shall be provided with covers. If metal covers are used, they shall be grounded. In energized installations each outlet box shall have a cover, faceplate, or fixture canopy. Covers of outlet boxes having holes through which flexible cord pendants pass shall be provided with bushings designed for the purpose or shall have smooth, well-rounded surfaces on which the cords may bear.

(3) *Pull and junction boxes for systems over 600 volts, nominal.* In addition to other requirements in this section for pull and junction boxes, the following shall apply to these boxes for systems over 600 volts, nominal:

(i) *Complete enclosure.* Boxes shall provide a complete enclosure for the contained conductors or cables.

(ii) *Covers.* Boxes shall be closed by covers securely fastened in place. Underground box covers that weigh over 100 pounds (43.6 kg) meet this requirement. Covers for boxes shall be permanently marked "HIGH VOLTAGE." The marking shall be on the outside of the box cover and shall be readily visible and legible.

(c) *Knife switches.* Single-throw knife switches shall be so connected that the blades are dead when the switch is in the open position. Single-throw knife switches shall be so placed that gravity will not tend to close them. Single-throw knife switches approved for use in the inverted position shall be provided with a locking device that will ensure that the blades remain in the open position when so set. Double-throw knife switches may be mounted so that the throw will be either vertical or horizontal. However, if the throw is vertical, a locking device shall be provided to ensure that the blades remain in the open position when so set.

(d) *Switchboards and panelboards.* Switchboards that have any exposed live parts shall be located in permanently dry locations and accessible only to qualified persons. Panelboards shall be mounted in cabinets, cutout boxes, or enclosures designed for the purpose and shall be dead front. However, panelboards other than the dead front externally-operable type are permitted where accessible only to qualified persons. Exposed blades of knife switches shall be dead when open.

(e) *Enclosures for damp or wet locations* (1) *Cabinets, fittings, and boxes.* Cabinets, cutout boxes, fittings, boxes, and panelboard enclosures in damp or wet locations shall be installed so as to prevent moisture or water from entering and accumulating within the enclosures. In wet locations the enclosures shall be weatherproof.

(2) *Switches and circuit breakers.* Switches, circuit breakers, and switchboards installed in wet locations shall be enclosed in weatherproof enclosures.

(f) *Conductors for general wiring.* All conductors used for general wiring shall be insulated unless otherwise permitted in this Subpart. The conductor insulation shall be of a type that is suitable for the voltage, operating temperature, and location of use. Insulated conductors shall be distinguishable by appropriate color or other means as being grounded conductors, ungrounded conductors, or equipment grounding conductors.

(g) Flexible cords and cables.—(1) *Use of flexible cords and cables*—(i) *Permitted uses.* Flexible cords and cables shall be suitable for conditions of use and location. Flexible cords and cables shall be used only for:

(A) Pendants;

(B) Wiring of fixtures;

(C) Connection of portable lamps or appliances;

(D) Elevator cables;

(E) Wiring of cranes and hoists;

(F) Connection of stationary equipment to facilitate their frequent interchange;

(G) Prevention of the transmission of noise or vibration; or

(H) Appliances where the fastening means and mechanical connections are designed to permit removal for maintenance and repair.

(ii) *Attachment plugs for cords.* If used as permitted in paragraphs (g)(1)(i)(C), (g)(1)(i)(F), or (g)(1)(i)(H) of this section, the flexible cord shall be equipped with an attachment plug and shall be energized from a receptacle outlet.

(iii) *Prohibited uses.* Unless necessary for a use permitted in paragraph (g)(1)(i) of this section, flexible cords and cables shall not be used:

(A) As a substitute for the fixed wiring of a structure;

(B) Where run through holes in walls, ceilings, or floors;

(C) Where run through doorways, windows, or similar openings, except as permitted in paragraph (a)(2)(ii)(1) of this section;

(D) Where attached to building surfaces; or

(E) Where concealed behind building walls, ceilings, or floors.

(2) *Identification, splices, and terminations*—(i) *Identification.* A conductor of a flexible cord or cable that is used as a grounded conductor or an equipment grounding conductor shall be distinguishable from other conductors.

(ii) *Marking.* Type SJ, SJO, SJT, SJTO, S, SO, ST, and STO cords shall not be used unless durably marked on the surface with the type designation, size, and number of conductors.

(iii) *Splices.* Flexible cords shall be used only in continuous lengths without splice or tap. Hard service flexible cords No. 12 or larger may be repaired if spliced so that the splice retains the insulation, outer sheath properties, and usage characteristics of the cord being spliced.

(iv) *Strain relief.* Flexible cords shall be connected to devices and fittings so that strain relief is provided which will prevent pull from being directly transmitted to joints or terminal screws.

(v) *Cords passing through holes.* Flexible cords and cables shall be protected by bushings or fittings where passing through holes in covers, outlet boxes, or similar enclosures.

(h) *Portable cables over 600 volts, nominal.* Multiconductor portable cable for use in supplying power to portable or mobile equipment at over 600 volts, nominal, shall consist of No. 8 or larger conductors employing flexible stranding. Cables operated at over 2000 volts shall be shielded for the purpose of confining the voltage stresses to the insulation. Grounding conductors shall be provided. Connectors for these cables shall be of a locking type with provisions to prevent their opening or closing while energized. Strain relief shall be provided at connections and terminations. Portable cables shall not be operated with splices unless the splices are of the permanent molded, vulcanized, or other equivalent type. Termination enclosures shall be marked with a high voltage hazard warning, and terminations shall be accessible only to authorized and qualified personnel.

(i) *Fixture wires*—(1) *General.* Fixture wires shall be suitable for the voltage, temperature, and location of use. A fixture wire which is used as a grounded conductor shall be identified.

(2) *Uses permitted.* Fixture wires may be used:

(i) For installation in lighting, fixtures and in similar equipment where enclosed or protected and not subject to bending or twisting in use; or

(ii) For connecting lighting fixtures to the branch-circuit conductors supplying the fixtures.

(3) *Uses not permitted.* Fixture wires shall not be used as branch-circuit conductors except as permitted for Class 1 power-limited circuits.

(j) *Equipment for general use*—(1) *Lighting fixtures, lampholders, lamps, and receptacles*—(i) *Live parts.* Fixtures, lampholders, lamps, rosettes, and receptacles shall have no live parts normally exposed to employee contact. However, rosettes and cleat-type lampholders and receptacles located at least 8 feet (2.44 m) above the floor may have exposed parts.

(ii) *Support.* Fixtures, lampholders, rosettes, and receptacles shall be securely supported. A fixture that weighs more than 6 pounds (2.72 kg) or exceeds 16 inches (406 mm) in any dimension shall not be supported by the screw shell of a lampholder.

(iii) *Portable lamps.* Portable lamps shall be wired with flexible cord and an attachment plug of the polarized or grounding type. If the portable lamp uses an Edison-based lampholder, the grounded conductor shall be identified and attached to the screw shell and the identified blade of the attachment plug. In addition, portable handlamps shall comply with the following:

(A) Metal shell, paperlined lampholders shall not be used;

(B) Handlamps shall be equipped with a handle of molded composition or other insulating material;

(C) Handlamps shall be equipped with a substantial guard attached to the lampholder or handle;

(D) Metallic guards shall be grounded by the means of an equipment grounding conductor run within the power supply cord.

(iv) *Lampholders.* Lampholders of the screw-shell type shall be installed for use as lampholders only. Lampholders installed in wet or damp locations shall be of the weatherproof type.

(v) *Fixtures.* Fixtures installed in wet or damp locations shall be identified for the purpose and shall be installed so that water cannot enter or accumulate in wireways, lampholders, or other electrical parts.

(2) *Receptacles, cord connectors, and attachment plugs (caps)*—(i) *Configuration.* Receptacles, cord connectors, and attachment plugs shall be constructed so that no receptacle or cord connector will accept an attachment plug with a different voltage or current rating than that for which the device is intended. However, a 20-ampere T-slot receptacle or cord connector may accept a 15-ampere attachment plug of the same voltage rating. Receptacles connected to circuits having different voltages, frequencies, or types of current (ac or dc) on the same premises shall be of such design that the attachment plugs used on these circuits are not interchangeable.

(ii) *Damp and wet locations.* A receptacle installed in a wet or damp location shall be designed for the location.

(3) *Appliances*—(i) *Live parts.* Appliances, other than those in which the current-carrying parts at high temperatures are necessarily exposed, shall have no live parts normally exposed to employee contact.

(ii) *Disconnecting means.* A means shall be provided to disconnect each appliance.

(iii) *Rating.* Each appliance shall be marked with its rating in volts and amperes or volts and watts.

(4) *Motors.* This paragraph applies to motors, motor circuits, and controllers.

(i) *In sight from.* If specified that one piece of equipment shall be "in sight from" another piece of equipment, one shall be visible and not more than 50 feet (15.2 m) from the other.

(ii) *Disconnecting means*—(A) A disconnecting means shall be located in sight from the controller location. The controller disconnecting means for motor branch circuits over 600 volts, nominal, may be out of sight of the controller, if the controller is marked with a warning label giving the location and identification of the disconnecting means which is to be locked in the open position.

(B) The disconnecting means shall disconnect the motor and the controller from all ungrounded supply conductors and shall be so designed that no pole can be operated independently.

(C) If a motor and the driven machinery are not in sight from the controller location, the installation shall comply with one of the following conditions:

(*1*) The controller disconnecting means shall be capable of being locked in the open position.

(*2*) A manually operable switch that will disconnect the motor from its source of supply shall be placed in sight from the motor location.

(D) The disconnecting means shall plainly indicate whether it is in the open (off) or closed (on) position.

(E) The disconnecting means shall be readily accessible. If more than one disconnect is provided for the same equipment, only one need be readily accessible.

(F) An individual disconnecting means shall be provided for each motor, but a single disconnecting means may be used for a group of motors under any one of the following conditions:

(*1*) If a number of motors drive special parts of a single machine or piece of apparatus, such as a metal or woodworking machine, crane, or hoist;

(*2*) If a group of motors is under the protection of one set of branch-circuit protective devices; or

(*3*) If a group of motors is in a single room in sight from the location of the disconnecting means.

(iii) *Motor overload, short-circuit, and ground-fault protection.* Motors, motor-control apparatus, and motor branch-circuit conductors shall be protected against overheating due to motor overloads or failure to start, and against short-circuits or ground faults. These provisions do not require overload protection that will stop a motor where a shutdown is likely to introduce additional or increased hazards, as in the case of fire pumps, or where continued operation of a motor is necessary for a safe shutdown of equipment or process and motor overload sensing devices are connected to a supervised alarm.

(iv) *Protection of live parts—all voltages*—(A) Stationary motors having commutators, collectors, and brush rigging located inside of motor end brackets and not conductively connected to supply circuits operating at more than 150 volts to ground need not have such parts guarded. Exposed live parts of motors and controllers operating at 50 volts or more between terminals shall be guarded against accidental contact by any of the following:

(*1*) By installation in a room or enclosure that is accessible only to qualified persons;

(*2*) By installation on a balcony, gallery, or platform, so elevated and arranged as to exclude unqualified persons; or

(*3*) By elevation 8 feet (2.44 m) or more above the floor.

(B) Where live parts of motors or controllers operating at over 150 volts to ground are guarded against accidental contact only by location, and where adjustment or other attendance may be necessary during the operation of the apparatus, insulating mats or platforms shall be provided so that the attendant cannot readily touch live parts unless standing on the mats or platforms.

(5) *Transformers*—(i) *Application.* The following paragraphs cover the installation of all transformers, except:

(A) Current transformers;

(B) Dry-type transformers installed as a component part of other apparatus;

(C) Transformers which are an integral part of an X-ray, high frequency, or electrostatic-coating apparatus;

(D) Transformers used with Class 2 and Class 3 circuits, sign and outline lighting, electric discharge lighting, and power-limited fire-protective signaling circuits.

(ii) *Operating voltage.* The operating voltage of exposed live parts of transformer installations shall be indicated by warning signs or visible markings on the equipment or structure.

(iii) *Transformers over 35 kV.* Dry-type, high fire point liquid-insulated, and askarel-insulated transformers installed indoors and rated over 35 kV shall be in a vault.

(iv) *Oil-insulated transformers.* If they present a fire hazard to employees, oil-insulated transformers installed indoors shall be in a vault.

(v) *Fire protection.* Combustible material, combustible buildings and parts of buildings, fire escapes, and door and window openings shall be safeguarded from fires which may originate in oil-insulated transformers attached to or adjacent to a building or combustible material.

(vi) *Transformer vaults.* Transformer vaults shall be constructed so as to contain fire and combustible liquids within the vault and to prevent unauthorized access. Locks and latches shall be so arranged that a vault door can be readily opened from the inside.

(vii) *Pipes and ducts.* Any pipe or duct system foreign to the vault installation shall not enter or pass through a transformer vault.

(viii) *Material storage.* Materials shall not be stored in transformer vaults.

(6) *Capacitors*—(i) *Drainage of stored charge.* All capacitors, except surge capacitors or capacitors included as a component part of other apparatus, shall be provided with an automatic means of draining the stored charge and maintaining the discharged state after the capacitor is disconnected from its source of supply.

(ii) *Over 600 volts.* Capacitors rated over 600 volts, nominal, shall comply with the following additional requirements:

(A) Isolating or disconnecting switches (with no interrupting rating) shall be interlocked with the load interrupting device or shall be provided with prominently displayed caution signs to prevent switching load current.

(B) For series capacitors the proper switching shall be assured by use of at least one of the following:

(*1*) Mechanically sequenced isolating and bypass switches,

(*2*) Interlocks, or

(*3*) Switching procedure prominently displayed at the switching location.

(Information collection requirements contained in paragraphs (g)(2)(ii), (j)(3)(iii), (j)(4)(ii)(A), (j)(5)(ii), and (j)(6)(ii)(B)(*3*) were approved by the Office of Management and Budget under control number 1218–0130)

§ 1926.406 Specific purpose equipment and installations.

(a) *Cranes and hoists.* This paragraph applies to the installation of electric equipment and wiring used in connection with cranes, monorail hoists, hoists, and all runways.

(1) *Disconnecting means*—(i) *Runway conductor disconnecting means.* A readily accessible disconnecting means shall be provided between the runway contact conductors and the power supply.

(ii) *Disconnecting means for cranes and monorail hoists.* A disconnecting means, capable of being locked in the open position, shall be provided in the leads from the runway contact conductors or other power supply on any crane or monorail hoist.

(A) If this additional disconnecting means is not readily accessible from the crane or monorail hoist operating station, means shall be provided at the operating station to open the power circuit to all motors of the crane or monorail hoist.

(B) The additional disconnect may be omitted if a monorail hoist or hand-propelled crane bridge installation meets all of the following:

(*1*) The unit is floor controlled;

(*2*) The unit is within view of the power supply disconnecting means; and

(*3*) No fixed work platform has been provided for servicing the unit.

(2) *Control.* A limit switch or other device shall be provided to prevent the load block from passing the safe upper limit of travel of any hoisting mechanism.

(3) *Clearance.* The dimension of the working space in the direction of access to live parts which may require examination, adjustment, servicing, or maintenance while alive shall be a minimum of 2 feet 6 inches (762 mm). Where controls are enclosed in cabinets, the door(s) shall open at least 90 degrees or be removable, or the installation shall provide equivalent access.

(4) *Grounding.* All exposed metal parts of cranes, monorail hoists, hoists and accessories including pendant controls shall be metallically joined together into a continuous electrical conductor so that the entire crane or hoist will be grounded in accordance with § 1926.404(f). Moving parts, other than removable accessories or attachments, having metal-to-metal bearing surfaces shall be considered to be electrically connected to each other through the bearing surfaces for grounding purposes. The trolley frame and bridge frame shall be considered as electrically grounded through the bridge and trolley wheels and its respective tracks unless conditions such as paint or other insulating materials prevent reliable metal-to-metal contact. In this case a separate bonding conductor shall be provided.

(b) *Elevators, escalators, and moving walks*—(1) *Disconnecting means.* Elevators, escalators, and moving walks shall have a single means for disconnecting all ungrounded main power supply conductors for each unit.

(2) *Control panels.* If control panels are not located in the same space as the drive machine, they shall be located in cabinets with doors or panels capable of being locked closed.

(c) *Electric welders—disconnecting means*—(1) *Motor-generator, AC transformer, and DC rectifier arc welders.* A disconnecting means shall be provided in the supply circuit for each motor-generator arc welder, and for each AC transformer and DC rectifier arc welder which is not equipped with a disconnect mounted as an integral part of the welder.

(2) *Resistance welders.* A switch or circuit breaker shall be provided by which each resistance welder and its control equipment can be isolated from the supply circuit. The ampere rating of this disconnecting means shall not be less than the supply conductor ampacity.

(d) *X-Ray equipment*—(1) *Disconnecting means*—(i) *General.* A disconnecting means shall be provided in the supply circuit. The disconnecting means shall be operable from a location readily accessible from the X-ray control. For equipment connected to a 120-volt branch circuit of 30 amperes or less, a grounding-type attachment plug cap and receptacle of proper rating may serve as a disconnecting means.

(ii) *More than one piece of equipment.* If more than one piece of equipment is operated from the same high-voltage circuit, each piece or each group of equipment as a unit shall be provided with a high-voltage switch or equivalent disconnecting means. This disconnecting means shall be constructed, enclosed, or located so as

to avoid contact by employees with its live parts.

(2) *Control—Radiographic and fluoroscopic types.* Radiographic and fluoroscopic-type equipment shall be effectively enclosed or shall have interlocks that deenergize the equipment automatically to prevent ready access to live current-carrying parts.

§ 1926.407 Hazardous (classified) locations.

(a) *Scope.* This section sets forth requirements for electric equipment and wiring in locations which are classified depending on the properties of the flammable vapors, liquids or gases, or combustible dusts or fibers which may be present therein and the likelihood that a flammable or combustible concentration or quantity is present. Each room, section or area shall be considered individually in determining its classification. These hazardous (classified) locations are assigned six designations as follows:

Class I, Division 1
Class I, Division 2
Class II, Division 1
Class II, Division 2
Class III, Division 1
Class III, Division 2

For definitions of these locations see § 1926.449. All applicable requirements in this subpart apply to all hazardous (classified) locations, unless modified by provisions of this section.

(b) *Electrical installations.* Equipment, wiring methods, and installations of equipment in hazardous (classified) locations shall be approved as intrinsically safe or approved for the hazardous (classified) location or safe for the hazardous (classified) location. Requirements for each of these options are as follows:

(1) *Intrinsically safe.* Equipment and associated wiring approved as intrinsically safe is permitted in any hazardous (classified) location included in its listing or labeling.

(2) *Approved for the hazardous (classified) location*—(i) *General.* Equipment shall be approved not only for the class of location but also for the ignitible or combustible properties of the specific gas, vapor, dust, or fiber that will be present.

Note.—NFPA 70, the National Electrical Code, lists or defines hazardous gases, vapors, and dusts by "Groups" characterized by their ignitible or combustible properties.

(ii) *Marking.* Equipment shall not be used unless it is marked to show the class, group, and operating temperature or temperature range, based on operation in a 40-degree C ambient, for which it is approved. The temperature marking shall not exceed the ignition temperature of the specific gas, vapor, or dust to be encountered. However, the following provisions modify this marking requirement for specific equipment:

(A) Equipment of the non-heat-producing type (such as junction boxes, conduit, and fitting) and equipment of the heat-producing type having a maximum temperature of not more than 100 degrees C (212 degrees F) need not have a marked operating temperature or temperature range.

(B) Fixed lighting fixtures marked for use only in Class I, Division 2 locations need not be marked to indicate the group.

(C) Fixed general-purpose equipment in Class I locations, other than lighting fixtures, which is acceptable for use in Class I, Division 2 locations need not be marked with the class, group, division, or operating temperature.

(D) Fixed dust-tight equipment, other than lighting fixtures, which is acceptable for use in Class II, Division 2 and Class III locations need not be marked with the class, group, division, or operating temperature.

(3) *Safe for the hazardous (classified) location.* Equipment which is safe for the location shall be of a type and design which the employer demonstrates will provide protection from the hazards arising from the combustibility and flammability of vapors, liquids, gases, dusts, or fibers.

Note.—The National Electrical Code, NFPA 70, contains guidelines for determining the type and design of equipment and installations which will meet this requirement. The guidelines of this document address electric wiring, equipment, and systems installed in hazardous (classified) locations and contain specific provisions for the following: wiring methods, wiring connections, conductor insulation, flexible cords, sealing and drainage, transformers, capacitors, switches, circuit breakers, fuses, motor controllers, receptacles, attachment plugs, meters, relays, instruments, resistors, generators, motors, lighting fixtures, storage battery charging equipment, electric cranes, electric hoists and similar equipment, utilization equipment, signaling systems, alarm systems, remote control systems, local loud speaker and communication systems, ventilation piping, live parts, lightning surge protection, and grounding. Compliance with these guidelines will constitute one means, but not the only means, of compliance with this paragraph.

(c) *Conduits.* All conduits shall be threaded and shall be made wrench-tight. Where it is impractical to make a threaded joint tight, a bonding jumper shall be utilized.

(Information collection requirements contained in paragraph (b)(2)(ii) were approved by the Office of Management and Budget under control number 1218-0130)

§ 1926.408 Special systems.

(a) *Systems over 600 volts, nominal.* Paragraphs (a)(1) through (a)(4) of this section contain general requirements for all circuits and equipment operated at over 600 volts.

(1) *Wiring methods for fixed installations*—(i) *Above ground.* Above-ground conductors shall be installed in rigid metal conduit, in intermediate metal conduit, in cable trays, in cablebus, in other suitable raceways, or as open runs of metal-clad cable designed for the use and purpose. However, open runs of non-metallic-sheathed cable or of bare conductors or busbars may be installed in locations which are accessible only to qualified persons. Metallic shielding components, such as tapes, wires, or braids for conductors, shall be grounded. Open runs of insulated wires and cables having a bare lead sheath or a braided outer covering shall be supported in a manner designed to prevent physical damage to the braid or sheath.

(ii) *Installations emerging from the ground.* Conductors emerging from the ground shall be enclosed in raceways. Raceways installed on poles shall be of rigid metal conduit, intermediate metal conduit, PVC schedule 80 or equivalent extending from the ground line up to a point 8 feet (2.44 m) above finished grade. Conductors entering a building shall be protected by an enclosure from the ground line to the point of entrance. Metallic enclosures shall be grounded.

(2) *Interrupting and isolating devices*—(i) *Circuit breakers.* Circuit breakers located indoors shall consist of metal-enclosed or fire-resistant, cell-mounted units. In locations accessible only to qualified personnel, open mounting of circuit breakers is permitted. A means of indicating the open and closed position of circuit breakers shall be provided.

(ii) *Fused cutouts.* Fused cutouts installed in buildings or transformer vaults shall be of a type identified for the purpose. They shall be readily accessible for fuse replacement.

(iii) *Equipment isolating means.* A means shall be provided to completely isolate equipment for inspection and repairs. Isolating means which are not designed to interrupt the load current of the circuit shall be either interlocked with a circuit interrupter or provided with a sign warning against opening them under load.

(3) *Mobile and portable equipment*—(i) *Power cable connections to mobile machines.* A metallic enclosure shall be

provided on the mobile machine for enclosing the terminals of the power cable. The enclosure shall include provisions for a solid connection for the ground wire(s) terminal to ground effectively the machine frame. The method of cable termination used shall prevent any strain or pull on the cable from stressing the electrical connections. The enclosure shall have provision for locking so only authorized qualified persons may open it and shall be marked with a sign warning of the presence of energized parts.

(ii) *Guarding live parts.* All energized switching and control parts shall be enclosed in effectively grounded metal cabinets or enclosures. Circuit breakers and protective equipment shall have the operating means projecting through the metal cabinet or enclosure so these units can be reset without locked doors being opened. Enclosures and metal cabinets shall be locked so that only authorized qualified persons have access and shall be marked with a sign warning of the presence of energized parts. Collector ring assemblies on revolving-type machines (shovels, draglines, etc.) shall be guarded.

(4) *Tunnel installations*—(i) *Application.* The provisions of this paragraph apply to installation and use of high-voltage power distribution and utilization equipment which is associated with tunnels and which is portable and/or mobile, such as substations, trailers, cars, mobile shovels, draglines, hoists, drills, dredges, compressors, pumps, conveyors, and underground excavators.

(ii) *Conductors.* Conductors in tunnels shall be installed in one or more of the following:

(A) Metal conduit or other metal raceway,

(B) Type MC cable, or

(C) Other suitable multiconductor cable.

Conductors shall also be so located or guarded as to protect them from physical damage. Multiconductor portable cable may supply mobile equipment. An equipment grounding conductor shall be run with circuit conductors inside the metal raceway or inside the multiconductor cable jacket. The equipment grounding conductor may be insulated or bare.

(iii) *Guarding live parts.* Bare terminals of transformers, switches, motor controllers, and other equipment shall be enclosed to prevent accidental contact with energized parts. Enclosures for use in tunnels shall be drip-proof, weatherproof, or submersible as required by the environmental conditions.

(iv) *Disconnecting means.* A disconnecting means that simultaneously opens all ungrounded conductors shall be installed at each transformer or motor location.

(v) *Grounding and bonding.* All nonenergized metal parts of electric equipment and metal raceways and cable sheaths shall be grounded and bonded to all metal pipes and rails at the portal and at intervals not exceeding 1000 feet (305 m) throughout the tunnel.

(b) *Class 1, Class 2, and Class 3 remote control, signaling, and power-limited circuits*— (1) *Classification.* Class 1, Class 2, or Class 3 remote control, signaling, or power-limited circuits are characterized by their usage and electrical power limitation which differentiates them from light and power circuits. These circuits are classified in accordance with their respective voltage and power limitations as summarized in paragraphs (b)(1)(i) through (b)(1)(iii) of this section.

(i) *Class 1 circuits*—(A) A Class 1 power-limited circuit is supplied from a source having a rated output of not more than 30 volts and 1000 volt-amperes.

(B) A Class 1 remote control circuit or a Class 1 signaling circuit has a voltage which does not exceed 600 volts; however, the power output of the source need not be limited.

(ii) *Class 2 and Class 3 circuits*—(A) Power for Class 2 and Class 3 circuits is limited either inherently (in which no overcurrent protection is required) or by a combination of a power source and overcurrent protection.

(B) The maximum circuit voltage is 150 volts AC or DC for a Class 2 inherently limited power source, and 100 volts AC or DC for a Class 3 inherently limited power source.

(C) The maximum circuit voltage is 30 volts AC and 60 volts DC for a Class 2 power source limited by overcurrent protection, and 150 volts AC or DC for a Class 3 power source limited by overcurrent protection.

(iii) *Application.* The maximum circuit voltages in paragraphs (b)(1)(i) and (b)(1)(ii) of this section apply to sinusoidal AC or continuous DC power sources, and where wet contact occurrence is not likely.

(2) *Marking.* A Class 2 or Class 3 power supply unit shall not be used unless it is durably marked where plainly visible to indicate the class of supply and its electrical rating.

(c) *Communications systems*—(1) *Scope.* These provisions for communication systems apply to such systems as central-station-connected and non-central-station-connected telephone circuits, radio receiving and transmitting equipment, and outside wiring for fire and burglar alarm, and similar central station systems. These installations need not comply with the provisions of §§ 1926.403 through 1926.408(b), except § 1926.404(c)(1)(ii) and § 1926.407.

(2) *Protective devices*— (i) *Circuits exposed to power conductors.* Communication circuits so located as to be exposed to accidental contact with light or power conductors operating at over 300 volts shall have each circuit so exposed provided with an approved protector.

(ii) *Antenna lead-ins.* Each conductor of a lead-in from an outdoor antenna shall be provided with an antenna discharge unit or other means that will drain static charges from the antenna system.

(3) *Conductor location*—(i) *Outside of buildings.*—(A) Receiving distribution lead-in or aerial-drop cables attached to buildings and lead-in conductors to radio transmitters shall be so installed as to avoid the possibility of accidental contact with electric light or power conductors.

(B) The clearance between lead-in conductors and any lightning protection conductors shall not be less than 6 feet (1.83 m).

(ii) *On poles.* Where practicable, communication conductors on poles shall be located below the light or power conductors. Communications conductors shall not be attached to a crossarm that carries light or power conductors.

(iii) *Inside of buildings.* Indoor antennas, lead-ins, and other communication conductors attached as open conductors to the inside of buildings shall be located at least 2 inches (50.8 mm) from conductors of any light or power or Class 1 circuits unless a special and equally protective method of conductor separation is employed.

(4) *Equipment location.* Outdoor metal structures supporting antennas, as well as self-supporting antennas such as vertical rods or dipole structures, shall be located as far away from overhead conductors of electric light and power circuits of over 150 volts to ground as necessary to avoid the possibility of the antenna or structure falling into or making accidental contact with such circuits.

(5) *Grounding*—(i) *Lead-in conductors.* If exposed to contact with electric light or power conductors, the metal sheath of aerial cables entering buildings shall be grounded or shall be interrupted close to the entrance to the building by an insulating joint or equivalent device. Where protective devices are used, they shall be grounded.

(ii) *Antenna structures.* Masts and metal structures supporting antennas shall be permanently and effectively grounded without splice or connection in the grounding conductor.

(iii) *Equipment enclosures.* Transmitters shall be enclosed in a metal frame or grill or separated from the operating space by a barrier, all metallic parts of which are effectively connected to ground. All external metal handles and controls accessible to the operating personnel shall be effectively grounded. Unpowered equipment and enclosures shall be considered grounded where connected to an attached coaxial cable with an effectively grounded metallic shield.

(Information collection requirements contained in paragraph (b)(2) were approved by the Office of Management and Budget under control number 1218-0130)

§§ 1926.409-1926.415 [Reserved]

Safety-Related Work Practices

§ 1926.416 General requirements.

(a) *Protection of employees*—(1) No employer shall permit an employee to work in such proximity to any part of an electric power circuit that the employee could contact the electric power circuit in the course of work, unless the employee is protected against electric shock by deenergizing the circuit and grounding it or by guarding it effectively by insulation or other means.

(2) In work areas where the exact location of underground electric powerlines is unknown, employees using jack-hammers, bars, or other hand tools which may contact a line shall be provided with insulated protective gloves.

(3) Before work is begun the employer shall ascertain by inquiry or direct observation, or by instruments, whether any part of an energized electric power circuit, exposed or concealed, is so located that the performance of the work may bring any person, tool, or machine into physical or electrical contact with the electric power circuit. The employer shall post and maintain proper warning signs where such a circuit exists. The employer shall advise employees of the location of such lines, the hazards involved, and the protective measures to be taken.

(b) *Passageways and open spaces*—(1) Barriers or other means of guarding shall be provided to ensure that workspace for electrical equipment will not be used as a passageway during periods when energized parts of electrical equipment are exposed.

(2) Working spaces, walkways, and similar locations shall be kept clear of cords so as not to create a hazard to employees.

(c) *Load ratings.* In existing installations, no changes in circuit protection shall be made to increase the load in excess of the load rating of the circuit wiring.

(d) *Fuses.* When fuses are installed or removed with one or both terminals energized, special tools insulated for the voltage shall be used.

(e) *Cords and cables.* (1) Worn or frayed electric cords or cables shall not be used.

(2) Extension cords shall not be fastened with staples, hung from nails, or suspended by wire.

§ 1926.417 Lockout and tagging of circuits.

(a) *Controls.* Controls that are to be deactivated during the course of work on energized or deenergized equipment or circuits shall be tagged.

(b) *Equipment and circuits.* Equipment or circuits that are deenergized shall be rendered inoperative and shall have tags attached at all points where such equipment or circuits can be energized.

(c) *Tags.* Tags shall be placed to identify plainly the equipment or circuits being worked on.

§§ 1926.418-1926.430. [Reserved]

Safety-Related Maintenance and Environmental Considerations

§ 1926.431 Maintenance of equipment.

The employer shall ensure that all wiring components and utilization equipment in hazardous locations are maintained in a dust-tight, dust-ignition-proof, or explosion-proof condition, as appropriate. There shall be no loose or missing screws, gaskets, threaded connections, seals, or other impairments to a tight condition.

§ 1926.432 Environmental deterioration of equipment.

(a) *Deteriorating agents*—(1) Unless identified for use in the operating environment, no conductors or equipment shall be located:

(i) In damp or wet locations;

(ii) Where exposed to gases, fumes, vapors, liquids, or other agents having a deteriorating effect on the conductors or equipment; or

(iii) Where exposed to excessive temperatures.

(2) Control equipment, utilization equipment, and busways approved for use in dry locations only shall be protected against damage from the weather during building construction.

(b) *Protection against corrosion.* Metal raceways, cable armor, boxes, cable sheathing, cabinets, elbows, couplings, fittings, supports, and support hardware shall be of materials appropriate for the environment in which they are to be installed.

§§ 1926.433-1926.440. [Reserved]

Safety Requirements for Special Equipment

§ 1926.441 Batteries and battery charging.

(a) *General requirements*—(1) Batteries of the unsealed type shall be located in enclosures with outside vents or in well ventilated rooms and shall be arranged so as to prevent the escape of fumes, gases, or electrolyte spray into other areas.

(2) Ventilation shall be provided to ensure diffusion of the gases from the battery and to prevent the accumulation of an explosive mixture.

(3) Racks and trays shall be substantial and shall be treated to make them resistant to the electrolyte.

(4) Floors shall be of acid resistant construction unless protected from acid accumulations.

(5) Face shields, aprons, and rubber gloves shall be provided for workers handling acids or batteries.

(6) Facilities for quick drenching of the eyes and body shall be provided within 25 feet (7.62 m) of battery handling areas.

(7) Facilities shall be provided for flushing and neutralizing spilled electrolyte and for fire protection.

(b) *Charging*—(1) Battery charging installations shall be located in areas designated for that purpose.

(2) Charging apparatus shall be protected from damage by trucks.

(3) When batteries are being charged, the vent caps shall be kept in place to avoid electrolyte spray. Vent caps shall be maintained in functioning condition.

§§ 1926.442-1926.448 [Reserved]

Definitions

§ 1926.449 Definitions applicable to this subpart.

The definitions given in this section apply to the terms used in Subpart K. The definitions given here for "approved" and "qualified person" apply, instead of the definitions given in § 1926.32, to the use of these terms in Subpart K.

Acceptable. An installation or equipment is acceptable to the Assistant Secretary of Labor, and approved within the meaning of this Subpart K:

(a) If it is accepted, or certified, or listed, or labeled, or otherwise determined to be safe by a qualified testing laboratory capable of determining the suitability of materials

and equipment for installation and use in accordance with this standard; or

(b) With respect to an installation or equipment of a kind which no qualified testing laboratory accepts, certifies, lists, labels, or determines to be safe, if it is inspected or tested by another Federal agency, or by a State, municipal, or other local authority responsible for enforcing occupational safety provisions of the National Electrical Code, and found in compliance with those provisions; or

(c) With respect to custom-made equipment or related installations which are designed, fabricated for, and intended for use by a particular customer, if it is determined to be safe for its intended use by its manufacturer on the basis of test data which the employer keeps and makes available for inspection to the Assistant Secretary and his authorized representatives.

Accepted. An installation is "accepted" if it has been inspected and found to be safe by a qualified testing laboratory.

Accessible. (As applied to wiring methods.) Capable of being removed or exposed without damaging the building structure or finish, or not permanently closed in by the structure or finish of the building. (See *"concealed"* and *"exposed."*)

Accessible. (As applied to equipment.) Admitting close approach; not guarded by locked doors, elevation, or other effective means. (See *"Readily accessible."*)

Ampacity. The current in amperes a conductor can carry continuously under the conditions of use without exceeding its temperature rating.

Appliances. Utilization equipment, generally other than industrial, normally built in standardized sizes or types, which is installed or connecetcd as a unit to perform one or more functions.

Approved. Acceptable to the authority enforcing this Subpart. The authority enforcing this Subpart is the Assistant Secretary of Labor for Occupational Safety and Health. The definition of "acceptable" indicates what is acceptable to the Assistant Secretary of Labor, and therefore approved within the meaning of this Subpart.

Askarel. A generic term for a group of nonflammable synthetic chlorinated hydrocarbons used as electrical insulating media. Askarels of various compositional types are used. Under arcing conditions the gases produced, while consisting predominantly of noncombustible hydrogen chloride, can include varying amounts of combustible gases depending upon the askarel type.

Attachment plug (Plug cap)(Cap). A device which, by insertion in a receptacle, establishes connection between the conductors of the attached flexible cord and the conductors connected permanently to the receptacle.

Automatic. Self-acting, operating by its own mechanism when actuated by some impersonal influence, as for example, a change in current strength, pressure, temperature, or mechanical configuration.

Bare conductor. See *"Conductor."*

Bonding. The permanent joining of metallic parts to form an electrically conductive path which will assure electrical continuity and the capacity to conduct safely any current likely to be imposed.

Bonding jumper. A reliable conductor to assure the required electrical conductivity between metal parts required to be electrically connected.

Branch circuit. The circuit conductors between the final overcurrent device protecting the circuit and the outlet(s).

Building. A structure which stands alone or which is cut off from adjoining structures by fire walls with all openings therein protected by approved fire doors.

Cabinet. An enclosure designed either for surface or flush mounting, and provided with a frame, mat, or trim in which a swinging door or doors are or may be hung.

Certified. Equipment is "certified" if it:

(a) Has been tested and found by a qualified testing laboratory to meet applicable test standards or to be safe for use in a specified manner, and

(b) Is of a kind whose production is periodically inspected by a qualified testing laboratory. Certified equipment must bear a label, tag, or other record of certification.

Circuit breaker.—(a) (600 volts nominal, or less.) A device designed to open and close a circuit by nonautomatic means and to open the circuit automatically on a predetermined overcurrent without injury to itself when properly applied within its rating.

(b) (Over 600 volts, nominal.) A switching device capable of making, carrying, and breaking currents under normal circuit conditions, and also making, carrying for a specified time, and breaking currents under specified abnormal circuit conditions, such as those of short circuit.

Class I locations. Class I locations are those in which flammable gases or vapors are or may be present in the air in quantities sufficient to produce explosive or ignitible mixtures. Class I locations include the following:

(a) *Class I, Division 1.* A Class I, Division 1 location is a location:

(1) In which ignitible concentrations of flammable gases or vapors may exist under normal operating conditions; or

(2) In which ignitible concentrations of such gases or vapors may exist frequently because of repair or maintenance operations or because of leakage; or

(3) In which breakdown or faulty operation of equipment or processes might release ignitible concentrations of flammable gases or vapors, and might also cause simultaneous failure of electric equipment.

Note.—This classification usually includes locations where volatile flammable liquids or liquefied flammable gases are transferred from one container to another; interiors of spray booths and areas in the vicinity of spraying and painting operations where volatile flammable solvents are used; locations containing open tanks or vats of volatile flammable liquids; drying rooms or compartments for the evaporation of flammable solvents; inadequately ventilated pump rooms for flammable gas or for volatile flammable liquids; and all other locations where ignitible concentrations of flammable vapors or gases are likely to occur in the course of normal operations.

(b) *Class I, Division 2.* A Class I, Division 2 location is a location:

(1) In which volatile flammable liquids or flammable gases are handled, processed, or used, but in which the hazardous liquids, vapors, or gases will normally be confined within closed containers or closed systems from which they can escape only in case of accidental rupture or breakdown of such containers or systems, or in case of abnormal operation of equipment; or

(2) In which ignitible concentrations of gases or vapors are normally prevented by positive mechanical ventilation, and which might become hazardous through failure or abnormal operations of the ventilating equipment; or

(3) That is adjacent to a Class I, Division 1 location, and to which ignitible concentrations of gases or vapors might occasionally be communicated unless such communication is prevented by adequate positive-pressure ventilation from a source of clean air, and effective safeguards against ventilation failure are provided.

Note.—This classification usually includes locations where volatile flammable liquids or flammable gases or vapors are used, but which would become hazardous only in case of an accident or of some unusual operating condition. The quantity of flammable material that might escape in case of accident, the adequacy of ventilating equipment, the total area involved, and the record of the industry or business with respect to explosions or fires are all factors

that merit consideration in determining the classification and extent of each location.

Piping without valves, checks, meters, and similar devices would not ordinarily introduce a hazardous condition even though used for flammable liquids or gases. Locations used for the storage of flammable liquids or of liquefied or compressed gases in sealed containers would not normally be considered hazardous unless also subject to other hazardous conditions.

Electrical conduits and their associated enclosures separated from process fluids by a single seal or barrier are classed as a Division 2 location if the outside of the conduit and enclosures is a nonhazardous location.

Class II locations. Class II locations are those that are hazardous because of the presence of combustible dust. Class II locations include the following:

(a) *Class II, Division 1.* A Class II, Division 1 location is a location:

(1) In which combustible dust is or may be in suspension in the air under normal operating conditions, in quantities sufficient to produce explosive or ignitible mixtures; or

(2) Where mechanical failure or abnormal operation of machinery or equipment might cause such explosive or ignitible mixtures to be produced, and might also provide a source of ignition through simultaneous failure of electric equipment, operation of protection devices, or from other causes, or

(3) In which combustible dusts of an electrically conductive nature may be present.

Note.—Combustible dusts which are electrically nonconductive include dusts produced in the handling and processing of grain and grain products, pulverized sugar and cocoa, dried egg and milk powders, pulverized spices, starch and pastes, potato and woodflour, oil meal from beans and seed, dried hay, and other organic materials which may produce combustible dusts when processed or handled. Dusts containing magnesium or aluminum are particularly hazardous and the use of extreme caution is necessary to avoid ignition and explosion.

(b) *Class II, Division 2.* A Class II, Division 2 location is a location in which:

(1) Combustible dust will not normally be in suspension in the air in quantities sufficient to produce explosive or ignitible mixtures, and dust accumulations are normally insufficient to interfere with the normal operation of electrical equipment or other apparatus; or

(2) Dust may be in suspension in the air as a result of infrequent malfunctioning of handling or processing equipment, and dust accumulations resulting therefrom may be ignitible by abnormal operation or failure of electrical equipment or other apparatus.

Note.—This classification includes locations where dangerous concentrations of suspended dust would not be likely but where dust accumulations might form on or in the vicinity of electric equipment. These areas may contain equipment from which appreciable quantities of dust would escape under abnormal operating conditions or be adjacent to a Class II Division 1 location, as described above, into which an explosive or ignitible concentration of dust may be put into suspension under abnormal operating conditions.

Class III locations. Class III locations are those that are hazardous because of the presence of easily ignitible fibers or flyings but in which such fibers or flyings are not likely to be in suspension in the air in quantities sufficient to produce ignitible mixtures. Class 111 locations include the following:

(a) *Class III, Division 1.* A Class III, Division 1 location is a location in which easily ignitible fibers or materials producing combustible flyings are handled, manufactured, or used.

Note.—Easily ignitible fibers and flyings include rayon, cotton (including cotton linters and cotton waste), sisal or henequen, istle, jute, hemp, tow, cocoa fiber, oakum, baled waste kapok, Spanish moss, excelsior, sawdust, woodchips, and other material of similar nature.

(b) *Class III, Division 2.* A Class III, Division 2 location is a location in which easily ignitible fibers are stored or handled, except in process of manufacture.

Collector ring. A collector ring is an assembly of slip rings for transferring electrical energy from a stationary to a rotating member.

Concealed. Rendered inaccessible by the structure or finish of the building. Wires in concealed raceways are considered concealed, even though they may become accessible by withdrawing them. [See *"Accessible.* (As applied to wiring methods.)"]

Conductor.—(a) *Bare.* A conductor having no covering or electrical insulation whatsoever.

(b) *Covered.* A conductor encased within material of composition or thickness that is not recognized as electrical insulation.

(c) *Insulated.* A conductor encased within material of composition and thickness that is recognized as electrical insulation.

Controller. A device or group of devices that serves to govern, in some predetermined manner, the electric power delivered to the apparatus to which it is connected.

Covered conductor. See *"Conductor."*

Cutout. (Over 600 volts, nominal.) An assembly of a fuse support with either a fuseholder, fuse carrier, or disconnecting blade. The fuseholder or fuse carrier may include a conducting element (fuse link), or may act as the disconnecting blade by the inclusion of a nonfusible member.

Cutout box. An enclosure designed for surface mounting and having swinging doors or covers secured directly to and telescoping with the walls of the box proper. (See *"Cabinet."*)

Damp location. See *"Location."*

Dead front. Without live parts exposed to a person on the operating side of the equipment.

Device. A unit of an electrical system which is intended to carry but not utilize electric energy.

Disconnecting means. A device, or group of devices, or other means by which the conductors of a circuit can be disconnected from their source of supply.

Disconnecting (or Isolating) switch. (Over 600 volts, nominal.) A mechanical switching device used for isolating a circuit or equipment from a source of power.

Dry location. See *"Location."*

Enclosed. Surrounded by a case, housing, fence or walls which will prevent persons from accidentally contacting energized parts.

Enclosure. The case or housing of apparatus, or the fence or walls surrounding an installation to prevent personnel from accidentally contacting energized parts, or to protect the equipment from physical damage.

Equipment. A general term including material, fittings, devices, appliances, fixtures, apparatus, and the like, used as a part of, or in connection with, an electrical installation.

Equipment grounding conductor. See *"Grounding conductor, equipment."*

Explosion-proof apparatus. Apparatus enclosed in a case that is capable of withstanding an explosion of a specified gas or vapor which may occur within it and of preventing the ignition of a specified gas or vapor surrounding the enclosure by sparks, flashes, or explosion of the gas or vapor within, and which operates at such an external temperature that it will not ignite a surrounding flammable atmosphere.

Exposed. (As applied to live parts.) Capable of being inadvertently touched or approached nearer than a safe distance by a person. It is applied to parts not suitably guarded, isolated, or insulated. (See *"Accessible* and *"Concealed."*)

Exposed. (As applied to wiring methods.) On or attached to the surface or behind panels designed to allow access. [See *"Accessible.* (As applied to wiring methods.)"]

Exposed. (For the purposes of § 1926.408(d), Communications systems.) Where the circuit is in such a position that in case of failure of supports or insulation, contact with another circuit may result.

Externally operable. Capable of being operated without exposing the operator to contact with live parts.

Feeder. All circuit conductors between the service equipment, or the generator switchboard of an isolated plant, and the final branch-circuit overcurrent device.

Festoon lighting. A string of outdoor lights suspended between two points more than 15 feet (4.57 m) apart.

Fitting. An accessory such as a locknut, bushing, or other part of a wiring system that is intended primarily to perform a mechanical rather than an electrical function.

Fuse. (Over 600 volts, nominal.) An overcurrent protective device with a circuit opening fusible part that is heated and severed by the passage of overcurrent through it. A fuse comprises all the parts that form a unit capable of performing the prescribed functions. It may or may not be the complete device necessary to connect it into an electrical circuit.

Ground. A conducting connection, whether intentional or accidental, between an electrical circuit or equipment and the earth, or to some conducting body that serves in place of the earth.

Grounded. Connected to earth or to some conducting body that serves in place of the earth.

Grounded, effectively (Over 600 volts, nominal.) Permanently connected to earth through a ground connection of sufficiently low impedance and having sufficient ampacity that ground fault current which may occur cannot build up to voltages dangerous to personnel.

Grounded conductor. A system or circuit conductor that is intentionally grounded.

Grounding conductor. A conductor used to connect equipment or the grounded circuit of a wiring system to a grounding electrode or electrodes.

Grounding conductor, equipment. The conductor used to connect the noncurrent-carrying metal parts of equipment, raceways, and other enclosures to the system grounded conductor and/or the grounding electrode conductor at the service equipment or at the source of a separately derived system.

Grounding electrode conductor. The conductor used to connect the grounding electrode to the equipment grounding conductor and/or to the grounded conductor of the circuit at the service equipment or at the source of a separately derived system.

Ground-fault circuit interrupter. A device for the protection of personnel that functions to deenergize a circuit or portion thereof within an established period of time when a current to ground exceeds some predetermined value that is less than that required to operate the overcurrent protective device of the supply circuit.

Guarded. Covered, shielded, fenced, enclosed, or otherwise protected by means of suitable covers, casings, barriers, rails, screens, mats, or platforms to remove the likelihood of approach to a point of danger or contact by persons or objects.

Hoistway. Any shaftway, hatchway, well hole, or other vertical opening or space in which an elevator or dumbwaiter is designed to operate.

Identified (conductors or terminals). Identified, as used in reference to a conductor or its terminal, means that such conductor or terminal can be recognized as grounded.

Identified (for the use). Recognized as suitable for the specific purpose, function, use, environment, application, etc. where described as a requirement in this standard. Suitability of equipment for a specific purpose, environment, or application is determined by a qualified testing laboratory where such identification includes labeling or listing.

Insulated conductor. See "*Conductor.*"

Interrupter switch. (Over 600 volts, nominal.) A switch capable of making, carrying, and interrupting specified currents.

Intrinsically safe equipment and associated wiring. Equipment and associated wiring in which any spark or thermal effect, produced either normally or in specified fault conditions, is incapable, under certain prescribed test conditions, of causing ignition of a mixture of flammable or combustible material in air in its most easily ignitible concentration.

Isolated. Not readily accessible to persons unless special means for access are used.

Isolated power system. A system comprising an isolating transformer or its equivalent, a line isolation monitor, and its ungrounded circuit conductors.

Labeled. Equipment or materials to which has been attached a label, symbol or other identifying mark of a qualified testing laboratory which indicates compliance with appropriate standards or performance in a specified manner.

Lighting outlet. An outlet intended for the direct connection of a lampholder, a lighting fixture, or a pendant cord terminating in a lampholder.

Listed. Equipment or materials included in a list published by a qualified testing laboratory whose listing states either that the equipment or material meets appropriate standards or has been tested and found suitable for use in a specified manner.

Location.—(a) *Damp location.* Partially protected locations under canopies, marquees, roofed open porches, and like locations, and interior locations subject to moderate degrees of moisture, such as some basements.

(b) *Dry location.* A location not normally subject to dampness or wetness. A location classified as dry may be temporarily subject to dampness or wetness, as in the case of a building under construction.

(c) *Wet location.* Installations underground or in concrete slabs or masonry in direct contact with the earth, and locations subject to saturation with water or other liquids, such as locations exposed to weather and unprotected.

Mobile X-ray. X-ray equipment mounted on a permanent base with wheels and/or casters for moving while completely assembled.

Motor control center. An assembly of one or more enclosed sections having a common power bus and principally containing motor control units.

Outlet. A point on the wiring system at which current is taken to supply utilization equipment.

Overcurrent. Any current in excess of the rated current of equipment or the ampacity of a conductor. It may result from overload (see definition), short circuit, or ground fault. A current in excess of rating may be accommodated by certain equipment and conductors for a given set of conditions. Hence the rules for overcurrent protection are specific for particular situations.

Overload. Operation of equipment in excess of normal, full load rating, or of a conductor in excess of rated ampacity which, when it persists for a sufficient length of time, would cause damage or dangerous overheating. A fault, such as a short circuit or ground fault, is not an overload. (See "*Overcurrent.*")

Panelboard. A single panel or group of panel units designed for assembly in the form of a single panel; including buses, automatic overcurrent devices, and with or without switches for the control of light, heat, or power circuits; designed to be placed in a cabinet or cutout box placed in or against a wall or partition and accessible only from the front. (See "*Switchboard.*")

Portable X-ray. X-ray equipment designed to be hand-carried.

Power fuse. (Over 600 volts, nominal.) See "*Fuse.*"

Power outlet. An enclosed assembly which may include receptacles, circuit breakers, fuseholders, fused switches, buses and watt-hour meter mounting means; intended to serve as a means for distributing power required to operate mobile or temporarily installed equipment.

Premises wiring system. That interior and exterior wiring, including power, lighting, control, and signal circuit wiring together with all of its associated hardware, fittings, and wiring devices, both permanently and temporarily installed, which extends from the load end of the service drop, or load end of the service lateral conductors to the outlet(s). Such wiring does not include wiring internal to appliances, fixtures, motors, controllers, motor control centers, and similar equipment.

Qualified person. One familiar with the construction and operation of the equipment and the hazards involved.

Qualified testing laboratory. A properly equipped and staffed testing laboratory which has capabilities for and which provides the following services:

(a) Experimental testing for safety of specified items of equipment and materials referred to in this standard to determine compliance with appropriate test standards or performance in a specified manner;

(b) Inspecting the run of such items of equipment and materials at factories for product evaluation to assure compliance with the test standards;

(c) Service-value determinations through field inspections to monitor the proper use of labels on products and with authority for recall of the label in the event a hazardous product is installed;

(d) Employing a controlled procedure for identifying the listed and/or labeled equipment or materials tested; and

(e) Rendering creditable reports or findings that are objective and without bias of the tests and test methods employed.

Raceway. A channel designed expressly for holding wires, cables, or busbars, with additional functions as permitted in this subpart. Raceways may be of metal or insulating material, and the term includes rigid metal conduit, rigid nonmetallic conduit, intermediate metal conduit, liquidtight flexible metal conduit, flexible metallic tubing, flexible metal conduit, electrical metallic tubing, underfloor raceways, cellular concrete floor raceways, cellular metal floor raceways, surface raceways, wireways, and busways.

Readily accessible. Capable of being reached quickly for operation, renewal, or inspections, without requiring those to whom ready access is requisite to climb over or remove obstacles or to resort to portable ladders, chairs, etc. (See *"Accessible."*)

Receptacle. A receptacle is a contact device installed at the outlet for the connection of a single attachment plug. A single receptacle is a single contact device with no other contact device on the same yoke. A multiple receptacle is a single device containing two or more receptacles.

Receptacle outlet. An outlet where one or more receptacles are installed.

Remote-control circuit. Any electric circuit that controls any other circuit through a relay or an equivalent device.

Sealable equipment. Equipment enclosed in a case or cabinet that is provided with a means of sealing or locking so that live parts cannot be made accessible without opening the enclosure. The equipment may or may not be operable without opening the enclosure.

Separately derived system. A premises wiring system whose power is derived from generator, transformer, or converter windings and has no direct electrical connection, including a solidly connected grounded circuit conductor, to supply conductors originating in another system.

Service. The conductors and equipment for delivering energy from the electricity supply system to the wiring system of the premises served.

Service conductors. The supply conductors that extend from the street main or from transformers to the service equipment of the premises supplied.

Service drop. The overhead service conductors from the last pole or other aerial support to and including the splices, if any, connecting to the service-entrance conductors at the building or other structure.

Service-entrance conductors, overhead system. The service conductors between the terminals of the service equipment and a point usually outside the building, clear of building walls, where joined by tap or splice to the service drop.

Service-entrance conductors, underground system. The service conductors between the terminals of the service equipment and the point of connection to the service lateral. Where service equipment is located outside the building walls, there may be no service-entrance conductors, or they may be entirely outside the building.

Service equipment. The necessary equipment, usually consisting of a circuit breaker or switch and fuses, and their accessories, located near the point of entrance of supply conductors to a building or other structure, or an otherwise defined area, and intended to constitute the main control and means of cutoff of the supply.

Service raceway. The raceway that encloses the service-entrance conductors.

Signaling circuit. Any electric circuit that energizes signaling equipment.

Switchboard. A large single panel, frame, or assembly of panels which have switches, buses, instruments, overcurrent and other protective devices mounted on the face or back or both. Switchboards are generally accessible from the rear as well as from the front and are not intended to be installed in cabinets. (See *"Panelboard."*)

Switches.—(a) *General-use switch.* A switch intended for use in general distribution and branch circuits. It is rated in amperes, and it is capable of interrupting its rated current at its rated voltage.

(b) *General-use snap switch.* A form of general-use switch so constructed that it can be installed in flush device boxes or on outlet box covers, or otherwise used in conjunction with wiring systems recognized by this subpart.

(c) *Isolating switch.* A switch intended for isolating an electric circuit from the source of power. It has no interrupting rating, and it is intended to be operated only after the circuit has been opened by some other means.

(d) *Motor-circuit switch.* A switch, rated in horsepower, capable of interrupting the maximum operating overload current of a motor of the same horsepower rating as the switch at the rated voltage.

Switching devices. (Over 600 volts, nominal.) Devices designed to close and/or open one or more electric circuits. Included in this category are circuit breakers, cutouts, disconnecting (or isolating) switches, disconnecting means, and interrupter switches.

Transportable X-ray. X-ray equipment installed in a vehicle or that may readily be disassembled for transport in a vehicle.

Utilization equipment. Utilization equipment means equipment which utilizes electric energy for mechanical, chemical, heating, lighting, or similar useful purpose.

Utilization system. A utilization system is a system which provides electric power and light for employee workplaces, and includes the premises wiring system and utilization equipment.

Ventilated. Provided with a means to permit circulation of air sufficient to remove an excess of heat, fumes, or vapors.

Volatile flammable liquid. A flammable liquid having a flash point below 38 degrees C (100 degrees F) or whose temperature is above its flash point, or a Class II combustible liquid having a vapor pressure not exceeding 40 psia (276 kPa) at 38° C (100° F) whose temperature is above its flash point.

Voltage. (Of a circuit.) The greatest root-mean-square (effective) difference of potential between any two conductors of the circuit concerned.

Voltage, nominal. A nominal value assigned to a circuit or system for the purpose of conveniently designating its voltage class (as 120/240, 480Y/277, 600, etc.). The actual voltage at which a circuit operates can vary from the nominal within a range that permits satisfactory operation of equipment.

Voltage to ground. For grounded circuits, the voltage between the given conductor and that point or conductor of the circuit that is grounded; for ungrounded circuits, the greatest voltage between the given conductor and any other conductor of the circuit.

Watertight. So constructed that moisture will not enter the enclosure.

Weatherproof. So constructed or protected that exposure to the weather will not interfere with successful operation. Rainproof, raintight, or watertight equipment can fulfill the requirements for weatherproof where varying weather conditions other than wetness, such as snow, ice, dust, or temperature extremes, are not a factor.

Wet location. See *"Location."*

[FR Doc. 86-15400 Filed 7-10-86; 8:45 am]
BILLING CODE 4510-26-M