

Section 8 Personal Protective Equipment

8.1 Requirements for Personal Protective Equipment

This section sets forth minimum personal protective equipment (PPE) requirements. It provides an overview of PPE requirements, including workplace assessment, PPE maintenance, and training. The supervisor must ensure availability, proper use, and maintenance of equipment specified in this section. The "Occupational Health" section details the requirements for respirator use.

8.1.1 Workplace Assessment. Assess each workplace to determine if hazards are present (or likely to be present) that would make it necessary to use personal protective equipment. Document the assessment in writing or in the Job Hazard Analysis.

8.1.2 PPE Maintenance. Each day, inspect PPE before use. Maintain and store PPE properly. After each use, clean and sanitize PPE (as appropriate).

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

- When will PPE be used?
- What PPE is necessary?
- How is the required PPE used?
- What are the limitations of the PPE?
- How is PPE properly maintained, inspected, and stored?

8.2 Requirements for Head Protection

8.2.1 Required Helmets (Hard Hats). All personnel, including contractors and visitors, must wear helmets (hard hats) when entering or working in designated hard hat areas.

8.2.2 Hard Hat Areas. Hard hat areas include all areas where a person may be injured from overhead hazards, including overhead storage, and any kind of construction, maintenance, and repair work in progress.

8.2.3 Posting of Hard Hat Areas. Post conspicuous signs at all entrances to hard hat areas and appropriate locations. Signs must state:

"HARD HATS REQUIRED BEYOND THIS POINT"

8.2.4 Hard Hat Design. Verify that hard hats comply with Type I, Class G or E, as specified in ANSI Z89.1-1997, "American National Standard for Industrial Head Protection." Confirm that hard hats worn by linemen, electricians, or employees working in tunnels, shafts, or near high-voltage conductors or apparatus conform to class E requirements of ANSI Z89.1-1997. Hard hats must have a manufacturer's label that indicates its design complies with ANSI requirements.

8.3 Requirements for Eye and Face Protection

Employees exposed to potential eye or face injury from physical, chemical, or radiation agents must be furnished and required to wear eye and/or face protection specifically designed for the exposure.

8.3.1 Design. Eye and face protection required by this section must comply with the standards published in the current ANSI Z87.1, "Practice for Occupational and Educational Eye and Face Protection."

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

- a. Protective spectacles with lenses that provide optical correction.
- b. Protective goggles or face shields that can be worn over corrective glasses or contact lenses.
- c. Goggles that incorporate corrective lenses mounted behind protective lenses.

8.3.3 Selection Guide. When selecting eye and face protection for the hazards and operations noted, use the information in table 8-1, table 8-2, and figure 8-1 as a guide.

8.3.4 Electric Welding. Employees must wear nonflammable welding helmets with lift-front or stationary-front lens when engaged in electric welding operations. Employees must wear plano prescription safety glasses or flash goggles under the helmet to protect their eyes when raising the helmet for scaling operations. Helmet filter lens shades must conform with table 8-2.

8.3.5 Gas-Torch Cutting and Welding. When gas-torch cutting and welding, employees must wear a welding mask, weld-view or cover-glass goggles, or similar goggles that provide equivalent eye and face protection. The eye protectors must have filter lenses that conform to the requirements in tables 8-1 and 8-2. Sunglasses do not meet this requirement.

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

Operation	Hazards	Recommended protectors (numbers refer to figure 8-1)
Acetylene-burning, acetylene-cutting, acetylene-welding	Sparks, harmful rays, molten metal, flying particles	7, 8, 9
Chemical handling	Splash, acid burns, fumes	2, 10 (for severe exposure, add 10 over 2)
Chipping	Flying particles	1, 3, 4, 5, 6, 7A, 8A
Electric (arc) welding	Sparks, intense rays, molten metal	9, 11 (11 in combination with 4, 5, 6 in tinted lenses advisable)
Furnace operations	Glare, heat, molten metal	7, 8, 9 (for severe exposure, add 10)
Grinding - light	Flying particles	1, 3, 4, 5, 6, 10
Grinding - heavy	Flying particles	1, 3, 7A, 8A (for severe exposure, add 10)
Laboratory	Chemical splash, glass breakage	2 (10 when in combination with 4, 5, 6)
Machining	Flying particles	1, 3, 4, 5, 6, 10
Molten metals	Heat, glare, sparks, splash	7, 8 (10 in combination with 4, 5, 6 in tinted lenses)
Spot welding	Flying particles, sparks	1, 3, 4, 5, 6, 10

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

Operations	Electrode size in 1/32 inches (0.8 millimeter)	Arc current	Minimum ¹ protective shade
Shielded metal arc welding	<3	<60	7
	3-5	60-160	8
	5-8	160-250	10
	>8	250-550	11
Gas metal-arc welding and flux-cored arc welding		<60	7
		60-160	10
		160-250	10
		250-500	10
Gas tungsten-arc welding		<50	8
		50-150	8
		150-500	10
Air carbon arc cutting	(light)	<500	10
	(heavy)	500-1,000	11
Plasma arc welding		<20	6
		20-100	8
		100-400	10
		400-800	11
Plasma arc cutting	(light) ²	<300	8
	(medium) ²	300-400	9
	(heavy) ²	400-800	10
Torch blazing			3
Torch soldering			2
Carbon arc welding			14
Gas welding:	<1/8	<3.2	4
	Light 1/8-1/2	3.2-12.7	5
	Medium >1/2	>12.7	6
	Heavy		
Oxygen cutting:	<1	<25	3
	Light 1-6	25-150	4
	Medium >6	>150	5
	Heavy		

Source: 29 CFR 1910.133(a)(5), <http://www.osha.gov/reg>

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

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

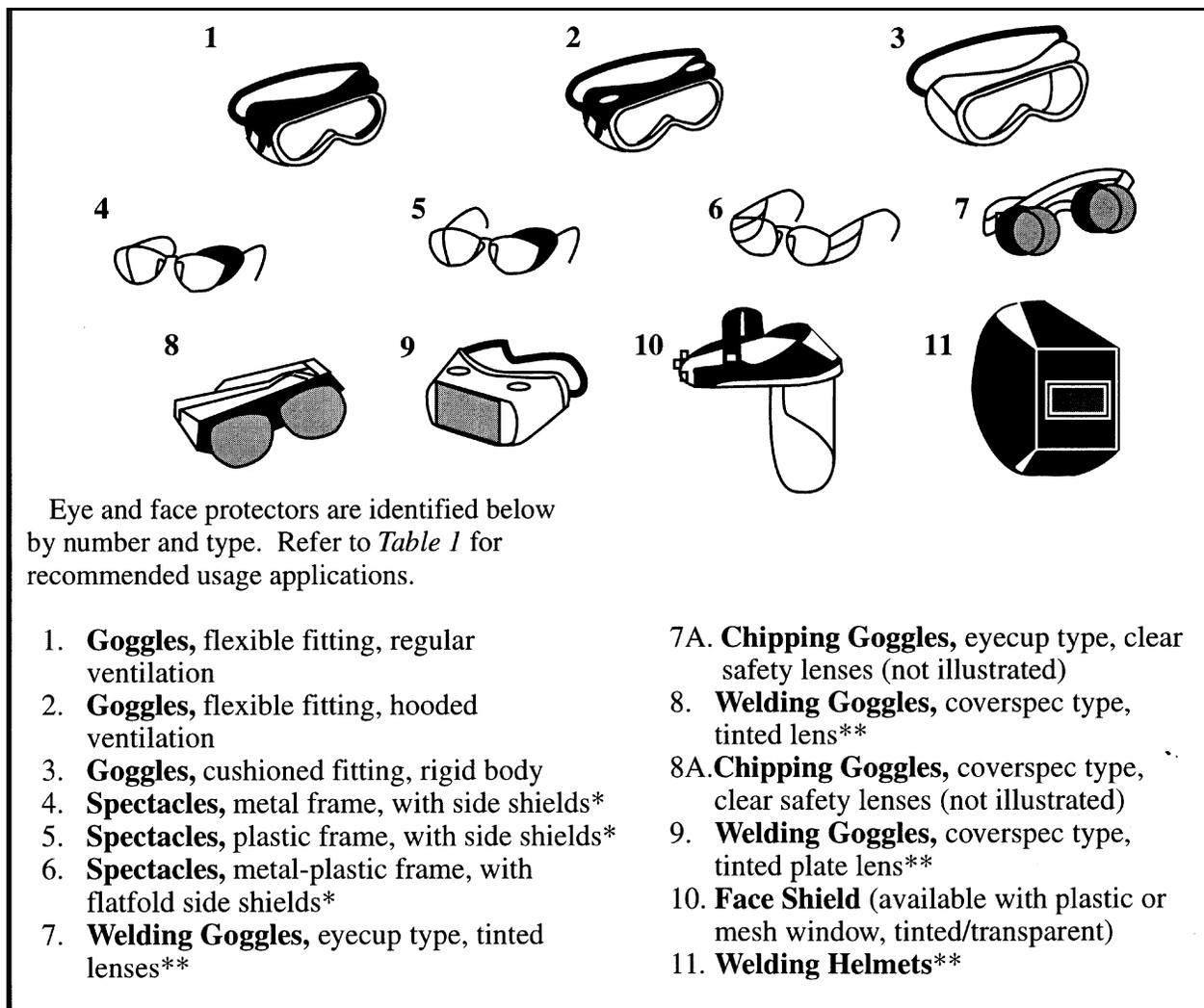


Figure 8-1.—Recommended eye and face protectors.

Source: 29 CFR 1926.102(a)(5) table E-1.

*These are also available without side shields for limited use requiring only frontal protection.

** See Table 2, Filter Lenses for Protection Against Radiant Energy.

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

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

8.4 Requirements for Hearing Protection

8.4.1 Hearing Protective Devices. Use hearing protective devices whenever ambient noise levels equal or exceed 85 dBa.

8.4.2 Noise Reduction Rating. Supervisor must verify that a noise reduction rating (NRR) of all hearing protective devices is used, which is based upon one of the following methods:

- a. One of the three methods developed by NIOSH (described in the "List of Personal Hearing Protectors and Attenuation Data," HEW Publication No. 76-120, 1975, pages 21-37). These methods are known as NIOSH methods No. 1, No. 2, and No. 3.
- b. ANSI S12.6-1984, "Method for the Measurement of the Real-Ear Attenuation of Hearing Protectors."
- c. ANSI S3.19-1974, "Measurement of Real-Ear Protection of Hearing Protectors and Physical Attenuation of Ear Muffs."

8.4.3 Hearing Device Labels. Use hearing protective devices labeled by manufacturer according to Environmental Protection Agency (EPA) 40 CFR Part 211.

8.5 Requirements for Protective Clothing

8.5.1 Welding Leathers. Employees engaged in overhead welding or burning where severe burn hazards exist must wear leather gloves, chrome-tanned leather chaps and coats, or a combination that provides equal protection to prevent exposure to sparks and slag. They must wear leather gloves and aprons when performing routine welding and burning.

8.5.2 High-Visibility Apparel. All employees exposed to vehicular traffic must wear high-visibility, orange apparel during the day and reflective, high-visibility apparel (with a minimum reflective area of 400 square inches) during dusk, dawn, and adverse weather conditions.

8.5.3 Gloves. Gloves that prevent exposure to biological, chemical, and physical hazards must be provided and used. Substances include acids, caustics, solvents, herbicides, infectious materials, and other toxic materials. Employees must wear leather-palm gloves when such gloves are essential to safely accomplish the work (e.g., when handling steel-plated cables, barbed wire, and rough-hewn timber).

8.5.4 Rubber Goods. Employees may use rubber gloves, sleeves, blankets, covers, and line hose only when required by special conditions for work on energized facilities. Rubber goods provided to protect employees who work on energized facilities must meet American Society of Testing and Materials (ASTM) specifications. Test, inspect, and maintain rubber goods according to current ASTM standards. At a minimum, perform a visual inspection prior to each use.

8.5.5 Protective Chaps. Employees who operate chain saws, hand-held abrasive wheel cutoff saws, and other similar power tools must wear protective chaps that meet current U.S. Forest Service requirements.

8.5.6 Foot Protection. When work endangers feet or requires special foot protection, employees must wear protective footwear that meets the requirements in ANSI Z41, "Protective Footwear." This footwear must meet the basic I/75 "impact," C/75 "compression" standards for the protective toe box. In addition, rubber footwear, including boots and packs, must meet the sole puncture-resistance requirements. Heavy-duty footwear must meet the MT/75 metatarsal requirements. Work environments that require protective footwear include construction sites and activities, industrial areas, underground work, and working with chemicals. Advise visitors of the existing hazards in the area before planned visits or before permitting entrance to the area.

8.5.7 Minimum Wearing Apparel. Along with other requirements of this paragraph, all employees who work outdoors must wear, as minimum protection, pants long enough to protect from environmental and physical hazards, and sleeved shirts with a minimum 4-inch sleeve. Cutoffs, tank tops, or modified shirts are not acceptable. Apparel must protect where irritants or toxic substances may come into contact with skin or clothing.

8.5.8 Electric Flash Protection. Any person who enters the flash protection zone (the area between the flash protection boundary and its associated conductor (see NFPA 70E, Part II, 2-1.3.3.2) must wear flame-resistant clothing and personal protective equipment, based on the incident exposure associated with the specific task. Refer to NFPA tables 70E 3-3.8 and 3-4.11 for PPE standards.

- a. **Eye and Face Protection.** Employees must wear protective eye equipment whenever there is a danger of injury from electric arcs, flashes, or from flying objects resulting from

electrical explosion. Always wear eye protection (safety glasses or goggles) under face shields or hoods.

b. **Body Protection.** Employees must wear flame resistant-clothing whenever they may be exposed to an electric arc flash. Flash suits and their closure design must permit easy and rapid removal. The entire flash suit, including the window, must have energy-absorbing characteristics suitable for arc-flash exposure. Use clothing and equipment to maximize worker protection. Clothing and equipment required by the degree of electrical hazard exposure can be worn alone or be integrated with normal apparel. Protective clothing and equipment must cover associated parts of the body and all normal apparel that is not flash-flame resistant, while allowing movement and visibility. Do not wear meltable synthetic fibers next to the skin.

c. **Hand and Arm Protection.** Employees must wear rubber insulating gloves where there is a danger of hand and arm injury from electric shock and burns, due to contact with live parts. Wear hand and arm protection where you may be exposed to arc flash burn. Gloves made from layers of flame-resistant material provide the highest level of hand arc flash protection. Heavy-duty leather gloves also provide good protection. Where voltage-rated gloves are used, wear leather protectors over the rubber gloves.

d. **Foot and Leg Protection.** Dielectric overshoes are required where electrically insulated footwear is used as protection against step and touch potential. Heavy-duty leather work shoes normally provide a significant degree of protection to the feet from arc flash.

e. **Flash Protection Boundary.** The flash protection boundary, D_c , is defined as the distance, in feet, of a person from an arc source for a just curable burn (i.e., skin temperature remains below 80 degrees C or 176 degrees F).

The flash protection boundary can be calculated using either of the following equations:

$$D_c = [2.65 \times MVA_{bf} \times t]^{1/2} \quad \text{(preferred equation for calculations applying to generating and pumping facilities)}$$

$$D_c = [53 \times MVA \times t]^{1/2} \quad \text{(for systems with single sources of electric fault current)}$$

where:

- MVA_{bf} = bolted fault MVA available at the point involved
- MVA = the MVA rating of the transformer. For transformers with MVA ratings below 0.75 MVA, multiply the transformer MVA rating by 1.25
- t = time or arc exposure in seconds

You must know the voltage rating and fault current available to find the MVA_{bf} factor in the first equation. The use of the second equation, based only on transformer rating, may not consider significant current contributions from large rotating machines, and its use for Reclamation facilities is discouraged.

According to NFPA, the flash protection boundary for systems rated at 600 volts and below, and with less than 50 kiloamperes of current available, is 4 feet.

Calculate the flash protection boundary for each item of electrical equipment in the plant. Include the flash protection boundary in the facility Hazardous Energy Control Program. Personnel entering the flash protection boundary near exposed energized electrical equipment must wear appropriate electrical flash protective equipment.

8.5.9 Determination of Appropriate Clothing. The NFPA system of hazard/risk classification associates many types of work on energized equipment and within the flash protection boundary and five levels of hazard/risk. Use the hazard/risk level to determine the required protective clothing characteristics appropriate for the work. The classification system is defined in several tables of the NFPA Standard No. 70E, Part II.

Determine the appropriate protective clothing in two steps:

- First, find the type of work planned in NFPA 70E, Part II, Table 3-3.9.1 (Hazard Risk Category Classifications). This four-page table lists over 70 of the various operations on various types of electrical equipment of various voltage ratings. A corresponding hazard/risk category from 0 to 4 (highest exposure) is listed for each type of work. The table also indicates whether voltage rated tools or gloves are required.
- Second, determine what types and layers of clothing are required for the Hazard/Risk category by looking on NFPA 70E, Part II, Table 3-3.9.2 (Protective Clothing and Personal Protective Equipment Matrix). Use the clothing and equipment indicated on this table when working on or near energized equipment within the flash protection boundary. Table 3-3.9.3 (Protective Clothing Characteristics) gives information on the weight of the clothing for the five levels of Hazard/Risk.

As an alternative to using tables 3-3.9.1 and 3-3.9.2, Table F-1 (Simplified, Two Category, Flame-Resistant Clothing System) provides a quicker method of determining appropriate clothing for use within the flash protection boundary of energized electrical equipment.

- a. **Synthetic Clothing Not Permitted.** Do not wear clothing made from synthetic materials such as acetate, nylon, polyester, rayon, either alone or in blends with cotton.

These materials will melt into the skin when exposed to high temperatures and can aggravate a burn injury.

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

8.6 Protection Against Drowning

Provide U.S. Coast Guard (USCG) approved type III or type V personal flotation devices (PFDs) to employees when working on or around water or where a drowning hazard exists.

Do not use PFDs that depend solely on inflation to provide flotation (USCG Type III or V inflatables) onboard watercraft or in activities that subject the PFD to abrasion or to substances that might affect the device's effectiveness.

8.6.1 Design. The PFD must be international orange and must have at least 200 square centimeters of retroreflective material attached to the front and 200 square centimeters of retroreflective material attached to the back. If the PFD is reversible, retroreflective material must be attached to each of its reversible sides.

8.6.2 Ring Buoys. Install ring buoys with at least 90 feet of line and approved by the U.S. Coast Guard at 200-foot intervals on worksites where a water hazard exists.

8.6.3 Inspection and Replacement. At regular intervals and after each use, inspect personal flotation devices and buoyant work vests for defects that would compromise safety. Replace any devices that have less than 13 pounds buoyancy or are otherwise defective.

8.7 Other Protective Equipment

Other sections of these standards cover other protective equipment, fire and rescue devices, first aid and medical facilities, seatbelts, and special devices and equipment for protecting personnel from specific hazards. Employees must use such specified protective equipment when exposed to the respective hazards.

8.8 Safety Nets

The employer must install safety nets to protect employees when the workplace is more than 25 feet above adjoining surfaces and where use of scaffolding, catch platforms, temporary floors,

safety belts, or lifelines is impractical. Use safety nets when required or directed by the office head or the COR, to protect employees or the public from overhead construction.

8.8.1 Net Specifications. The mesh size of safety nets must not exceed 6 by 6 inches. Nets must meet accepted performance standards of 17,500 foot-pounds minimum impact resistance, as determined and certified by the manufacturer, and must bear a label of proof test. Edge ropes must withstand a minimum breaking strength of 5,000 pounds. Line nets installed for overhead protection with wire or synthetic netting of not more than 1-inch mesh. Wire mesh must not be less than No. 22 gauge; synthetic must not be less than No. 18 twine.

8.8.2 Installation. Design and construct the net suspension system with a minimum safety factor of four. The net suspension system must withstand test loading without permitting contact between the net and any surface or object below the net. Connections between panels must develop the full strength of the net. Use forged steel safety hooks or shackles to fasten the net to its supports.

8.8.3 Positioning. Install safety nets as close under the work surface as practical, but not more than 25 feet below the working level. Extend nets at least 8 feet beyond the perimeter of the work area.

8.8.4 Testing. Field test safety nets immediately following installation, repositioning, or major repair. Conduct the test by dropping a 400-pound bag of sand, more than 30 inches in diameter, from at least 25 feet high onto the center of the net.

8.8.5 Inspection and Maintenance. The care, maintenance, and storage of nets must conform to the net manufacturer's recommendations. Give due attention to the factors affecting net life. (See subsection on equipment.) Protect nets and debris from sparks and hot slag resulting from welding and cutting operations. Nets must be capable of a minimum service life of 2 years under normal, on-the-job exposure to weather, sunlight, and handling, excluding damage from misuse, mishandling, and exposure to chemicals and airborne contaminants.

Inspect nets daily for damage, and make necessary replacement or repairs before work above the net resumes. Remove debris from nets at least daily. Maintain an up-to-date record for each personnel net. The record must include the following information:

- a. Net serial number.
- b. Date installed.
- c. Dates inspected.

- d. Inspection results. If results are unsatisfactory, state the reasons why and describe the corrections made for each deficiency.
- e. Dates tested.
- f. Test results. If unsatisfactory, state the reasons.
- g. Date removed.
- h. Disposition and reason.

The competent person responsible for the nets must initial each entry.

8.8.6 Training. When using personnel nets, the employer must provide appropriate training, so employees will recognize the hazards of falling into nets and the procedures to follow to limit potential injury. The training program must include the following:

- a. The tested limits of installed nets.
- b. Avoiding falls.
- c. Recording and reporting of training.
- d. Location of inspection records and the responsible person.

8.8.7 Factors Affecting Net Life

- a. **Sunlight.** Ropes of natural and synthetic fibers can lose a significant amount of strength after prolonged exposure to direct sunlight. Take special precautions to shield ropes one-half inch in diameter and less from the sun's rays. When they are not in use, store properly and protect nets from direct and indirect sunlight.
- b. **Abrasion.** Keep in mind the adverse effects of abrasion. Do not drag nets or allow them to chafe over the ground or other rough surfaces. No test will predict the life of a net under the wide variety of abrasion conditions that may be encountered.
- c. **Sand.** Embedded sand can cut into fibers, reducing the strength of nets. Keep nets as clean and free of sand as possible.
- d. **Rust.** Prolonged contact with rusting iron or steel can cause significant degradation and loss of strength.

- e. **Airborne Contaminants.** Many chemicals and airborne contaminants can adversely affect the strength of nets. Where such hazards exist, identify the chemicals and measure the concentrations. Determine the effect on the net materials by test, if not known.

8.9 Lifesaving Skiffs

Provide one or more lifesaving boats or skiffs where employees work over or immediately adjacent to water where a drowning hazard exists. Persons trained in launching and operating the skiff must be immediately available during working hours. Use the skiff only for drills and in emergencies.

8.9.1 **Equipment.** Lifesaving skiffs must have the following equipment on board:

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