

tests,¹ by durability tests of the cord and cord armor,² and by the general behavior of the lamp equipment during the investigation. The amount and distribution of the light shall be judged both by observation of the illumination on a white screen and by photometric measurements.

(b) *Angle of light beam.* MSHA recommends that the angle of the light beam be at least 130 degrees horizontally to insure that the contrast edge of the beam is away from the more sensitive sector of the wearer's vision; however, to allow for manufacturing and assembly tolerances and the use of multiple filament bulbs, MSHA will approve lamps giving a minimum beam angle of 120 degrees. If the bulb has more than one major filament, the one giving the smaller angle will be used in the determination.

(c) *Light distribution, visual.* Excepting special headpieces for inspection purposes, the area illuminated by the beam shall be free from sharp gradations in light intensity and spectral shadows.

(d) *Light distribution, photometric.* (1) Excepting special headpieces for inspection purposes, the maximum candlepower of the light beam shall not be greater than 25 times the average or mean candlepower of the beam.³ 0

(2) The minimum candlepower of the beam based upon readings at the design voltage of the bulb shall not be less than 1.

§ 19.7 Protection against explosion hazard.

Unless properly designed, electric cap lamps may present two sources of probable explosion hazards: Ignition of an explosive atmosphere by the heated filament of the bulb in case the bulb glass is accidentally broken, and igni-

tion by sparks or flashes from the battery. MSHA therefore requires the following safeguards:

(a) *Safety device or design.* The headpiece shall have a safety device to prevent the ignition of explosive mixtures of methane and air if the bulb glass surrounding the filament is broken. Alternatively, if the lamp is designed and constructed to prevent the ignition of explosive mixtures of methane and air by protecting the bulb from breakage and preventing exposure of the hot filament, no safety device is required.

(b) *Headpiece lock or seal.* The headpiece shall be provided with a lock or seal to prevent unauthorized removal of the lens and tampering with the safety device, the bulb, or the electrical contacts.

(c) *Locks on charging terminals.* Lamps shall be equipped with a magnetic or other equally effective lock at the battery, the headpiece, or the cord assembly to prevent unauthorized access to live charging terminals.

(d) *Protection of battery terminals.* The battery covers of lamps that are recharged through the cord shall be so constructed and assembled as to prevent unauthorized access to the battery terminals.

(e) *Battery current restricted.* The amount of current flow between the conductors of the cord, if short-circuited just outside of the battery casing or cord armor, shall be limited by the design of the battery or by a fuse to such a value⁴ as will not produce sparks that will ignite an explosive mixture of methane and air.

(f) It shall not be possible to obtain a difference of potential between any two accessible points of the cap lamp when assembled for use.

NOTE: Paragraph (a) of this section is issued under the authority of Sec. 101 of the Federal Mine Safety and Health Act of 1977, Pub. L. 91-173 as amended by Pub. L. 95-164,

¹ Batteries are dropped 3 feet, at least 20 times onto an oak floor. Headpieces are dropped 6 feet, at least 20 times, onto concrete.

² Ten cords, assembled with the cord armor and outlet of the lamp with which it is to be used, are slatted at least 100,000 times through an arc of 50 degrees at approximately 90 slattings per minute.

³ The minimum allowable angle of 120 degrees will be used in determining the mean candlepower of the beam.

⁴ The following maximum short-circuit current values may be used as a guide in the design of cap lamp batteries: 100 amperes for a 4-volt battery; 75 amperes for a 6-volt battery; 50 amperes for an 8-volt battery.

91 Stat. 1291 (30 U.S.C. 811). All other paragraphs in this section continue under the original authority.

(Sec. 101, Federal Mine Safety and Health Act of 1977, 91 Stat. 1291 (30 U.S.C. 811))

[Sched. 6D, 4 FR 4003, Sept. 21, 1939, as amended at 47 FR 11369, Mar. 16, 1982]

§ 19.8 Protection against bodily hazard.

This hazard is chiefly due to the possible burning of the wearer by electrolyte spilled from the battery. MSHA therefore requires that:

(a) *Spilling of electrolyte.* The lamp shall be so designed and constructed that, when properly filled, the battery will neither leak nor spill electrolyte under actual service conditions. Lamps passing a laboratory spilling test will be considered satisfactory in this respect, contingent upon satisfactory performance in service.

(b) *Corrosion of battery container.* The material of which the container is made shall resist corrosion under conditions of use.

§ 19.9 Performance.

In addition to the general design and the safety features, MSHA considers that a lamp of permissible type should meet certain minimum requirements with respect to performance, as follows:

(a) *Time of burning and candlepower.* Permissible electric cap lamps shall burn for at least 10 consecutive hours on one charge of the battery and shall give during that period a mean candlepower of light beam of not less than 1.

(b) *Bulb life.* The average life of the bulbs shall be not less than 200 hours, and at least 92 percent of the bulbs shall have a life of 150 hours. The life of a bulb is the number of hours its main filament will burn in the cap lamp or its equivalent.

The life of a bulb having main filaments in parallel is considered ended when the first filament ceases to burn; the life of a bulb having independent main filament is considered ended when the last filament ceases to burn.

(c) *Bulb uniformity.* (1) The bulbs submitted shall meet the following minimum requirements for variation in current consumption and candlepower:

(2) The current consumption of at least 94 percent of the bulbs shall not exceed the average current by more than 6 percent. The candlepower (s. cp.) of at least 90 percent of the bulbs shall not fall short of the average candlepower by more than 30 percent.

(d) *Corrosion of contacts.* Battery terminals and leads therefrom, as well as the battery gas vents, shall be designed to minimize corrosion of the electrical contacts.

[Sched. 6D, 4 FR 4003, Sept. 21, 1939, as amended at 47 FR 11369, Mar. 16, 1982]

§ 19.10 Material required for MSHA records.

In order that MSHA may know exactly what it has tested and approved, detailed records are kept covering each investigation. These include drawings and actual equipment, as follows:

(a) *Drawings.* The original drawings submitted with the application for the tests and the final drawings, which the manufacturer must submit to MSHA before the approval is granted, to show the details of the lamp as approved. These drawings are used to identify the lamp in the approval and as a means of checking the future commercial product of the manufacturer.

(b) *Actual equipment.* (1) If MSHA so desires, parts of the lamps which are used in the tests will be retained as a permanent record of the investigation and of the lamps submitted.

(2) If the lamp is approved, MSHA will require the manufacturer, as soon as his first manufactured lamps are available, to submit one complete lamp, bearing the approval plate, as a record of his commercial product.

§ 19.11 How approvals are granted.

(a) All approvals are granted by official letter from MSHA. A lamp will be approved under this part only when the testing engineers judge that the lamp has met the requirements of the part and MSHA's records concerning the lamp are complete, including drawings from the manufacturer that show the lamp as it is to be commercially made. No verbal reports of MSHA's decisions, concerning the investigation will be given, and no informal approvals will be granted.