§ 19.5 General requirements for approval.

Electric cap lamps shall be complete units. They shall be durable in construction, practical in operation, and suitable for the conditions of underground service. They shall offer no probable explosion hazard if used in gassy or dusty mine atmospheres or bodily hazard from the spilling of the battery electrolyte. They shall exhibit, under laboratory test conditions, the various minimum performance requirements specified in this part.

§ 19.6 Specific requirements for approval.

(a) *Design.* In the determination of the adequacy of the lamp, with respect to design, the following points will be considered: (1) The materials used; (2) construction; (3) weight; (4) amount of light; (5) distribution of light; and (6) exclusion of dust from the headpiece. The suitability of the materials and the construction shall be determined by preliminary inspection, by dropping 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 ignition 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

[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.