

**§ 18.66**

the tests. The letters and numbers shall be at least ¼-inch high.

[33 FR 4660, Mar. 19, 1968, as amended at 43 FR 12314, Mar. 24, 1978]

**§ 18.66 Tests of windows and lenses.**

(a) *Impact tests.* A 4-pound cylindrical weight with a 1-inch-diameter hemispherical striking surface shall be dropped (free fall) to strike the window or lens in its mounting, or the equivalent thereof, at or near the center. Three of four samples shall withstand without breakage the impact according to the following table:

Lens diameter, (D), inches	Height of fall, inches
D<4 .....	6
4≤ D<5 .....	9
5≤ D<6 .....	15
6≤ D .....	24

Windows or lenses of smaller diameter than 1 inch may be tested by alternate methods at the discretion of MSHA.

(b) *Thermal-shock tests.* Four samples of the window or lens will be heated in an oven for 15 minutes to a temperature of 150 °C. (302 °F.) and immediately upon withdrawal of the samples from the oven they will be immersed in water having a temperature between 15 °C. (59 °F) and 20 °C. (68 °F.). Three of the four samples shall show no defect or breakage from this thermal-shock test.

**§ 18.67 Static-pressure tests.**

Static-pressure tests shall be conducted by the applicant on each enclosure of a specific design when MSHA determines that visual inspection will not reveal defects in castings or in single-seam welds. Such test procedure shall be submitted to MSHA for approval and the specifications on file with MSHA shall include a statement assuring that such tests will be conducted. The static pressure to be applied shall be 150 pounds per square inch (gage) or one and one-half times the maximum pressure recorded in MSHA's explosion tests, whichever is greater.

**§ 18.68 Tests for intrinsic safety.**

(a) General:

(1) Tests for intrinsic safety will be conducted under the general concepts of "intrinsically safe" as defined in Subpart A of this part. Further tests or requirements may be added at any time if features of construction or use or both indicate them to be necessary. Some tests included in these requirements may be omitted on the basis of previous experience.

(2) Intrinsically safe circuits and/or components will be subjected to tests consisting of making and breaking the intrinsically safe circuit under conditions judged to simulate the most hazardous probable faults or malfunctions. Tests will be made in the most easily ignitable mixture of methane or natural gas and air. The method of making and breaking the circuit may be varied to meet a particular condition.

(3) Those components which affect intrinsic safety must meet the following requirements:

(i) Current limiting components shall consist of two equivalent devices each of which singly will provide intrinsic safety. They shall not be operated at more than 50 percent of their ratings.

(ii) Components of reliable construction shall be used and they shall be so mounted as to provide protection against shock and vibration in normal use.

(iii) Semiconductors shall be amply sized. Rectifiers and transistors shall be operated at not more than two-thirds of their rated current and permissible peak inverse voltage. Zener diodes shall be operated at not more than one-half of their rated current and shall short under abnormal conditions.

(iv) Electrolytic capacitors shall be operated at not more than two-thirds of their rated voltage. They shall be designed to withstand a test voltage of 1,500 volts.

(4) Intrinsically safe circuits shall be so designed that after failure of a single component, and subsequent failures resulting from this first failure, the circuit will remain intrinsically safe.

(5) The circuit will be considered as intrinsically safe if in the course of testing no ignitions occur.

(b) Complete intrinsically safe equipment powered by low energy batteries:

(1) Short-circuit tests shall be conducted on batteries at normal operating temperature. Tests may be made on batteries at elevated temperature if such tests are deemed necessary.

(2) Resistance devices for limiting short-circuit current shall be an integral part of the battery, or installed as close to the battery terminal as practicable.

(3) Transistors of battery-operated equipment may be subjected to thermal "run-away" tests to determine that they will not ignite an explosive atmosphere.

(4) A minimum of 1,000 make-break sparks will be produced in each test for direct current circuits with consideration given to reversed polarity.

(5) Tests on batteries shall include series and/or parallel combinations of twice the normal battery complement, and the effect of capacitance and inductance, added to that normally present in the circuit.

(6) No ignition shall occur when approximately 1/2-inch of a single wire strand representative of the wire used in the equipment or device is shorted across the intrinsically safe circuit.

(7) Consideration shall be given to insure against accidental reversal of polarity.

(c) Line-powered equipment and devices:

(1) Line-powered equipment shall meet all applicable provisions specified for battery-powered equipment.

(2) Nonintrinsically safe components supplying power for intrinsically safe circuits shall be housed in explosion-proof enclosures and be provided with energy limiting components in the enclosure.

(3) Wiring for nonintrinsically safe circuits shall not be intermingled with wiring for intrinsically safe circuits.

(4) Transformers that supply power for intrinsically safe circuits shall have the primary and secondary windings physically separated. They shall be designed to withstand a test voltage of 1,500 volts when rated 125 volts or less and 2,500 volts when rated more than 125 volts.

(5) The line voltage shall be increased to 120 percent of nominal rated voltage to cover power line voltage variations.

(6) In investigations of alternating current circuits a minimum of 5,000 make-break sparks will be produced in each test.

(d) The design of intrinsically safe circuits shall preclude extraneous voltages caused by insufficient isolation or inductive coupling. The investigation shall determine the effect of ground faults where applicable.

(e) Identification markings: Circuits and components of intrinsically safe equipment and devices shall be adequately identified by marking or labeling. Battery-powered equipment shall be marked to indicate the manufacturer, type designation, ratings, and size of batteries used.

**§ 18.69 Adequacy tests.**

MSHA reserves the right to conduct appropriate test(s) to verify the adequacy of equipment for its intended service.

**Subpart D—Machines Assembled With Certified or Explosion-Proof Components, Field Modifications of Approved Machines, and Permits To Use Experimental Equipment**

**§ 18.80 Approval of machines assembled with certified or explosion-proof components.**

(a) A machine may be a new assembly, or a machine rebuilt to perform a service that is different from the original function, or a machine converted from nonpermissible to permissible status, or a machine converted from direct- to alternating-current power or vice versa. Properly identified components that have been investigated and accepted for application on approved machines will be accepted in lieu of certified components.

(b) A single layout drawing (see Figure 1 in Appendix II) or photographs will be acceptable to identify a machine that was assembled with certified or explosion-proof components. The following information shall be furnished:

- (1) Overall dimensions.
- (2) Wiring diagram.