

1.0 PURPOSE

- 1.1. This test procedure is used by the Electrical Safety Division (ESD) to determine if representative samples of a bulb ejector mechanism, a filament quenching device, or lamp bulb designs meet the requirements of 30 CFR 19.7(a), 30 CFR 20.8(a) or ACRI2001 "Criteria for the Evaluation and Test of Intrinsically Safe Apparatus and Associated Apparatus," Section 9.11.
- 1.2. To provide a person knowledgeable in the appropriate technical field with a written procedure that will assure consistent repeatable test data and results independent of the person conducting the test.

2.0 SCOPE

This Standard Test Procedure (STP) applies to bulb ejector mechanisms, filament quenching devices, and lamp bulb designs for use in electric cap lamps approved per 30 CFR Part 19, electric mine lamps other than standard cap lamps, per 30 CFR Part 20, and intrinsically safe apparatus evaluated, approved, or certified per 30 CFR Parts 18, 22, 23, and 27.

3.0 REFERENCES

- 3.1. ACRI2001 "Criteria for the Evaluation and Test of Intrinsically Safe Apparatus and Associated Apparatus".
- 3.2. ASTP2208 "Hot Wire Calibration Procedure and Small Component Ignition Procedure"
- 3.3. 30 CFR Part 18 "Electric Motor-Driven Mine Equipment and Accessories"
- 3.4. 30 CFR Part 19 "Electric Cap Lamps"
- 3.5. 30 CFR Part 20 "Electric Mine Lamps other than Standard Cap Lamps"
- 3.6. 30 CFR Part 22 "Portable Methane Detectors"
- 3.7. 30 CFR Part 23 "Telephones and Signaling Devices"
- 3.8. 30 CFR Part 27 "Methane-Monitoring Systems"

4.0 DEFINITIONS

- 4.1. Ejection Mechanism - A device located in the headpiece of a cap lamp, flashlight, or other equipment that disconnects power to the bulb filaments when the bulb envelope is broken.
- 4.2. Filament Quenching Device - A device located in the cap lamp headpiece, flashlight, or other equipment that crushes the heated filament when the bulb envelope is broken.

5.0 TEST EQUIPMENT

- 5.1. Power Supply. Range, from 0 volts to at least the voltage determined in Section 7.5 with sufficient current capacity to power the bulb (HP6002A or equivalent).
- 5.2. Chamber. Chamber shall be of sufficient size to house the ejection mechanism or filament quenching device being tested with the mechanism used to crush the bulb envelope. The chamber shall have two connection ports, one for connecting the test gas input, and the other to vent the test chamber to a safe area. Chamber shall be of adequate construction to withstand explosion of test gas.
- 5.3. Test Gases. Test gases shall consist of methane and air.
- 5.4. Gas blending and measuring. Gas mixing (Modular Dyna-blender or equivalent) and gas concentration measuring equipment (Horiba VIA-510) with the capability of providing a 7.7% ($\pm 0.2\%$) methane-in-air test gas.
- 5.5. Voltmeter. Minimum resolution of 0.01 volt and range from 0 to at least the voltage determined in Section 7.5 (Fluke 25 or equivalent).
- 5.6. Ammeter. Minimum resolution of 0.01 ampere and range from 0 to at least the current needed from the voltage determined in Section 7.5 (Fluke 25 or equivalent).
- 5.7. Digital Thermometer. Minimum resolution of 0.10 degree Celsius and minimum range from 0 to 40 degrees Celsius (Fluke 2170A or equivalent).
- 5.8. Bulb Crushing Fixture (Ejection Mechanism Type). The bulb crush fixture shall be so designed as to not interfere with the operation of the ejection safety device and not damage the lamp bulb filament after the bulb envelope has been crushed. If filament damage occurs the test is not valid. Contact point shall be of minimum mass to minimize heat transfer.

- 5.9. Bulb Crushing Fixture (Filament Quenching Device Type). The bulb crush fixture shall be so designed as to not interfere with the operation of the filament quenching device after the bulb envelope has been crushed. Contact point shall be of minimum mass to minimize heat transfer.
- 5.10. Bulb Crushing Fixture (Lamp Bulb Holder Assembly). The bulb crush fixture shall be so designed as to not damage the lamp bulb filament after the bulb envelope has been crushed. If filament damage occurs the test is not valid. Contact point shall be of minimum mass to minimize heat transfer.
- 5.11. Various connecting wires, switches, etc. as necessary.

6.0 TEST SAMPLES

- 6.1. One sample of the equipment with the ejection mechanism, filament quenching device, or lamp bulb holder assembly in its proposed final design.
- 6.2. Fifty samples of each type of lamp bulb to be used in equipment.

7.0 PROCEDURES

- 7.1. Conduct the test in an ambient temperature of $25^{\circ} \pm 10$ Celsius. Record ambient temperature.
- 7.2. Turn on the gas mixing equipment. Fill the test chamber with the test gas mixture and purge the chamber for at least two test chamber volume changes.
- If chamber volume is known;
- purge time = $2 * \text{Volume of chamber} / \text{combined flow rates of air and methane}$ (typically two minutes with available chambers).
- 7.3. Perform a calibration of the test chamber using the hot wire ignition calibration procedure ASTP2208.
- 7.4. Place the ejection mechanism, filament quenching device, or lamp bulb holder assembly and bulb crushing fixture into the test chamber.
- 7.5. Without energizing the test sample, connect the power supply to the lamp bulb and set the maximum test voltage. The test voltage is determined by applying a safety factor of $\sqrt{1.5}$ to the maximum fault voltage applied to the

lamp. If premature burnout of the bulb occurs, the voltage shall be lowered to where the bulb does not burn out for the duration of the test.

- 7.6. Visually verify the operation of the gas mixing equipment by checking flow rates to ensure that the bulb is continuously exposed to the test gas mixture in the chamber.
- 7.7. Energize the lamp bulb and purge the test chamber for a period of time determined in Section 7.2 with the test gas mixture.
- 7.8. Record the test voltage and current.
- 7.9. Quickly break the bulb envelope using the bulb crushing fixture. Observe if an ignition of the chamber occurred and record the results.
 - 7.9.1. For Ejection Mechanism Types: Continue to apply power to the headpiece. Open the test chamber, allow it to purge with fresh air. Push the bulb back into the socket to energize the filament and verify that the filament was not damaged. If the filament of the test sample does not reenergize, repeat the test with a new bulb. If ignition of a valid test sample occurs, discontinue testing.
 - 7.9.2. For Filament Quenching Device Types: Open the test chamber, allow it to purge with fresh air. The filament of each test sample shall be crushed. If ignition of a valid test sample occurs, discontinue testing.
 - 7.9.3. For Lamp Bulb Holder Assembly: If ignition of a test sample occurs, discontinue testing.
- 7.10. Repeat steps 7.4 through 7.9 on four additional bulb samples.
- 7.11. Repeat step 7.3.
- 7.12. Continue testing until a total of thirty bulb samples have been tested. Note: If the bulb is a dual filament type bulb, conduct fifteen tests on each of the two filaments.

8.0 TEST DATA

- 8.1. Test number.
- 8.2. Sample number.

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- 8.3. Ignition of the chamber? Yes/No
 - 8.4. Filament intact? Yes/No (For ejection type design)
 - 8.5. Current through the bulb before it was crushed.
 - 8.6. Voltage across the bulb before it was crushed.
 - 8.7. If a dual filament bulb, note which filament was tested
 - 8.8. Test equipment with calibration due dates.
 - 8.9. Manufacturer and part number of the bulb tested.
 - 8.10. Manufacturer and model number of the cap lamp/flashlight or lamp bulb holder assembly.
 - 8.11. Ambient temperature.

9.0 PASS/FAIL CRITERIA

The heated filament of any of the bulb samples tested shall not ignite the methane-air atmosphere of the test chamber.