

DEPARTMENT OF THE INTERIOR

JOHN BARTON PAYNE, SECRETARY

U.S. BUREAU OF MINES

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PROCEDURE FOR ESTABLISHING A  
LIST OF PERMISSIBLE MINERS' FLAME  
SAFETY LAMPS

CHARACTER OF TESTS, CONDITIONS UNDER  
WHICH LAMPS WILL BE TESTED, AND FEES



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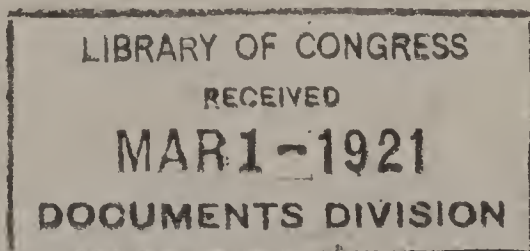
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**PROCEDURE FOR ESTABLISHING A LIST OF PERMISSIBLE MINERS' SAFETY LAMPS:  
CHARACTER OF TESTS, CONDITIONS UNDER WHICH LAMPS WILL BE TESTED,  
AND FEES.**

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**PRELIMINARY STATEMENT.**

**AUTHORIZATION.**

An act of Congress (37 Stat., 681) approved February 25, 1913, contains the following provision in regard to tests or investigations performed by the Bureau of Mines:

That for tests or investigations authorized by the Secretary of the Interior under the provisions of this act, other than those performed by the Government of the United States, or State governments within the United States, a reasonable fee covering the necessary expenses shall be charged, according to a schedule prepared by the Director of the Bureau of Mines, and approved by the Secretary of the Interior, who shall prescribe rules and regulations under which such tests or investigations may be made. All moneys received from such sources shall be paid into the Treasury to the credit of miscellaneous receipts.

The Bureau of Mines is prepared, at its Pittsburgh experiment station, to conduct tests of miners' flame safety lamps for the purpose of establishing a list of permissible safety lamps for use in gaseous mines. This schedule of tests is issued for the information of those who may desire to submit equipment for test. It supersedes schedule No. 7, issued under date of January 30, 1915, and goes into effect on the date of its approval by the Secretary.

**DEFINITION OF PERMISSIBLE.**

The Bureau of Mines considers a miners' flame safety lamp to be permissible for use in gaseous mines if the details of the construction of the lamp are the same in all respects as those tested and approved by the bureau in accordance with this schedule.

**CONDITIONS UNDER WHICH FLAME SAFETY LAMPS WILL BE  
TESTED.**

The conditions under which the Bureau of Mines will examine and test miners' flame safety lamps to establish their permissibility are as follows:

1. The tests will be made at the experiment station of the Bureau of Mines, at Pittsburgh, Pa.

2. Applications for tests shall be addressed to the Director, Bureau of Mines, Washington, D. C., and shall be accompanied by a complete description of the lamp to be tested and a full set of the drawings mentioned below:

A drawing or drawings clearly showing the character, size, and relative arrangement of the lamp parts. The drawing or drawings shall specify the material of which all parts are made.

Any other drawings necessary to identify or explain any feature that is to be considered in the approval of the lamp or its accessories.

A copy of the description, a duplicate set of the drawings, and one complete lamp shall be sent to the electrical engineer, Bureau of Mines, 4800 Forbes Street, Pittsburgh, Pa.

3. As soon as possible after receipt of his application for test the manufacturer will be notified as to the date on which his equipment will be tested and the amount of any additional material that it will be necessary for him to submit.

4. The manufacturer shall deliver to the Bureau of Mines, 4800 Forbes Street, Pittsburgh, Pa., two weeks prior to the date set for the test, the necessary parts for determining the permissibility of his lamp.

5. No one is to be present during the permissibility tests except the necessary Government officers at the experiment station, their assistants, representatives of the manufacturer of the lamp under test, and such other persons as may be mutually agreed upon by the manufacturer and the bureau.

6. Permissibility tests of flame safety lamps will not be made unless the lamps have been completely developed and are in a form in which they may be put on the market.

7. Tests will be made in the order of the receipt of application for them, provided that the necessary material is submitted at the proper time.

8. The details of the results of the tests shall be regarded as confidential by all present at the tests and shall not be made public in any way prior to the formal approval of the lamp by the Bureau of Mines.

#### GENERAL REQUIREMENTS FOR LAMPS.

1. None but bonneted lamps will be tested for permissibility.

2. Gauzes shall be made of steel, charcoal-annealed iron, or other suitable material which will pass the tests devised to determine the safety and practicability of the gauze material.

The gauze wire shall not be larger than No. 27 nor smaller than No. 29 American wire gage.

The gauze wires shall be evenly spaced not less than 28 per linear inch. If No. 29 (A. W. G.) wire is used there shall be at least 30 wires per linear inch.

The fabrication into gauzes shall be effected so that there shall be no material distortion of the gauze fabric. The engineers in charge of the tests shall decide whether or not sufficient distortion exists to affect the safety of the lamp.

3. If lamp standards are used, a straight line touching the exterior part of any two consecutive standards shall not touch the glass.

4. The lamp shall be so constructed that it will not be possible without easy detection to assemble the component parts of the lamp without the gauzes.

5. The lamp shall be provided with an effective magnetic locking device to prevent the fuel vessel, glass, or gauzes from being removed or from being loosened to such an extent that the safety of the lamp is impaired while the lamp is in the locked condition. Provision shall also be made for taking up the play due to wear of the screw threads.

6. The glasses shall have smooth surfaces throughout. They should have their ends ground parallel and at right angles to the axis of the glass.

The maximum allowable deviation in the distance between the ends of the glass measured at any two places shall be 0.01 inch.

The glasses shall be as nearly uniform in thickness as it is practicable to make them.

7. The glass shall be distinctly and permanently marked by a name or design by which its type is designated for trade purposes.

8. The lamp shall burn for at least 12 hours with flame adjusted to a height of 1 inch.

9. The lamp, fully assembled, shall give an average mean zonal candlepower<sup>1</sup> of at least 0.3 throughout a period of 10 hours, during which the height of the flame is 1 inch.

10. The angle of the light zone shall be not less than 90°, measured when the height of the flame is 1 inch.

11. The lamp shall develop a well-defined gas cap in a gas and air mixture of 2 per cent gas. Observation shall be made by at least three persons in a totally dark inclosure.

12. The lamp shall not be extinguished when let swing through an arc of 35° against a wood bumper, when the length of the radius from the point of support to the bottom of the lamp is 7 feet. The height of the wick flame shall be 1 inch for this test.

13. Lamps will be examined with special reference to the mechanical construction, size, weight, replacement of parts, ease of inspection, and attention required.

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<sup>1</sup> As defined in the standardization rules of the A. I. E. E.

## CHARACTER OF TESTS.

## MECHANICAL TESTS USING A COMPLETE LAMP.

Tests to determine the security of the lamp as an assembled unit and the durability of the lamp glasses under severe conditions shall be made under the following conditions: 1. Dropping the lamp itself. 2. Dropping a weight upon the lamp. 3. Dropping a weight attached to the bottom of the lamp (the lamp being suspended).

## DETAILS OF TESTS.

1. *Dropping the lamp.*—This test shall consist of five trials in which a completely assembled lamp is dropped onto a wood floor. The lamp shall be suspended at a height of 6 feet, measured from the floor to the bottom of the lamp, and then released by mechanical means. The lamp shall be fitted with a new glass before each trial.

This test is devised to show the durability of the glass in case of accident or in case of rough handling of the lamp. Therefore, if the glass is broken in not more than one trial, the lamp glasses will be considered satisfactory. If the glass is broken in more than one trial, the lamp glasses will be considered unsatisfactory. However, if the glass is broken in two but not more than two of the five trials, a retest of five trials will be made. If more than one glass is broken in the retest the lamp glasses will fail to pass the test.

2. *Dropping a weight upon lamp.*—This test shall consist of a single trial in which a 5-pound weight is dropped upon a completely assembled lamp. The lamp shall be placed in a vertical position upon a wood floor and a lead weight (3 inches in diameter and  $1\frac{3}{4}$  inches thick) shall be suspended directly over the lamp at a height of 6 feet, measured from the top of the lamp to the bottom of the weight. The weight shall be released mechanically.

This test is devised to show the ability of the lamp framework to withstand impact blows such as might result from falling rock. Therefore, if the framework is materially distorted, the lamp will fail to pass the tests. Also, if the lamp glass is broken, in this test, and in a retest made under identical conditions, the lamp glasses will be considered unsatisfactory.

3. *Dropping weight attached to bottom of the lamp.*—This test shall consist of three trials in which a 10-pound weight is attached to a suspended lamp. The lamp shall be held in position by a clamp around its upper part, and the weight shall be attached by means of a second clamp and wire rope to the bottom part of the lamp. The weight is then raised after which it is released mechanically in such a manner as to permit it to fall through a distance of 6 feet (at which point the rope is taut) giving a sudden jerking force to the lamp.



This test is devised to show the security of the framework of the lamp, especially the lamp standards. Therefore, if, as a result of any of the three trials, the standard or other parts become so loosened, weakened, or otherwise distorted as to affect the safety of the lamp, the framework of the lamp will be considered unsatisfactory and the lamp will fail to pass the test.

The mechanical tests shall all be made with the same lamp. The engineer in charge of the tests shall decide whether or not sufficient distortion resulted to affect the safety of the lamp. A lamp that has successfully passed the mechanical tests shall be reassembled and subjected to at least three trials in moving explosive mixtures of Pittsburgh natural gas and air. These trials may be made either before or after the regular tests in gas and under such conditions as the engineer in charge of the tests shall judge most likely to prove the safety of the lamp.

The term "broken glass" wherever used in this schedule shall be interpreted to mean a glass having any of the following defects: (a) Three or more cracks; (b) one or more spalls or chipped places which include more than two-thirds of the thickness of the glass; (c) one or more cracks which extend the entire length of the glass; (d) two or more cracks which include an area.

#### TESTS OF LAMP GLASSES.

In addition to tests in the assembled lamp, glasses submitted for use with a lamp shall be tested separately for durability under the following conditions: 1. Dropping a weight upon the glass. 2. Spraying heated glasses with cold water.

#### DETAILS OF TEST.

1. *Dropping a weight upon the glasses.*—This test shall consist of 20 trials (one for each of 20 glasses), in which a 1-pound lead weight is dropped upon a glass. The glass shall be placed vertically on a wood floor and a lead weight (2½ inches in diameter and ½ inch thick) shall be suspended directly over the glass at a height of 4 feet, measured from the top of the glass to the bottom of the weight. The weight shall be guided in its fall by a mechanical arrangement in order that the end of the glass will be hit squarely.

If two or more glasses are broken they will fail to pass the test and will be rejected without further tests.

2. *Spraying heated glasses.*—This test shall consist of subjecting 50 glasses to a water spray after they have been heated to a predetermined temperature. The glasses will be tested in groups of 10. The glasses shall be heated to a temperature of 212° F. and then sprayed with water ranging from 60° to 65° F.

If five or more glasses are broken as a result of this test, the glasses will fail to pass the test.

#### TESTS TO DETERMINE THE MEAN ZONAL CANDLEPOWER OF THE LAMP.

At least three lamps shall be tested for candlepower and the average result taken as the true performance of the lamp. Each lamp shall be placed in a photometric cube and compared with a specially made standard electric lamp.

The lamp shall have been burning for at least one-half hour before the start of the test and the flame height shall be maintained at 1 inch throughout the test.

The height of the flame shall be measured from the tip of the luminous flame to the top of the wick holder.

The fuel used shall be that which the manufacturer supplies for use with his lamp. This fuel should be identified by specifications.

The angle of the light zone shall be the angle between the extreme light rays from the upper and the lower parts of the wick flame.

#### TESTS TO DETERMINE THE SAFETY OF THE LAMP IN EXPLOSIVE MIXTURES.

Completely assembled, lighted lamps shall be tested in moving mixtures of Pittsburgh natural gas and air as follows:

*Horizontal currents (Gallery 6).*—Tests in 6, 8.6, and 11 per cent gas mixtures at velocities of 600, 800, 1,000, 1,200, 1,500, 2,000, and 2,500 feet per minute. Three trials shall be made under each combination of gas percentage and velocity (two trials of two minutes' duration and one trial of five minutes' duration). Coal dust shall be mixed with the gaseous mixture during the last minute of each five-minute trial. At the end of every trial the gas valve shall be closed very slowly, other settings remaining untouched until the gas valve is closed.

Into a horizontal current of 8.6 per cent gas mixture moving at 1,500 feet per minute the lighted lamp will be suddenly thrust from below. Three trials.

*Vertical ascending, vertical descending, 45° ascending, and 45° descending currents (Gallery 6).*—One to three trials of two minutes' duration in an 8.6 per cent gas mixture at 600, 1,000, 1,500, and 2,500 feet per minute velocity shall be made for each direction of current.

*Still, gaseous mixture (Gallery 3).*—A completely assembled lighted lamp shall be placed in an 8.6 per cent mixture of natural gas and air for five minutes. Three trials. (This test need not be made upon lamps which are tested in connection with igniters.)

In all of the tests in gaseous mixtures the lamp will be fitted with new gauzes for every trial if the preceding trial has oxidized or otherwise noticeably changed the surface of the gauze.

An explosion exterior to the lamp in any of these tests will cause the lamp to be rejected.

## IGNITER TESTS.

Lamps having igniters will be tested to determine the safety and permissibility of the igniter device.

These tests will be made:

1. To determine if external ignition is possible when the igniter is operated in still and in moving currents of gas and air mixtures.

2. To determine if the residue left in the lamp after working the igniter device is a source of danger in the subsequent use of the lamp in inflammable mixtures of gas and air.

3. To determine the nature of the material used in the igniter device.

The igniter will have passed the tests if no external ignition is caused by manipulating the igniter when in position within the lamp, or if no external ignition is caused by the use of the lamp in inflammable mixtures of gas and air after the igniter has been in service.

Applicants for tests will be required to furnish two complete igniter devices and five dozen igniter refills, which shall be shipped in sealed boxes or packages with the trade name written on the outside and addressed to the electrical engineer, Bureau of Mines, 4800 Forbes Street, Pittsburgh, Pa. The approximate chemical composition of the igniter tape or point and the name of the manufacturer shall be furnished.

## PROPERTIES OF GAS USED IN THE TESTS.

The inflammable gas used in these series of tests will be the natural gas supplied to the city of Pittsburgh.

## APPROVAL OF PERMISSIBLE MINERS' SAFETY LAMPS.

## NOTIFICATION OF MANUFACTURER.

When the bureau's engineers are satisfied that a lamp is permissible, the manufacturer, agent or applicant, and the mine inspection departments of the several States shall be notified to that effect. As soon as a manufacturer receives formal notification that his lamp has passed the tests prescribed by the Bureau of Mines, he shall be free to advertise such lamp as permissible.

## SCOPE OF APPROVAL.

The bureau's approval of any flame lamp shall be construed as applying to all lamps of the same manufacturer that have the same construction as the lamps tested and approved by the bureau, but to no other lamps. The manufacturer shall, before claiming the bureau's approval for any modification of his approved lamp, submit to the bureau drawings that shall show the extent and nature of such modification in order that the bureau may decide whether or not it should

test the remodeled lamp before approving it. Each approval of a permissible flame safety lamp will be given a serial number. Approvals of modified forms of a previously approved lamp will bear the same number as the original approval with the addition of the letters a, b, c, etc.

APPROVAL PLATE.

The manufacturer will be required to attach to the lamp a plate bearing the seal of the Bureau of Mines and inscribed as follows:

|   |
|---|
| <p>PERMISSIBLE MINERS' FLAME SAFETY LAMP.<br/> ISSUED FOR SAFETY, DURABILITY, AND EFFICIENCY TO THE<br/> ----- COMPANY.<br/> APPROVAL NO. -----</p> |
|---|

An attached approval plate will not be required when the seal and inscription can be satisfactorily stamped into the lamp.

WITHDRAWAL OF APPROVAL.

The bureau reserves the right to rescind, for cause, at any time, any approval granted under the conditions herein set forth.

FEES FOR TESTING FLAME SAFETY LAMPS.

The following fees, to be charged on and after the date of approval of this schedule, have been established and approved by the Secretary of the Interior:

|  |           |
|--|-----------|
| Item 1. <i>Lamp with igniter</i> .—For a complete official investigation of a lamp which is equipped with an igniter-----        | \$150. 00 |
| Item 2. <i>Lamp without igniter</i> .—For a complete official investigation of a lamp which is not equipped with an igniter----- | 100. 00   |
| Item 3. <i>Segregated charges</i> —  |           |
| Preliminary inspection-----  | 5. 00     |
| Tests to determine the mechanical strength of the lamp-----  | 5. 00     |
| Tests to determine the mechanical strength of the glasses-----   | 5. 00     |
| Temperature test of glasses-----   | 10. 00    |
| Tests to determine the safety of the lamp in explosive mixtures--  | 50. 00    |
| Tests to determine the mean zonal candlepower and time of burn-<br>ing of the lamp-----  | 20. 00    |
| Final inspection-----  | 5. 00     |
| Igniter tests-----   | 50. 00    |
|  | 150. 00   |

Item 4. *Special tests*.—Special tests to assist the manufacturer in the development of equipment will be made at his request and will be charged for in accordance with the work involved. Each request for special tests should be accompanied by a fee of \$100 made payable to the Secretary of the Interior. Any unused moneys from such deposit will be refunded at the completion of the special tests on request by the manufacturer.

**REMITTANCES.**

Manufacturers who submit lamps for tests to determine permissibility for use in gaseous mines will be required to furnish a certified check or bank draft that shall cover the total fees required for the tests and shall be made payable to the Secretary of the Interior. Such fees shall be received at least one week prior to the date set for beginning the tests; otherwise the equipment of the next applicant on the list will be tested.

**SYNOPSIS OF PROCEDURE TO BE FOLLOWED IN MAKING APPLICATION FOR TESTS, SUBMITTING MATERIAL, CONDUCTING TESTS, AND NOTIFYING APPLICANT OF RESULTS.**

1. Application for tests should be addressed to the Director of the Bureau of Mines, Washington, D. C. The application should be accompanied by a check or draft and by a complete description of the lamp to be tested and a set of the drawings described under "Conditions for Tests." Duplicate copies of the application, description, and drawings should be sent to the electrical engineer, Bureau of Mines, 4800 Forbes Street, Pittsburgh, Pa., accompanied by a complete lamp.

2. As soon as the application has been reviewed by the bureau's engineers the applicant will be notified of the date of the test and the number of lamp parts and accessories that it will be necessary for him to submit.

3. After receiving this notification the applicant should send the material required to the electrical engineer, Bureau of Mines, 4800 Forbes Street, Pittsburgh, Pa. This material should be delivered not less than two weeks in advance of the date set for the beginning of the tests. At this time the applicant should state the name and address of the applicant's representative who will witness the tests.

4. The tests will be begun on the date set and continued until the lamp is approved, rejected, or withdrawn. In case the lamp is withdrawn by the manufacturer before an investigation has been completed, fees will be charged in accordance with the work performed up to the time of withdrawal. Any surplus funds over and above those covering the tests made will be refunded upon due notification by the manufacturer that no more tests are contemplated.

5. After the bureau's engineers have considered the result of the tests, a formal report of the approval or disapproval of the lamp will be made to the applicant in writing by the Director of the Bureau of Mines. No verbal report will be made, and the details of the tests must be regarded as confidential by all present.

F. G. COTTRELL,  
*Director.*

Approved, December 20, 1920.

JOHN BARTON PAYNE,  
*Secretary.*





