

# BUREAU OF EXPLOSIVES

## SPECIFICATIONS FOR RED RAILWAY OR RED HIGHWAY FUSES

### SECTION I

#### General Requirements

1. The fusee shall consist of a tube of suitable material containing flare composition together with a suitable means of ignition by friction with or without a means of support while burning. If such means of support is used it shall be of a type approved by the Bureau of Explosives.
2. The tube shall be colored red to indicate its burning color.
3. Directions for use, date of manufacturer and the name of the manufacturer shall be printed legibly on the tube of the fusee. Coding is permitted on Highway Fusees when approved by the Bureau. The Directions for use shall include the following instructions printed in capital letters:

"ALWAYS POINT FUSEE AWAY FROM FACE  
AND BODY WHILE IGNITING AND AFTERWARDS.  
AFTER IGNITING HOLD 5 SECONDS BUT NOT  
MORE THAN 10 SECONDS BEFORE DROPPING."  
(Last sentence required only for railway fusees).

For ten minutes or longer fusees, letters of above quoted instructions must not be less than 12 point type.

4. If the fusees are to be marked in compliance with Bureau of Explosives specifications, the manufacturer must have sample fusees examined and tested at least once in each calendar year by the Bureau of Explosives to determine compliance with these specifications.
5. Samples shall be selected by a Bureau inspector from production. One gross required for complete examination.
6. The fusee shall meet all specification requirements and pass all tests.

### SECTION II

#### Specific Requirements

1. Fusees with a nominal burning time not exceeding 10 minutes shall not exceed 14 in. overall length or 1-1/8 in. outside diameter. Fusees with a nominal burning time not exceeding 5 minutes shall not exceed 9 in. overall length or 1-1/8 in. outside diameter, exclusive of handle.
2. The base of the fusee shall be closed by means of a disc or plug except that other designs may be used if approved by the Bureau of Explosives. The efficiency of the closure shall not be impaired when the fusee is dropped freely through a vertical distance of 20 ft. onto concrete (The angle of impact being 20 deg.) Bending of the spike, if any, shall not be considered as failure.
3. The entire rim of the head of the fusee shall be free from ignition compound.
4. The head of the fusee shall be protected by a removable cap not less than 1-3/4 in. long, which is so constructed that it is mechanically impossible for the inner surface of the cap to cause ignition or impair the efficiency of the ignition compound under normal conditions of handling.
5. The cap shall be securely fastened to the body of the fusee in such a manner as to minimize the likelihood of accidental detachment. Cap or fastenings must not cover or obscure required printed matter.
6. The cap shall be so constructed that after detachment it forms a device for lighting the ignition composition by friction.
7. The ignition composition and the scratch surface shall be protected from accidental exposure or ignition.
8. The completed fusee shall be of strength sufficient to prevent it from breaking when a weight is applied for 5 minutes in accordance with the following test:
  - (a) The fusee is placed on two supports having a flat bearing surface of 1/4 in. width set 6 in. apart and a weight of 80 lb. applied at a point equidistant from the two supports through a looped wire under which is centrally placed a 1-in. wide half ring section of rigid metal tube not over 1-1/4 in. in diameter.
 

Where the length of fusee does not permit the above test, the following method shall be used:
  - (b) The fusee is placed on two supports having a flat bearing surface of 1/4 in. width set 4 in. apart and a weight of 120 lb. applied at a point equidistant from the two supports through a looped wire under which is centrally placed a 1-in. wide half ring section of rigid metal tube not over 1-1/4 in. in diameter.
9. Not more than 20 per cent of the fusees tested shall be extinguished when dropped from a height of 30 feet onto railroad ballast after being ignited and held for 10 seconds. This test is not required for 15, 20 and 30 minute highway fusees.
10. (a) The ignition compound shall be waterproof and shall be capable of withstanding immersion in water at 70 deg. F for 10 minutes without impairing efficiency to the extent that the fusee cannot be fully ignited by the usual means. When conducting this test the ignition cap shall be removed. The body of the fusee shall be immersed horizontally so that the upper portion of the tube shall be 2 inches below the surface of the water. When the body of the fusee is removed excess water shall be removed from the ignition mix (by wiping or other means).
  - (b) This test to be conducted the same as 10(a) except the striking cap is to remain on the fusee. The excess water shall be removed from the striking surface of the cap and the ignition mix.

11. The ignition or head composition shall be securely fastened to the fusee and shall withstand friction of the scratch cap without breaking or becoming detached in whole or in significant part from the fusee.
12. The cap shall be removed from the fusee and it shall be ignited in the prescribed manner. After being held for 10 seconds in air, and while still being held, it shall be slowly submerged in water in a vertical position head down for a period of one minute. The depth of the water above the head of the fusee shall be at least 4 inches and the temperature shall be 70 deg. F. Continued burning under water for the full one-minute period shall qualify the fusee under this test. Not more than 20 per cent of the fusees tested shall be extinguished. It is not required that the fusee continue to burn when removed from the water.
13. The fusee shall not chimney in such a manner as to materially obscure the flame when placed at an angle of 20 deg. from the vertical (ignition end up).
14. The composition of the fusee shall be such that spontaneous ignition does not occur when the moistened composition is exposed to a temperature of 212 deg. F. for 72 consecutive hours.
15. Flare color composition containing sulphur shall not contain more than .5% of any chlorate.
16. No fusees containing any amount of chlorate shall contain ammonium salts.
17. The ignition temperature of the igniter composition and flare color composition shall be not lower than 350 deg. F. when determined by either of the following methods:
  - (a) After separation, the compositions shall be placed in separate loosely covered beakers which shall be placed for one hour in an oven maintained at a temperature of 350 deg. F. The compositions shall not ignite or explode during this period.
  - (b) A brass block 1" x 1-1/2" x 10" is used. Two rows of eight holes, 3/8" diameter by 3/4" deep, are bored with centers about 1/2" from and along the two long edges of the block. The rows start 3" from both ends of the block and are spaced evenly in the center 4 inches. A hole for a thermometer is bored longitudinally through the exact center of the body of the block. The block is used over a shield and is heated by a burner fitted with a "fishtail". The procedure is as follows: about one gram portion of the flare and ignition compositions (separately) are placed in several of the holes and tamped lightly with a glass rod. The "approximate ignition temperature" is determined by heating the block at about 10 deg. F. per minute until the composition ignites or to 350 deg. F. if no ignition occurs. To determine the actual ignition temperature the block is heated to 25 - 30 deg. F below the "approximate ignition temperature" determined above or to 320 deg. F. (which ever is lower) and the mixture placed in the holes and tamped. The temperature is then raised to the ignition temperature or to a maximum of 350 deg. F. The composition shall not ignite or explode during this period.
18. The completed fusee shall withstand incubation at 167 deg. F. for 48 hours without ignition or significant decomposition.

### SECTION III

#### Performance Requirements

##### 1. Burning Time:

Burning time is calculated immediately upon ignition of the fusee.

When ignited and placed at an angle of 20 degrees to the vertical (ignition end up) or in a horizontal position, fusees shall burn within the following limits:

| Type      | Minimum    | Maximum       |
|-----------|------------|---------------|
| 5 minute  | 5 minutes  | 6-1/2 minutes |
| 10 minute | 10 minutes | 13 minutes    |
| 15 minute | 15 minutes | 18 minutes    |
| 20 minute | 20 minutes | 23 minutes    |
| 30 minute | 30 minutes | 33 minutes    |

##### 2. Color:

The color of the light from burning red fusees shall show values in terms of the I. C. I. Standard Observer and Coordinate System of not less than 0.61 for the X-coordinate and not more than 0.34 for the Y-coordinate for any of the determinations made during the positive flame emitting period.

##### 3. Intensity:

Except for the first 45 seconds and the last 15 seconds of burning time which need not be considered, the mean intensity of the light emitted from a burning fusee shall be not less than 70 candles and shall not be less than 50 candles for more than any 25 consecutive seconds. This test to be conducted with fusee placed at an angle of 20 degrees from the vertical (ignition end up) and sloping directly away from the photometer. The photometer shall be level with the flame and not less than 24 inches therefrom.

Additional copies may be obtained from:  
Bureau of Explosives  
Association of American Railroads  
American Railroads Building  
1920 "L" Street N. W.  
Washington, D. C. 20036

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