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|--|-------------------------|
| CDS No. ASTP2137   | Page: 1 of 16           |
| Original Issue Date: 09/08/97  | Revision Date: 12/11/03 |
| Signature/Initial: Chief, Division Of Electrical Safety <i>David C Chirdon</i> |                         |

## REQUIREMENTS FOR EXPLOSION TESTING PER 30 CFR, 18.62

### 1.0 Purpose

The purpose of this document is to outline test procedures to be used in conducting explosion testing as required by 30 CFR, Part 18.62.

### 2.0 Scope

This STP outlines the procedures used to perform explosion tests in the Electrical Test Laboratory.

### 3.0 Reference

30 CFR 18.62

### 4.0 Definitions

- 4.1 Pressure Piling - The development of abnormal pressure as a result of accelerated rate of burning of a gas-air mixture, frequently caused by restricted configurations within enclosures.
- 4.2 Dummies - Parts substituted during explosion testing for internal electrical components.
- 4.3 General Enclosures - about 2000 cu. inches or greater and 10 feet long maximum
- 4.4 Small Enclosures and Headlights - about 2000 cubic inches in volume or less, and about 1.5 feet maximum length
- 4.5 Tube Luminaires- Tubes used to house fluorescent lights. Usually tubes are polycarbonate.
- 4.6 Direct Sampling Arrangement - a test setup where the explosion-proof enclosure is placed in the gallery and the transducers and gas in and gas out is hooked directly into the X/P enclosure.
- 4.7 Standard Test Vessel - A vessel designed to test

|  |                         |
|--|-------------------------|
| CDS No. ASTP2137   | Page: 2 of 16           |
| Original Issue Date: 09/08/97  | Revision Date: 12/11/03 |
| Signature/Initial: Chief, Division Of Electrical Safety <i>David C Chirdon</i> |                         |

enclosures with volume of less than 30 cubic inches. The enclosure is placed in the test vessel and the fittings for the transducers and gas in and gas out are hooked up to the test vessel rather than the enclosure.

## 5.0 Test Procedures

5.1 The general sequence of the tests shall be:

5.1.1 Check for pressure piling,

5.1.2 Check for integrity of flamepaths and general mechanical design, and

5.1.3 Check for weakened areas and areas of minimal design.

5.2 With dummies installed, choose spark locations most likely to cause pressure piling.

5.3 With dummies removed, choose spark location to produce the highest pressure.

5.4 Centralize ignition location: cross-sectional center when firing from the ends and geometrical when firing from the center.

5.5 If explosion pressure exceeds 80 psig, then recheck test fittings for tightness: dope and retighten if necessary to assure that the explosion-proof enclosure is adequately sealed against stray leakage.

5.6 Keep fittings short - especially for small enclosures.

5.7 For enclosures having a free volume less than 300 cu. in., use the 3/8" solenoid valves.

5.8 For enclosures between 30 and 300 cu. in. of free volume, use the direct sampling setup.

5.9 For enclosures having a free volume less than 30 cu. in., use the 22.4 liter standard test vessel arrangement.

5.10 If an area of an enclosure is suspected of being damaged during explosion testing or the design of a

|  |                         |
|--|-------------------------|
| CDS No. ASTP2137   | Page: 3 of 16           |
| Original Issue Date: 09/08/97  | Revision Date: 12/11/03 |
| Signature/Initial: Chief, Division Of Electrical Safety <i>David C Chirdon</i> |                         |

flamepath is questionable then additional check tests may be conducted using a 9.6% mixture in the enclosure and 7.0% in the gallery. International Electrotechnical Commission (IEC) tests per Publication 79-1 - "Electrical Apparatus for Explosive Gas Atmospheres" may be considered.

## 6.0 Test Procedures

6.1 Tests are conducted in a gallery with observation ports at all sides.

6.2 The enclosure is filled with and surrounded by an explosive mixture of natural gas and air or methane and air.

6.2.1 If natural gas is used, the content of methane and ethane shall total at least 98.0 by volume per centum with nitrogen and propane the remainder.

6.2.2 The enclosure and gallery gas concentrations shall be monitored with an accuracy of +/-0.1 by volume per centum just before ignition of each test.

6.2.2.1 The enclosure and gallery gas concentration shall not differ by more than +/-0.3 by volume per centum at the time of ignition.

6.2.3 The internal mixture shall be ignited by an electrical spark with an energy of 100 millijoules or greater. A single spark plug is used for all testing.

6.2.4 Pressure-time records shall be obtained for each test to identify pressure piling.

6.2.4.1 The pressure measuring and recording system shall have a frequency response of 40 hertz (10 ms sample rate for digital systems) or greater and shall provide rate of rise detail equivalent to recorder chart speed of at least 25

|  |                         |
|--|-------------------------|
| CDS No. ASTP2137   | Page: 4 of 16           |
| Original Issue Date: 09/08/97  | Revision Date: 12/11/03 |
| Signature/Initial: Chief, Division Of Electrical Safety <i>David C Chirdon</i> |                         |

mm/s for all tests using dummies.

6.2.4.2 The accuracy of the pressure record trace shall be within +/-1 psi at 100 psig static.

6.2.5 The enclosure and gallery atmosphere shall be completely purged and recharged with fresh combustible mixture after every test or else a 40 to 1 or greater gallery to enclosure volume ratio per test is used.

6.2.6 After each test, the pressure-time shall be examined for spike pressure peaks and for a sudden increase in the rate of pressure rise. Pressure piling occurs when the rate of rise is 2 psi/millisecond or faster.

6.2.6.1 If this occurs, and no pressure peaks exceed 125 psig, then at least six additional tests, as follows, (or until a test has a pressure which exceeds 125 psig, whichever occurs first) shall be conducted using the same ignition location. The following tests can be discontinued if a pressure in excess of 125 psig is recorded.)

6.2.6.2 Two tests shall be repeats of the previous tests.

6.2.6.3 Two tests will be conducted with a gas concentration 1 percentage point above and 1 percentage point below the original concentration.

6.2.6.4 Two tests shall be conducted with the spark beyond (one test) and behind (one test) the original location by one-half the distance between the original location and physical interference to the spark. No change will be greater than six inches.

6.2.7 If any pressure peak exceeds 125 psig for

|  |                         |
|--|-------------------------|
| CDS No. ASTP2137   | Page: 5 of 16           |
| Original Issue Date: 09/08/97  | Revision Date: 12/11/03 |
| Signature/Initial: Chief, Division Of Electrical Safety <i>David C Chirdon</i> |                         |

any enclosure tests, the manufacturer must either make constructional changes that will result in a reduction of pressure to 125 psi or less or conduct static pressure tests of the enclosure, with the enclosure withstanding a static pressure of twice the highest value recorded in any previous tests.

6.2.8 Identical tests may be conducted employing a high frequency response (4000 hertz or greater) pressure measuring and recording system to verify the excess pressures.

6.3 Tests must be conducted under conditions most likely to show failure, such as 9.6%CH<sub>4</sub> gas-air mixture, optimum spark location, and testing with and without dummies. Placement of the electrical spark must be determined on a case by case basis for the various size and shape enclosures and the internal component configurations. Attempt to centralize the ignition location cross-sectionally when firing from the ends and geometrically when firing from the center.

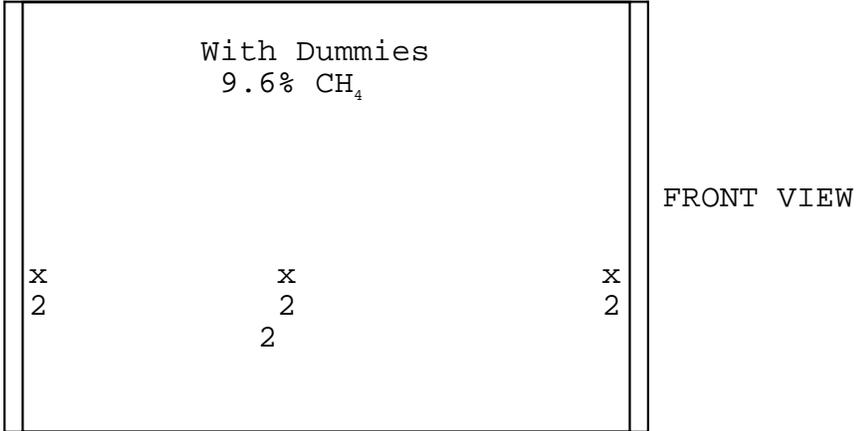
6.4 When previously certified cable glands are to be used on an enclosure, at least one complete gland assembly, including the acceptable cable, of each type of gland assembly shall be tested. The remaining stuffing boxes may be plugged.

6.5 Explosion testing of windows and lenses shall not be conducted within 24 hours after the drop weight tests are completed. Windows and lenses shall be inspected for explosion damage a day or more after testing.

## 7.0 Explosion Testing Sequence - General Size Enclosures

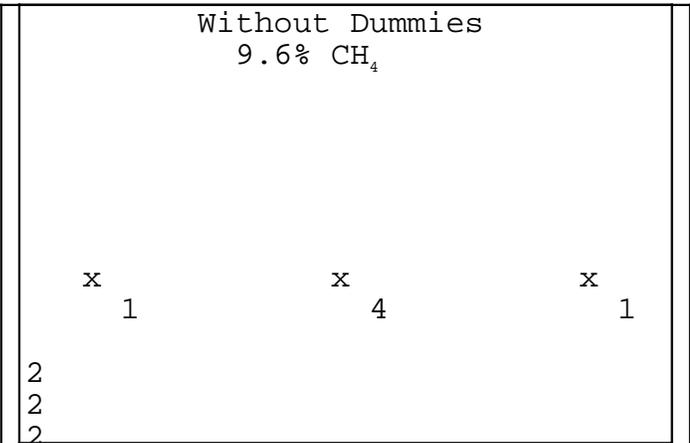
7.1. FIRST SERIES - 2 tests at each ignition. Use 25 mm/s recorder paper speed. This set is to check for pressure piling.

|  |                         |
|--|-------------------------|
| CDS No. ASTP2137   | Page: 6 of 16           |
| Original Issue Date: 09/08/97  | Revision Date: 12/11/03 |
| Signature/Initial: Chief, Division Of Electrical Safety <i>David C Chirdon</i> |                         |



7.1.1 With dummies installed and a 9.6% CH<sub>4</sub> mixture, conduct two tests each with ignition at each end and at the center of the enclosure for a total of six tests.

7.1.2 SECOND SERIES - 5 mm/s recorder paper speed normally acceptable for rest of tests. This second series of tests is to check for flamepaths and general mechanical design.



7.1.2.1 With dummies removed an a 9.6% CH<sub>4</sub> mixture,

|  |                         |
|--|-------------------------|
| CDS No. ASTP2137   | Page: 7 of 16           |
| Original Issue Date: 09/08/97  | Revision Date: 12/11/03 |
| Signature/Initial: Chief, Division Of Electrical Safety <i>David C Chirdon</i> |                         |

conduct one test each with ignition at each end of the enclosure and four tests with ignition at the center of the enclosure for a total of six tests.

7.1.3

|   |
|---|
| Without Dummies<br>7.0% CH <sub>4</sub><br><br><br><br><br><br><br><br><br><br>x<br>2 |
|---|

THIRD SERIES - If one of the tests with dummies produced a pressure higher than without by more than 2 psi, then that configuration will be used. A maximum of 16

tests must be conducted.

7.1.3.1 With dummies removed and a 6.8 to 7.2% CH<sub>4</sub> mixture, conduct two tests with ignition at

|  |                         |
|--|-------------------------|
| CDS No. ASTP2137   | Page: 8 of 16           |
| Original Issue Date: 09/08/97  | Revision Date: 12/11/03 |
| Signature/Initial: Chief, Division Of Electrical Safety <i>David C Chirdon</i> |                         |

the center of the enclosure.

Without Dummies  
9.6% CH<sub>4</sub> & Coal Dust

x  
2

|  |                         |
|--|-------------------------|
| CDS No. ASTP2137   | Page: 9 of 16           |
| Original Issue Date: 09/08/97  | Revision Date: 12/11/03 |
| Signature/Initial: Chief, Division Of Electrical Safety <i>David C Chirdon</i> |                         |

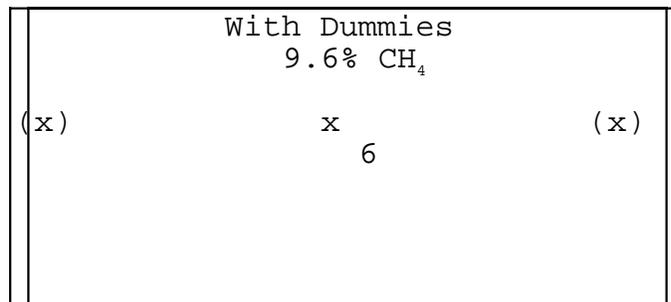
7.1.3.2 With dummies removed and a 9.6 CH<sub>4</sub> mixture, and coal dust inserted through any opening in the enclosure, conduct two tests with ignition at the center of the enclosure.

## 7.2 SMALL ENCLOSURES AND HEADLIGHTS

NOTE: Four samples of the headlights or machine lights are required to be submitted for testing.

7.2.1 FIRST SERIES - Conduct two tests with ignition at the center of the enclosure. If the dummies and or constructional details form a 60% restriction or greater which divides the enclosure into two volumes, conduct 2 tests with ignition in each volume (4 tests total) instead of central ignition. Use 25mm/s recorder speed. Six tests total.

### FRONT VIEW



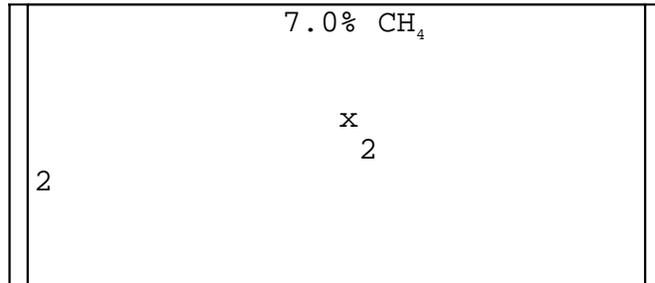
7.2.2 SECOND SERIES - 5mm/s recorder paper speed normally acceptable for remaining tests.

7.2.2.1 With dummies removed and 9.6% CH<sub>4</sub> mixture, conduct six tests with ignition at the center of the enclosure.

7.2.3 THIRD SERIES - (\* with dummies if they resulted in highest test pressure.) A total of 16 tests minimum must be performed.

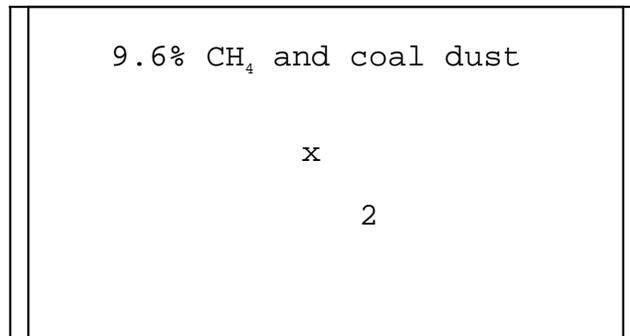
|  |                         |
|--|-------------------------|
| CDS No. ASTP2137   | Page: 10 of 16          |
| Original Issue Date: 09/08/97  | Revision Date: 12/11/03 |
| Signature/Initial: Chief, Division Of Electrical Safety <i>David C Chirdon</i> |                         |

7.2.3.1 With dummies removed and 7.0% CH<sub>4</sub> mixture, conduct two tests with ignition at the center of the enclosure.



\*Without Dummies

7.2.3.2 With dummies removed and 9.6% CH<sub>4</sub> mixture and coal dust inserted through any opening in the enclosure, conduct two tests with ignition at the center of the enclosure.



\*Without

Dummies

7.2.3.3 For headlights and machine lights, the other three samples shall have tests each as described in 7.2.2.1. If the lenses in the lights are made of polycarbonate, then the sample scheduled for a minimum of 10 tests shall have 3 tests as described in 7.2.2.1, wait one or more days, and

|  |                         |
|--|-------------------------|
| CDS No. ASTP2137   | Page: 11 of 16          |
| Original Issue Date: 09/08/97  | Revision Date: 12/11/03 |
| Signature/Initial: Chief, Division Of Electrical Safety <i>David C Chirdon</i> |                         |

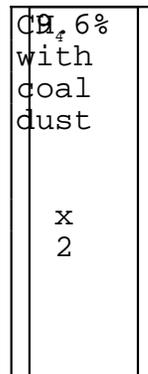
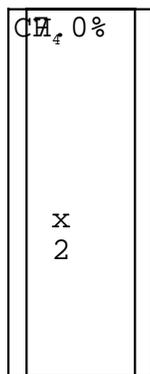
then conduct the remaining tests as described in 7.2.3.1, and 7.2.3.2

### 7.3 TUBE LUMINAIRES

7.3.1 FIRST SERIES - The tube luminaires shall be tested in the vertical position with the ignition point located in the bottom housing. Some tests with the tube in a horizontal position may be conducted. If conducted, try both 8.6% CH<sub>4</sub> and 9.6% CH<sub>4</sub>, because in some horizontal tubes, 8.6% will produce the highest pressures. 5 mm/s recorder paper speed is acceptable. Using 9.6% CH<sub>4</sub> mixture, conduct six tests.



7.3.2 SECOND SERIES. A total of 10 tests minimum must be performed.



7.3.2.1 Using a

|  |                         |
|--|-------------------------|
| CDS No. ASTP2137   | Page: 12 of 16          |
| Original Issue Date: 09/08/97  | Revision Date: 12/11/03 |
| Signature/Initial: Chief, Division Of Electrical Safety <i>David C Chirdon</i> |                         |

7.0% CH<sub>4</sub> mixture, conduct two tests.

7.3.2.2 Using a 9.6% CH<sub>4</sub> mixture and with coal dust inserted through any opening in the assembly, conduct two tests.

7.3.4 The other three samples shall have three tests each as described in 7.3.2.1. If the lens tube is made of polycarbonate, then the samples scheduled for a minimum of 10 tests shall have three tests as described in 7.3.2.1, wait one day or more, then conduct the remaining tests as described in 7.3.2.1, 7.3.3.1 and 7.3.3.2.

7.4 Enclosures 30 to 300 cubic inches in volume are to be tested using the direct sampling method, as shown in Figure A.

7.4.1 Conduct a minimum of six tests using a 9.6% CH<sub>4</sub> mixture. For permissible connectors two of the six tests are to be conducted with plug withdrawn to the safety stop.

7.4.2 Conduct a minimum of two tests using a 7.0% CH<sub>4</sub> mixture. For permissible connectors, two additional tests must be performed with plug withdrawn to the safety stop.

7.4.3 Insert coal dust through any opening in the enclosure and conduct a minimum of two tests as described in 7.4.1.

7.4.4 A total of sixteen tests minimum must be performed.  
The additional tests should be conducted with the CH<sub>4</sub> mixture that resulted in the highest pressures.

7.5 Enclosures less than 30 cubic inches will be tested in the 22.4 liter standard test vessel and set up as shown in the illustration marked Figure A.

7.5.1 Conduct a minimum of six tests in which the

|  |                |
|--|----------------|
| CDS No. ASTP2137   | Page: 13 of 16 |
| Original Issue Date: 09/08/97  | Revision Date: |
| Signature/Initial: Chief, Division Of Electrical Safety <i>David C Chirdon</i> |                |

standard test vessel explosion is about 60 psig (7.1% CH<sub>4</sub>). Use a 2 inch spark plug, centrally located as shown in the illustration. For permissible connectors, two of the six tests will be conducted with the plug withdrawn to the safety stop.

7.5.2 Conduct two tests using a 7.0% CH<sub>4</sub> mixture. For permissible connectors, 2 additional tests with the plug withdrawn to the safety stop will be performed.

7.5.3 A minimum of sixteen tests will be performed, with the additional tests conducted with the CH<sub>4</sub> mixture which resulted in the highest pressures.

7.5.4 Dummies will not be used in the small boxes when using the standard test vessel. Dummies are used to check for pressure piling. If pressure piling appears to be likely, the direct sampling method should be used.

7.5.5 A small volume and some leakage will greatly reduce the explosion pressures, therefore all plumbing should be wrench tight.

8.0 Acceptable performance for an enclosure which has been explosion testing is:

8.1 No discharge of flame,

8.2 No ignition of the explosive mixture in the gallery,

8.3 No development of afterburning,

8.4 No rupture of any part,

8.5 No permanent distortion of any planar surface of the enclosure exceeding 0.040" per linear foot,

8.6 No excessive clearances along flame-arresting paths following retightening of fastenings, as required,

8.7 No pressure exceeding 125 psi, unless the enclosure has withstood a static pressure of twice the highest value recorded in the tests, or

|  |                |
|--|----------------|
| CDS No. ASTP2137   | Page: 14 of 16 |
| Original Issue Date: 09/08/97  | Revision Date: |
| Signature/Initial: Chief, Division Of Electrical Safety <i>David C Chirdon</i> |                |

8.8 Looseness or physical damage to a window or lens.

#### 9.0 Responsibility

It is the responsibility of Electrical Equipment Branch personnel who conduct testing to ensure that this policy is followed.

#### 10.0 Distribution

This document may be distributed to equipment manufacturers and Electrical Equipment Branch personnel.

#### 11.0 Review

All CDS documents are to be reviewed at least once every three years.

#### 12.0 Authority

Chief, Division of Electrical Safety