

**TITLE: STANDARD TEST PROCEDURE FOR NON-ASBESTOS PACKING MATERIAL****MSHA Mine Safety and Health Administration, Approval & Certification Center**

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**1.0 PURPOSE**

This document establishes the Standard Testing Procedure (STP) for Non-Asbestos Packing Material.

**2.0 SCOPE**

Non-Asbestos Packing Material is used in explosion-proof packing glands per Title 30 Code of Federal Regulations (30CFR) Part 18.37.

**3.0 REFERENCES**

3.1. "Standard Application Procedure for Acceptance of Non-Asbestos Packing Material" - ASAP5010.

3.2. "Design and Performance Requirements for Non-Asbestos Packing Material" - ACRI5002.

"Standard Operating Procedure for Non-Asbestos Packing Material." - ASOP5027.

**4.0 DEFINITIONS**

There are no terms that need defined.

**5.0 TEST EQUIPMENT****5.1. Compression Ratio Testing Equipment**

5.1.1. Strain Gage Dynamometer with variable speed control capable of measuring greater than 200 pounds in one pound increments, with a full scale accuracy of  $\pm$  two pounds.

5.1.2. Compression Ratio Glands as described in Figure 1, Appendix.

**5.2. Flame Testing Equipment**

5.2.1. Test equipment as listed in 30 CFR Part 18.65.

**5.3. Explosion-Proof Testing Equipment**

5.3.1. Test equipment listed in 30 CFR Part 18.62.

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- 5.3.2. A welded - type 1028 steel enclosure- with  $\frac{3}{4}$ -inch side and bottom walls, and a  $\frac{1}{2}$ -inch thick cover with 41 Grade 5 bolts,  $\frac{3}{8}$ -inch diameter, 1-inch long, placed two inches on center. A  $\frac{3}{4}$ -inch thick steel plate with a centrally located  $\frac{1}{2}$ -inch NPT hole welded 6  $\frac{1}{2}$ - inches from the pressure pickup point is utilized for pressure piling (see Figure 2, Appendix).
- 5.3.3. Three specially designed steel boxes as described in Figure 3, Appendix.
- 5.3.4. An MSHA-accepted/approved neoprene cable with an O.D. of  $0.562 \pm 0.02$ -inches.

**6.0 TEST SAMPLES**

- 6.1. Packing material diameters of  $\frac{1}{4}$ -inch,  $\frac{3}{8}$ -inch, and  $\frac{1}{2}$ -inch will be tested. A  $\frac{3}{16}$ -inch diameter will be accepted without testing provided a  $\frac{1}{4}$ -inch diameter of the same material meets all the requirements.
- 6.2. No material less than  $\frac{3}{16}$ -inch diameter - round or square - will be accepted.

**7.0 PROCEDURES**

Three different tests will be conducted on each diameter of packing material: 1) compression ratio, 2) flame resistance and 3) explosion tests. The results from the compression test are used to determine the length of sample used for the explosion tests.

**7.1. Compression Ratio (CR) Test Procedure**

7.1.1. The length of the material to be compression ratio tested is as follows:

- $\frac{1}{4}$ " diameter....10  $\frac{1}{4}$ " long
- $\frac{3}{8}$ " diameter....11  $\frac{3}{4}$ " long
- $\frac{1}{2}$ " diameter....13  $\frac{3}{8}$ " long

These lengths will allow approximately four (4) wraps of material around the shaft.

- 7.1.2. A length of material is packed into the appropriate gland listed in Section 5.1.2 by wrapping it four times around the shaft and then inserting it into the cylinder.

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- 7.1.3. The packed gland is positioned in the Strain Gage Device listed in Section 5.1.1 and a load of 200 pounds  $\pm$  5 pounds is gradually applied and tension held for one minute. After one minute the load is again adjusted to 200 pounds  $\pm$  5 pounds. After another minute, the load is again adjusted. After the third application of 200 pounds, the height (H) of the compressed material is determined by measuring the distance between the shaft and the cylinder. Three samples of each diameter will be tested.
- 7.1.4. The measurement obtained in Section 7.2.3 is the height (H) of the compressed material and is used in the final volume formula to calculate the compression ratio (CR). The CR is used to determine the length of material to be used for the explosion tests.
- 7.1.5. The compression ratio (CR) for each sample is determined as follows:

$$CR = V_1 / V_F$$

Where:  $V_1 = 3.14 / 4 L_m D_m^2 \dots$  for round material

$V_1 = W_m^2 L_m \dots$  for square material

CR = Compression Ratio

$V_1$  = initial volume

$L_m$  = length of material

$D_m$  = diameter of round material

$W_m$  = width of square material

$V_F = 3.14 / 4 H(d_1^2 - d_2^2)$

$d_1$  = inside diameter of cylinder

$d_2$  = diameter of shaft

H = height of compressed packing material  
(from Section 7.2.3)

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The CR will be determined for three (3) samples and averaged to obtain an average CR.

## **7.2. Flame Test Procedures**

- 7.2.1. The procedures listed under 30 CFR Part 18.65 are followed.
- 7.2.2. Four samples of ¼-inch diameter and four samples of the largest diameter that is to be considered for acceptance will be tested.
- 7.2.3. Each sample will be six inches long and be cut lengthwise to expose the inner surface.
- 7.2.4. The inner surface will face the flame for testing.
- 7.2.5. The test requirements are the same as listed in 30 CFR Part 18.65.

## **7.3. Explosion-Proof Test Procedures**

- 7.3.1. The length (L) of the material to be used is determined as follows:

### ROUND

¼" dia.: L=CR(10.92)

⅜" dia.: L=CR(8.6)

½" dia.: L=CR(6.74)

### SQUARE

¼" dia.: L=CR(8.58)

⅜" dia.: L=CR(6.75)

½" dia.: L=CR(5.29)

- 7.3.2. A length (L) of ¼-inch material, determined by Section 7.4.1 above, is packed into each of the two ¼-inch stuffing boxes. One length of ⅜-inch and one length of ½-inch material is packed into their respective stuffing boxes.
- 7.3.2.1. If only ¼-inch diameter is to be considered, then the two openings in the test enclosure will be plugged. If only one diameter other than ¼-inch is to be considered, it will be tested as the ¼-inch would have been for the purposes of these explosion tests.
- 7.3.2.2. The entire intact length of material is packed into the stuffing box by wrapping the material around the cable so that no voids are created when the wraps are laid. The packing gland nut is then threaded into

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the stuffing box until 1/8 inch  $\pm$  1/32 inch clearance remains between the packing nut flange and the surface of the stuffing box.

- 7.3.3. One of the packed 1/4-inch stuffing boxes is placed into the "high pressure" end of the explosion test enclosure (Section 5.3.2); the other 1/4-inch stuffing box is placed into the "normal" end of the enclosure. The 3/8-inch and the 1/2-inch stuffing boxes are placed into the remaining two openings in the test enclosure.
- 7.3.4. The test facilities that are listed under Section 5.3.1 are used. The enclosure is connected to a transducer, air/gas mixture, and spark plug connections as specified in the test procedures listed in Section 5.3.1. The calibration and general operation of the test facilities are also listed per Section 5.3.1.
- 7.3.5. The enclosure will undergo a total of 32 explosion tests, with the last two test (numbers 31 & 32) using coal dust (Pittsburgh coal seam ground to a fineness of minus 200 mesh).
- 7.3.5.1. At the end of the first 16 tests (1 through 16), the stuffing boxes will be removed and disassembled, and condition of the material observed. The material will be repacked in the same stuffing boxes per Section 9.4.2.2 and replaced into the test enclosure. However, the stuffing boxes will be replaced into opposite ends of the enclosure from which they were removed.
- 7.3.5.2. The final 16 tests (17 through 32) will be conducted.
- 7.3.5.3. Unless flames were observed during any of the tests, or ignition of the explosive mixture surrounding the enclosure occurs, the total series of 32 tests will be conducted.
- 7.3.6. Peak pressures will be recorded for each test. Pressure will be measured at the "high pressure" end of the enclosure. The pressure recorded must be a minimum of 100 PSI to constitute a valid test.
- 7.3.7. The first four tests of each series of 16 will be conducted using a 7% gas/air mixture. The remaining 12 tests in each series will be conducted using a 9.6% gas/air mixture.
- 7.3.8. The explosion testing must not result in:

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- a) Discharge of flame from any packing gland;
- b) Ignition of the explosion mixture surrounding the enclosure due to failure of the packing glands.

**7.4. Test Modifications**

7.4.1. Since all possible materials, compositions, physical properties, and application methods can not be foreseen, MSHA reserves the right to modify construction and test requirements to obtain the same degree of protection as provided in this Standard Test Procedure.

**8.0 TEST DATA**

A summary of test results will be sent to the applicant.

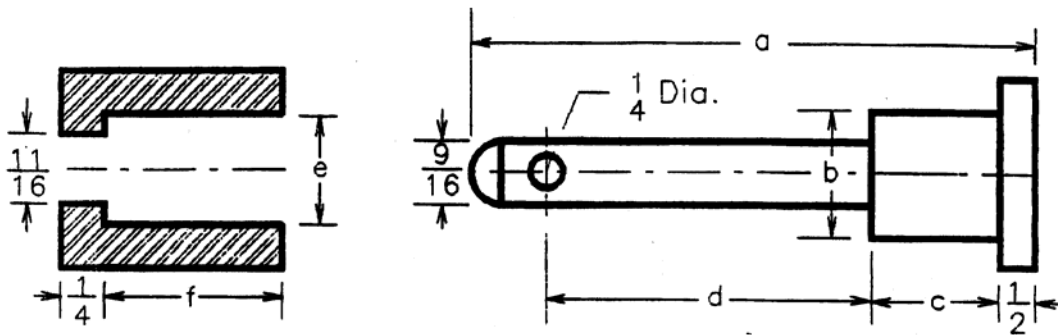
**9.0 PASS/FAIL CRITERIA**

- 9.1. The material must be flame resistant in accordance with Section 7.3, in that:
  - 1) no sample shall result in flame duration of one minute after removal of the flame,
  - 2) no sample shall exhibit afterglow exceeding three minutes and
  - 3) no sample shall burn completely.
- 9.2. The material must pass the explosion tests in accordance with Section 7.4, in that:
  - 1) no test shall result in discharge of flame or:
  - 2) ignition of the explosive mixture surrounding the enclosure.
- 9.3. The material must have a compressibility ratio between 4:3 and 8:3 as determined by Section 7.2.

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MATERIAL

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## Appendix



GLAND	a	b	c	d	e	f
1/4	$6 \frac{5}{8}$	$1 \frac{1}{32}$	$1 \frac{1}{2}$	$4 \frac{7}{8}$	$1 \frac{1}{16}$	$1 \frac{1}{2}$
3/8	$8 \frac{7}{8}$	$1 \frac{9}{32}$	$2 \frac{1}{2}$	6	$1 \frac{5}{16}$	$2 \frac{1}{2}$
1/2	$8 \frac{7}{8}$	$1 \frac{17}{32}$	$2 \frac{1}{2}$	6	$1 \frac{9}{16}$	$2 \frac{1}{2}$

## NOTES:

1. Surface finish = 63 micro inches
2. All dimensions in inches
3. Material - mild steel ( Brinell Hardness 150/200 )
4. Machine tolerance  $\pm 1/64$

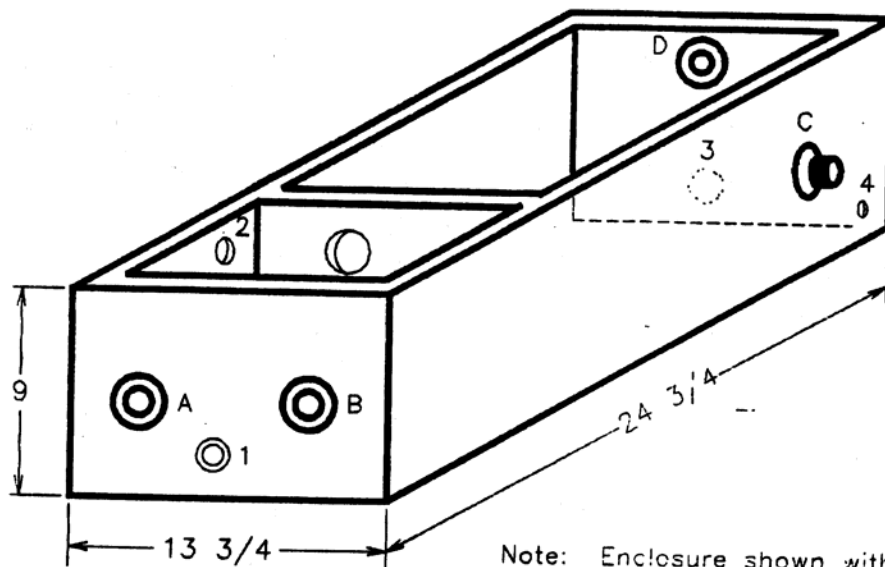
## COMPRESSION GLAND

FIGURE 1

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## Appendix



Note: Enclosure shown without cover for clarity

All dimensions in inches

Legend

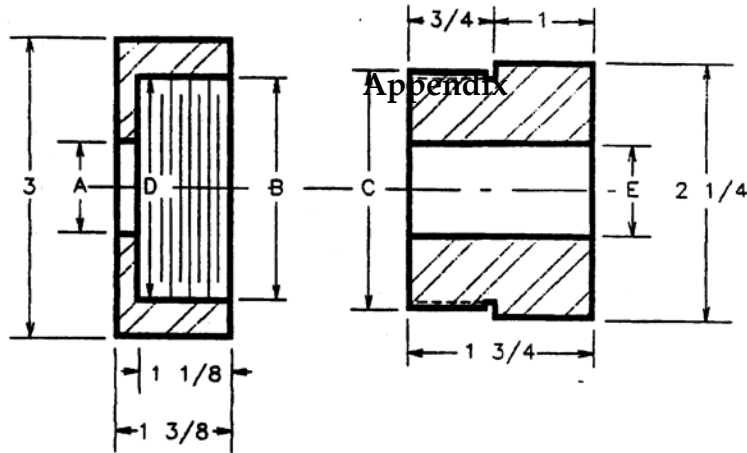
- 1- Pressure recording point
- 2- Gas out
- 3- Ignition point
- 4- Gas in
- A, B, C, D- Packing Glands

Explosion Test Enclosure  
Figure 2



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## NOTES:

1. All dimensions in inches
2. Material: 3" CRS Rod  
2 1/4" CRS Hex stock
3. Machine Tolerance  $\pm 1/64$

STUFFING BOX				PACKING NUT		
pkg dia	A	B	D	pkg dia	C	E
1/4	3/4	1 3/8-12unc	1 19/64	1/4	1 3/8-12unc	3/4
3/8	13/16	1 3/4-12unc	1 42/64	3/8	1 3/4-12unc	13/16
1/2	15/16	2-12unc	1 59/64	1/2	2-12unc	15/16

## PACKING GLAND

## FIGURE 3