1.0 PURPOSE

This document establishes MSHA's Standard Flame Test Procedure (STP) for Hose, and Other Materials: Title 30, Code of Federal Regulations, Part 18, Section 8.65.

2.0 SCOPE

2.1. The Quality Assurance and Materials Testing Division, Approval and Certification Center conducts the flame test that is outlined in 30 CFR, Part 18, Section 18.65. The following products are required by 30 CFR to be fire resistant or flame resistant:

a. Hose conduit,

b. Fire hose liner,

c. Fire suppression hose cover,

d. Cable reel insulation,

e. Insulation for battery box covers,

f. Packing gland material.

2.2. This flame test is also used for the evaluation of other products not covered by mandatory regulations, but issued acceptance for underground use under the "Standard Application Procedures for Acceptance of Flame-Resistant Solid Products Taken into Mines" (ASAP5001). Some of these products are belt skirting, chute liner, cover of hydraulic hose, rock dusting hose and mine spray hose.

3.0 REFERENCES

3.1. 30 CFR, Part 18, Section 18.65.

4.0 DEFINITIONS

4.1. Afterflame - means the continuation of visible flaming of the specimen under the specified test conditions after the applied flame is removed.

4.2. Afterglow - means the continuation of visible glowing of a specimen after flaming has ceased.

4.3. Ignition flame/time– the external flame applied to the specimen to determine its flame propagation properties and the associated time it is applied to the specimen

4.4. Sample - means at least four specimens from a given lot.

4.5. Specimen - means a piece of the material that is six (6) inches long by ½ inch wide by the thickness of the material as used in the final product.

4.6. Applicant - is defined in 30 CFR, Part 18, Section 18.2 as "an individual, partnership, company, corporation, organization, or association that designs, manufacturers, assembles or controls the assembly of an electrical machine or accessory and seeks approval, certification, or permit, or MSHA acceptance for listing of flame-resistant cable or hose."

4.7. Acceptance is defined in 30 CFR, Part 18, Section 18.2 as "written notification by MSHA that a cable or hose has met the applicable requirements of this part and will be listed by MSHA as acceptable flame-resistant auxiliary equipment."

5.0 TEST EQUIPMENT

5.1. A schematic of the flame test apparatus is shown in the at the end of this document (Drawing B-1281 and B-1282). The principal parts of the test apparatus are a chamber with a transparent access door, air flow nozzle, fume exhaust system, specimen holder, Pittsburgh-Universal Bunsen burner, burner placement guide and a mirror.

5.1.1. Test Chamber - The test chamber is a 21 inch cubical chamber constructed of 16 gage metal. A close-fitting transparent door located on the front side of the chamber is used for viewing the specimen during testing and for access to the interior of the chamber. An 8.5 inch diameter hole is made in one side of the chamber to accommodate the air flow nozzle (inlet). An 8.5 x 11 inch exhaust port is located on the opposite side of the chamber. The top of the test chamber is removable for periodic cleaning and contains a ½-inch diameter hole with a removable cover cap for inserting a probe to measure air flow.

5.1.2. Air Flow Nozzle - An ASME flow nozzle with a 16 to 8 ½ -inch reduction is mounted on one side of the chamber as the air inlet. The nozzle directs the air flow over the specimen.

5.1.3. Exhaust System - An electrically driven exhaust fan, controlled by a variable autotransformer is connected at the exhaust side of the chamber (opposite from the air flow nozzle) to produce the air flow over the specimen. Ducting is used to taper the exhaust hole to match the fan size. The fan must be equipped with an "on/off" switch. If the exhaust system is equipped with a damper, it must not be used to turn the air flow on and off. The "on/off" switch must be used for starting the motor used to produce the air flow. The airflow must go from zero to 300 feet

per minute in 8.5 seconds ± 1.0 seconds. Once the airflow reaches 300 feet per minute, the air flow through the test chamber is to remain at 300 feet per minute (± 5%) for the duration of a test. Independent studies by MSHA and NIST have both shown that afterflame times are directly dependent on the acceleration or time to go from zero to 300 feet per minute.

5.1.4. Specimen holder - A metal support stand with an adjustable clamp (or fixed specimen holder) is used to hold the specimen. Twenty mesh wire gauze, five inches square, is fastened on the ring clamp and positioned approximately 0.25 inches below the specimen. The specimen is held at a 45-degree angle on the specimen holder.

5.1.5. Burner - A Pittsburgh-Universal Bunsen-type burner with inside diameter of 11 mm and a variable orifice, controlled by a needle valve, is used as an ignition source. The fuel is natural gas with a heat content of 890 to 900 BTU/ft^3. The BTU is calculated at 60°F, 30 inches of Mercury (net) dry basis.

5.1.6. Burner Placement Guide - A metal guide, set on the floor of the chamber, is used to position the burner directly beneath the test specimen. The guide should have a stop bar to insure that the burner is positioned in the same place for each specimen during application of the ignition flame. Positioning and retracting of the burner is accomplished by means of a metal rod (3/32" diameter) connected to the burner and passing through a small hole in the front side of the chamber. The guide may be connected with a circuit to automatically start timing the ignition.

5.1.7. Mirror - A mirror is placed inside the back wall of the test chamber to permit a rear view of the specimen during the test.

6.0 TEST SAMPLES

6.1. The size of the test specimens is to be 6 inches long by 0.5 inches wide by the thickness of the material. A minimum of 4 specimens is required as follows:

6.1.1. Hose conduit; full thickness (complete wall) of the hose, typically cut longitudinally.

6.1.2. Fire hose; the liner (inner tube), typically cut longitudinally.

6.1.3. Fire suppression hose; the cover of the hose, typically cut longitudinally.

6.1.4. Cable reel insulation; normal thickness of the material, either on substrate, or without backing. If possible, without backing.

6.1.5. Insulation for battery box covers; normal thickness of the material, either on substrate, or without backing. If possible, without backing.

6.1.6. Packing Gland material; diameters being requested.

6.2. If the samples are not tested as they are present in the final product, the testing should represent a worse-case scenario. Examples: rubbers removed from metal in composite products (metal would conduct heat away) and woven materials cut-to-size having frayed edges, corrugation tested both with and against the grain.

6.3. Prior to testing, the specimens should be conditioned for a minimum of 24 hours at an ambient temperature of 73± 5°F and a maximum relative humidity of 55%.

7.0 PROCEDURES

7.1. Turn on the hood housing the instrument and adjust the sash to whatever height it will be at during the post-ignition observation phase of the test, where airflow must be 300 fpm. The sash height will affect the flow rate.

7.2. Remove the ½-inch diameter cover cap in the top of the test chamber. Insert the probe of a hot-wire anemometer to measure air flow. The hot wire probe is positioned at the location where the ignition flame with touch the specimen. Through a series of five (5) successive and successful trials, establish the proper setting for the fan, damper, and hood settings to deliver the proper acceleration in air flow. When the exhaust fan is turned on, the airflow must accelerate from still air to 300 (± 10 %) feet per minute within a period of 8.5 (± 1.0) seconds.

7.3. Remove the anemometer and replace the cover cap.

7.4. Reduce area lighting to aid in observing flame and afterglow.

7.5. With the exhaust fan turned off, adjust the air and gas supply to give an overall blue flame 3 inches in height, with a 1 inch inner cone, and no persistence of yellow coloration. The flame should retain these properties once the chamber door is shut.

7.6. Place a specimen in the sample holder with its longitudinal axis horizontal (parallel to the floor) and its transverse axis inclined (rolled) at 45°. Angle the top of the specimen toward the viewing mirror at the back of the chamber and the bottom toward the viewing door at the front. A half inch of the specimen should extend beyond the 20-mesh wire gauze and be centered one-inch above the top of the burner. (See Figure 1.)

7.7. Materials which are too thin to be self -supporting in the horizontal position are held in position by means of a No. 12 copper or steel wire through the specimen.

7.8. Keep the chamber door closed from the beginning of ignition through the end of observation and evacuation of the chamber.

7.9. Ready a stop watch or timer to measure the duration of the applied flame, afterflame and afterglow.

7.10. Slide the burner under the specimen to the stop position and immediately start the stopwatch (if the system does not employ an automatically triggered timer). Apply the flame for 60 s to complete the ignition phase of the test.

7.11. After ignition, fully retract the burner from beneath the specimen and simultaneously turn on the exhaust fan by means of the "on/off" switch, if the system does not do so automatically. The gas to the burner may be shut off.

7.12. Beginning with the removal of the burner, determine and record the total duration of afterflame, even if it exceeds 60 seconds, as the exact time will be needed for averaging four specimens. Afterflame includes any flame that may occur after the initial flame extinguishes. Also record afterglow, even in excess of 180 seconds.

7.13. When recording data, the final reported afterglow time is a combination of raw flame time and afterglow time. Adding the two raw values eliminates situations where samples present a hazard for longer total time and pass the test (raw data 55 s flame, 170 s afterglow), while another samples are a hazard for less total time and fail (raw data 0 s flame, 185 s afterglow).

7.14. The sample must be extinguished (no flame or afterglow), for at least 60 s before ending the test run. This time ensures the sample is fully extinguished and gives time for fumes and particles to leave the test chamber.

7.15. Remove the specimen and place it in an area with good ventilation (an active hood, or the corner of the test chamber)

7.16. Repeat the procedure for a total of four specimens.

8.0 TEST DATA

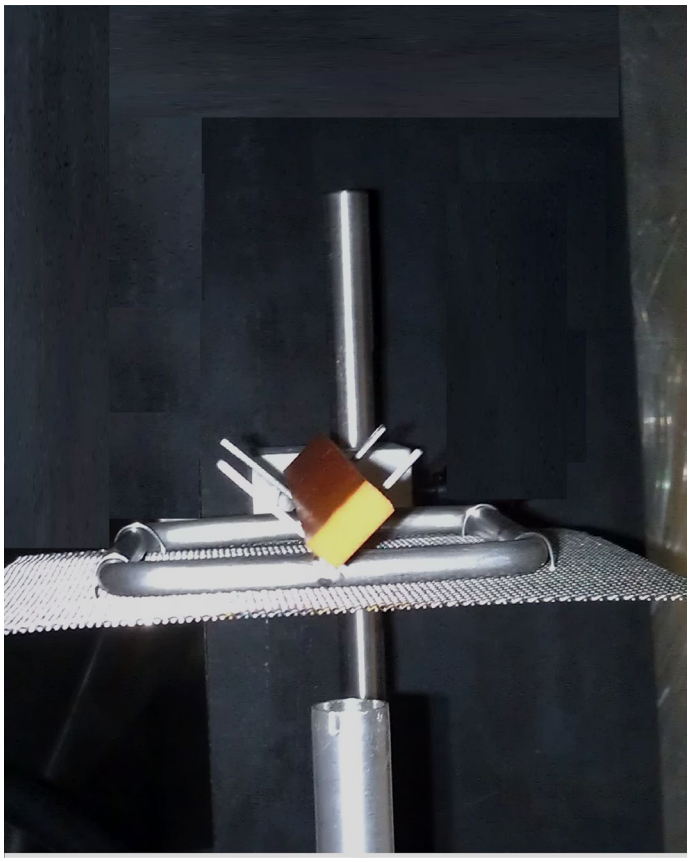
8.1. The test results are compiled for the four test specimens and listed on a test report.

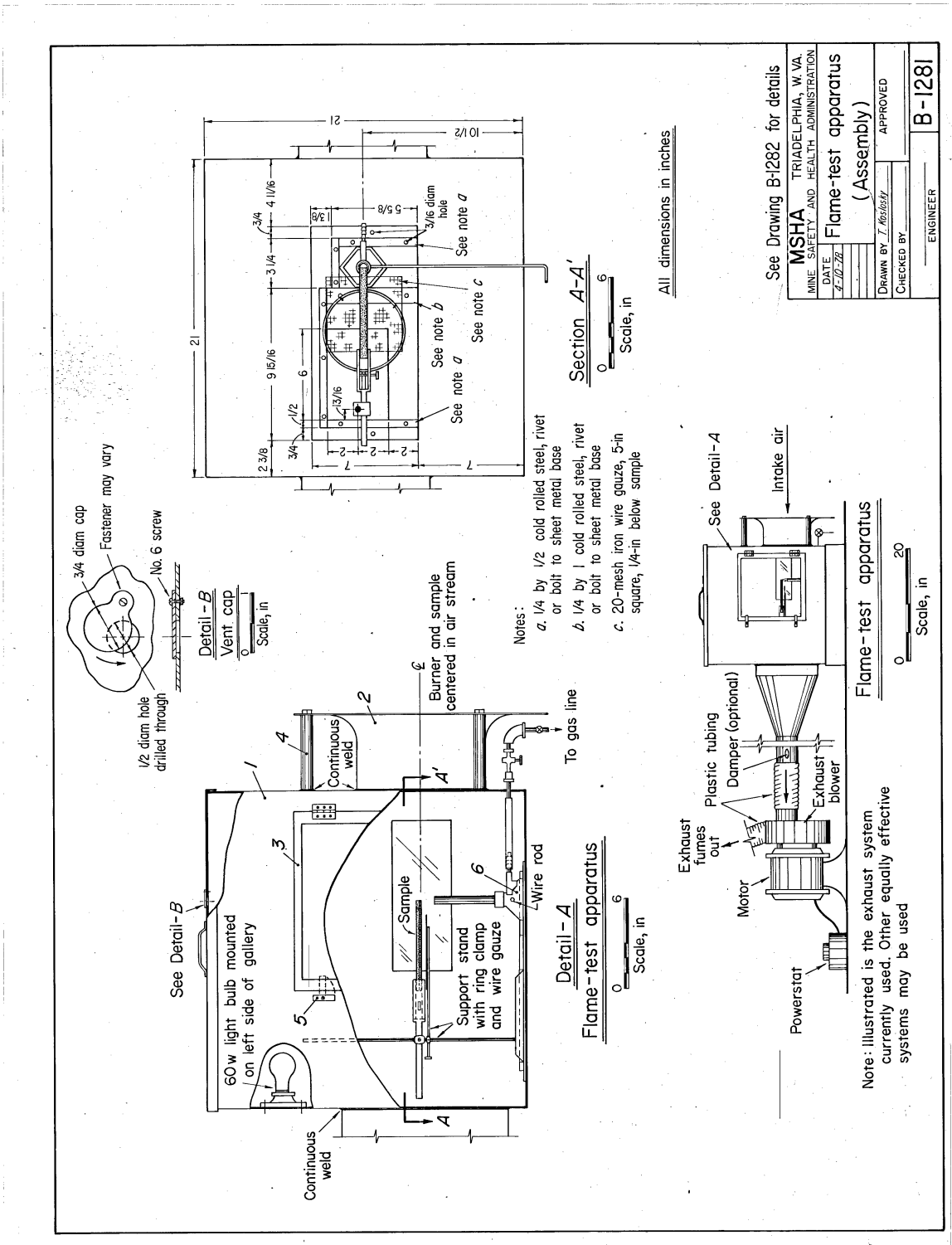
9.0 PASS/FAIL CRITERIA

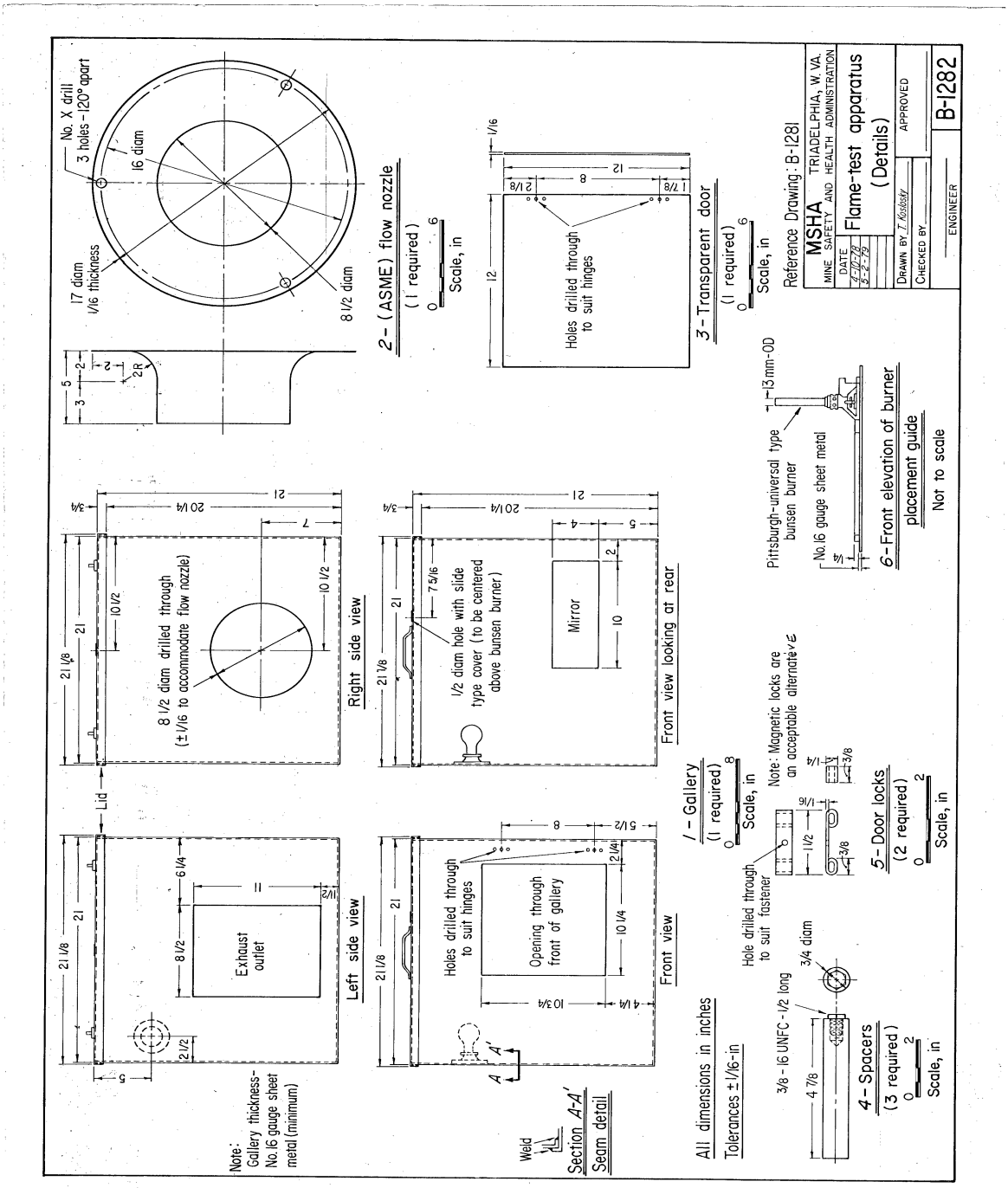
9.1. The average results of the four (4) test specimens must not exceed one (1) minute duration of afterflame or three (3) minutes afterglow.

9.2. When recording data, the final reported afterglow time is a combination of raw flame time and afterglow time. Adding the two raw values eliminates situations where samples present a hazard for longer total time and pass the test (raw data 55 s flame, 170 s afterglow), while another samples are a hazard for less total time and fail (raw data 0 s flame, 185 s afterglow).

Figure 1 - an orange specimen is in the specimen holder. The longitudinal axis is horizontal, and the transverse axis is inclined (rolled) to 45 degrees. The distance between the burner tube and the specimen is one inch. The burner is not lit.




See Drawing B-1282 for details
MSHA
MINE SAFETY AND HEALTH ADMINISTRATION
TRIADELPHIA, W. VA.
DATE 4-10-78
Flame-test apparatus (Assembly)
DRAWN BY T. Mosbey
CHECKED BY
APPROVED
ENGINEER
B-1281
All dimensions in inches
Section A-A'
Scale, in
Notes:
a. 1/4 by 1/2 cold rolled steel, rivet or bolt to sheet metal base
b. 1/4 by 1 cold rolled steel, rivet or bolt to sheet metal base
c. 20-mesh iron wire gauze, 5-in square, 1/4-in below sample
Detail-B
Vent cap
3/4 diam cap
Fastener may vary
No. 6 screw
1/2 diam hole drilled through
Detail-A
Flame-test apparatus
Burner and sample centered in air stream
To gas line
Continuous weld
See Detail-B
60w light bulb mounted on left side of gallery
Sample
Wire rod
Support stand with ring clamp and wire gauze
Intake air
See Detail-A
Plastic tubing
Damper (optional)
Exhaust blower
Exhaust fumes out
Motor
Powerstat
Note: Illustrated is the exhaust system currently used. Other equally effective systems may be used


No. X drill
3 holes - 120° apart
16 diam
17 diam
1/16 thickness
8 1/2 diam
2 - (ASME) flow nozzle
(1 required)
Scale, in
3 - Transparent door
(1 required)
Holes drilled through to suit hinges
Reference Drawing: B-1281
MSHA
MINE SAFETY AND HEALTH ADMINISTRATION
TRIADELPHIA, W.VA.
Flame-test apparatus
(Details)
DRAWN BY J. Kosisky
CHECKED BY
APPROVED
ENGINEER
B-1282
Right side view
8 1/2 diam drilled through (± 1/16 to accommodate flow nozzle)
Front view looking at rear
1/2 diam hole with slide type cover (to be centered above bunsen burner)
Mirror
Pittsburgh-universal type bunsen burner
13 mm-OD
No. 16 gauge sheet metal
6 - Front elevation of burner placement guide
Not to scale
Lid
Left side view
Exhaust outlet
Front view
Holes drilled through to suit hinges
Opening through front of gallery
1 - Gallery
(1 required)
Note: Magnetic locks are an acceptable alternative
Hole drilled through to suit fastener
5 - Door locks
(2 required)
All dimensions in inches
Tolerances ± 1/16-in
Note: Gallery thickness - No. 16 gauge sheet metal (minimum)
Weld
Section A-A'
Seam detail
3/8 - 16 UNFC - 1/2 long
3/4 diam
4 - Spacers
(3 required)