UNITED STATES OF AMERICA
CONSUMER PRODUCT SAFETY COMMISSION

CONSUMER FIREWORKS TESTING MANUAL

Directorate for Laboratory Sciences
Division of Chemistry

This manual is to provide guidance to the Commission staff that test fireworks devices for compliance with fireworks regulations. This manual is not intended to supersede or limit fireworks regulations. In the case of discrepancies between this manual and the regulations, the regulations will supersede this manual.

This manual has not been reviewed or approved by, and may not necessarily represent the views of, the Commission.

Fourth Edition (17 August 2006)

TABLE OF CONTENTS

I. BACKGROUND

Regulations under the Federal Hazardous Substances Act include a variety of requirements for fireworks. Certain exploding devices which exceed specified powder content are banned (16 CFR 1500.17(a)(3) and (8), and 16 CFR 1500.85(a)(2)). Other regulations that establish cautionary labeling requirements are 16 CFR 1500.14(b)(7), 16 CFR 1500.83(a)(27), and 16 CFR 1500.121. A third category of regulations (16 CFR 1500.17(a)(9), (11), and (12), and 16 CFR 1507) ban fireworks which fail to conform to performance standards addressing aspects such as fuse function, stability, and leakage, among others.

This manual addresses testing of consumer fireworks (1.4G or UN 0336). Laboratory staff should consult with the Office of Compliance before testing 1.3G or UN 0335 fireworks to determine whether the devices should be tested to other requirements.

II. SAFETY AND EQUIPMENT

A. Safety Precautions

Fireworks devices are potentially explosive and can cause severe personal injury and damage property in the vicinity. Every logical precaution should be taken during handling, testing, and storage of the fireworks samples.

SMOKING AND OPEN FLAMES ARE STRICTLY PROHIBITED AROUND FIREWORKS.

Most of the time, the pyrotechnic powder contained in firecrackers, aerial reports, and party poppers will not ignite from discharges of static electricity or minor friction; however, if static dissipating flooring material is not present, touch a water pipe or other ground to eliminate static charges. During the laboratory analysis, if the analyst is not working in a dust/fume hood, dust masks and surgical gloves should be worn to avoid inhalation or skin contact with chemicals when dissecting fireworks for structural evaluation and powder weighing.

Prior to the scheduled field-testing the analyst must ensure that the test site is adequate. In addition to and beyond the "Testing Site", an additional 200 foot wide perimeter should exist around the entire "Testing Site" (approximately 250000 square feet) that is free of tall weeds, dry brush or other combustible material. The test site should be isolated from both residential and commercial dwellings, and provide sufficient clearance for the fireworks device to fire and land without interfering with pedestrian or vehicle traffic. During field testing analysts ***MUST*** wear hearing protection and either safety glasses or face shield and flame resistant clothing (denim or equivalent). Also, during field testing, some kind of water source must be present, such as a charged garden hose, a fire hose connected to a live fire hydrant, or charged water fire extinguishers. Always understand how the

device should function by reading and following the instructions on the label before igniting the device.

DURING BOTH FIELD TESTING AND LABORATORY ANALYSIS, TWO (2) ANALYSTS SHALL BE PRESENT AT ALL TIMES.

In general it is desirable to test the devices in an open configuration. However, personal and property safety takes precedence over open testing. If experience shows a device to be unpredictable or to have a propensity to cause field fires, perform testing in the containment cage or use other restriction configurations. Specific safety precautions will be discussed with appropriate tests.

B. Equipment and Supplies

The following items will be needed to conduct fireworks analysis:

1. **Field Analysis**
   - **a.** Face shield or safety glasses, sound absorbing earmuffs or earplugs, and clothing made of denim or equivalent. Avoid synthetic and lightweight fabrics.
   - **b.** Water source such as a fire truck, charged fire hydrant with attached fire hoses, a charged garden hose, or charged water fire extinguishers. **NOTE: When only water fire extinguishers are available, all devices must be fired in a cage to contain the pyrotechnic effects.**
   - **c.** General supplies:
     - Stopwatch
     - Cigarette lighter or matches
     - Cell Phone ***(When field testing, the cell phone must be on at all times)***
     - Clipboards with Field Sheets and Site Log Sheets, and ink pens
     - Water cooler
     - Punk sticks
     - Fireworks samples

2. **Laboratory Analysis**
   - **a.** Surgical masks (dust) and surgical latex gloves
   - **b.** Analytical balance capable of reading to 1 mg and calibration weight(s)
   - **c.** 8 ounce weight, scissors, forceps, hemostats, box knives, razor blades or scalpels, tape measure or ruler, blunt dissecting needle or probe
   - **d.** 12 degree tilt block covered with 400 grit sand paper
   - **e.** Weighing paper
   - **f.** Ring stand and clamps
   - **g.** Rocket test board (Droop/Straightness Test)
   - **h.** 60-Degree Tilt Tester for Large Multiple Tube Mine and Shell Fireworks Devices

i. 8 1/2" x 11" lined paper, scotch tape, paper clips, rubber bands, ink pens, plastic storage bags (small and large), 12-B storage boxes (15" x 15" x 15"), 1.4 G Explosive stickers, Box Location labels, box tape
j. Official CPSC seals (Form 164)
k. Water fire extinguisher
l. Pall Mall unfiltered cigarettes, lighter or matches

C. Equipment Calibration and Accuracy

The calibration of the weighing balance (readable to 1 mg) shall be checked before use in the following manner:

1. Place the balance on a flat surface where it will be used. Level and calibrate the balance according to the manufacturer's directions. Use the certified weights to check the balance calibration. If the balance is not within the manufacturer's specifications follow the calibration directions or obtain expert service. The balance(s) readings of the certified weights must be recorded and entered into the balance certification spreadsheet.

D. General Fireworks Testing Data Forms (Appendix 1)

III. SAMPLE ACCOUNTABILITY, HANDLING AND SPLITTING

Fireworks samples will be collected, packaged, handled, stored, transported and analyzed in such a manner that the identity of the sample is maintained and that the integrity of the sample is preserved. Records must be kept that show continuity of sample handling and how sample integrity was maintained. If the analyst discovers any discrepancies between the sample that was received and the Collection Report or investigator's seals, the analyst must immediately call such discrepancies to the attention of the investigator, the investigator's supervisor or to the Office of Compliance. If a sample is received without a Collection Report (CPSC Form 166), the analyst can obtain the collection report online from the CIS/IFS Database or through the LSC Fireworks Database when the sample is logged in.

Samples will be collected by investigative personnel from various Regional Centers in accordance with CPSC Directive 9010.36 and delivered to the designated laboratory or test location for testing.

A. Sample Identification

A **"Sample"** includes all items received under one sample number. A **“Sample”** is the physical item that is delivered to the laboratory that is sealed with CPSC Form 164. The sample can be the shipping container itself with single or multiple seals (CPSC Form 164) affixed to the exterior on the container. A shipping container may contain the sample as an interior enclosure or container such as another box, a paper or plastic bag, an envelope, etc., that is sealed with CPSC Form 164. In rare

cases, the **"Sample"** may not be sealed with CPSC Form 164; this should be noted on the "Fireworks Split Sheet" in the Seal Condition block.

A **"Sample"** may contain one sub-sample, or multiple sub-samples. A **"Sub-sample"** is an individual retail item or a retail package of multiple items. A sample will generally consist of nine to nineteen sub-samples. Each sub-sample should be identified with a bar-code label that displays the sample number and sub-sample number. The collecting investigator should also have placed either on the bar-code label or somewhere on the sub-sample, the date the sample was collected, and their initials. All of the seal and sub-sample identification information will be needed when the sample is split for analysis, and the data entered into the LSC Fireworks Database.

B. Pre-analytical Split Procedure

The **Pre-analytical Split Procedure** includes examining and recording the condition of the sealed sample, and the number and type of container(s) the sample was shipped in. The condition and effectiveness of the seal are recorded along with the sample number, and the product name. The analyst then breaks the CPSC seal (Form 164). The seal should be torn or cut across the section showing sample number, date and signature. The analyst then mounts the seal(s) and any label(s) on mounting paper (an 8.5" X 11" piece of lined paper) and identifies the mounting paper in the upper right corner with the sample number, the date and the initials of the analyst preparing the display. The analyst must then initial and date the seal (in ink) in the spaces provided. The broken seal must be submitted with the completed Laboratory Report (CPSC Forms 224, 221, and 222).

At this point the appropriate numbers of sub-samples or devices are divided up for laboratory and field analysis. As a general rule, eight sub-samples or individual devices are for field analysis, and eight sub-samples or individual devices (ten sub-samples or individual devices if reports are present) are for laboratory analysis (See **Appendix 2** for a summary of **General Split Information**). Any remaining sub-samples or devices that are not used for laboratory or field analysis are repackaged, sealed, and stored as the "Reserve Sample". Storage of sub-samples or devices is discussed in the following section.

While dividing the sample for lab and field analysis, check the fireworks devices to determine if they have an additional attached base or whether assembly of the base is necessary. If attached bases are present, record the condition of the bases (detached, cracked, or broken into pieces) and the number of bases in that particular condition on the "Fireworks Split Sheet".

Additionally, during the split process, the sub-samples and the sub-sample container(s) are checked for pyrotechnic leakage**.** If leakage is present, attempt to identify how many of the units leaked, and collect and quantify the amount of leakage present. If only a slight amount of leakage is present, and the leakage is clay material, record the leakage as "Light Dusting". If more than a "Light Dusting" is present, collect all of the material that leaked from the devices. Next, gently shake each device to determine if additional pyrotechnic leakage occurs. If additional leakage occurs, continue to gently

shake each device until leakage can no longer be removed from the sub-sample or device. Collect any additional leakage material and add it to the previously collected material, and weigh. If pyrotechnic leakage is present, and the sample was loosely packaged, make a note that handling and jarring of the sample during shipment due to loose packaging, could have been the cause of the leakage.

Test the pyrotechnic leakage material for ignitability by placing the material in a small pile and attempting to ignite it with a fuse or the flame from a small butane torch. If ignition occurs, describe whether it is a rapid burning material (flash powder or black powder), a slower burning material (stars), a very slow burning material (filler, sawdust, hulls, etc.), or non-ignitable material such as clay from the end plugs. The ignitability test results and weight results of the pyrotechnic leakage material collected during the sample splitting process are recorded on the "Fireworks Split Sheet".

NOTE: For samples that have pyrotechnic leakage, place the LAB and FIELD sample split in plastic bags. This will allow the analyst the ability to collect any additional pyrotechnic leakage that occurs during normal sample handling. This material is tested during the Laboratory Analysis (See Section IV.B.1).

NOTE: DO NOT TEST FOR IGNITABILITY IN THE FIREWORKS TESTING LAB. OPEN FLAMES ARE FORBIDDEN. TEST FOR IGNITABILITY USING A HOOD IN THE CHEMISTRY LABORATORY BUILDING OR TEST IT OUTSIDE ON THE GROUND.

NOTE: It is not necessary to take firecrackers to the field for analysis, unless the Recalls and Compliance Division (CRC) in the Office of compliance has specifically asked for field analysis. Firecrackers only require the determination of pyrotechnic leakage, and the explosive pyrotechnic powder weight.

When the sample splitting process is complete, record in the "Sample Comment" section of the "Fireworks Split Sheet" any other discrepancies, problems, or oddities that were noted during the sample splitting process. Record such things as: detached or missing fuses; crushed or deformed devices; etc.

C. Reserve Sample Procedure

Any remaining sub-samples or individual devices that are to be sealed are to be handled as follows:

1. Individual devices and/or sub-sample(s) are placed in a plastic bag, taped shut, and sealed with a completed CPSC Form 164. Affix the seal in such a way that it actually seals the sample container. More than one seal may be required. If possible, use a single strand of tape to close the sample container. Place the seal across the tape and closure. Affix to the newly sealed sample container, the original Collection Report Envelope (CPSC Form 165)

with the Sample I.D. Bar-code that was attached to the original sample container. The sealed sample is then placed in a DOT 12-B box for storage.

DOT 12-B boxes for storage of reserve samples are prepared by closing the bottom portion of the box and taping it shut. If possible, use a single strand of tape to close the sample container. All sample reserve DOT 12-B boxes are labeled with a diamond shaped 1.4 G Explosive sticker in the lower right quadrant on one of the box faces. Place a CPSC Form 328 (storage location label) in the upper left quadrant of the face with the 1.4 G Explosive sticker. Record the sample number(s) that are inside the box on the CPSC Form 328, and place the box in a secure location for storage.

2. If the "Reserve Sample" is too large for other sealed samples to be placed inside of the box (e.g. – Reloadable Tube Aerial Shells, etc.), place the device(s) and/or sub-sample(s) in a DOT 12-B box that has been prepared as in step 2 above, and with these additional instructions. Affix to the **inside bottom** of the box a completed seal (CPSC Form 164). The completed seal (CPSC Form 164) should be placed such that the seal crosses over the bottom inside closure. Place the "Reserve" devices and/or sub-sample(s) into the box. Close the upper portion of the box and tape it shut. If possible, use a single strand of tape to close the sample container. Affix a second completed seal (CPSC Form 164) so that the seal crosses over the tape of the upper outer closure. More than one seal may be required. Affix to the newly sealed sample container (box), the original Collection Report Envelope (CPSC Form 165) with the Sample I.D. Bar-code that was attached to the original sample container. Place the box in a secure location for storage.

Record the number of remaining sub-sample or individual devices that were repackaged, sealed, and placed in reserve storage, on the “Fireworks Split Sheet”.

Upon completing the "Fireworks Split Sheet", enter the data into the “LSC Fireworks Database” to provide sample tracking continuity or give the split sheet to the secretary for entry into the “LSC Fireworks Database”.

IV. FIREWORKS ANALYTICAL PROCEDURES

A. Field Analysis for all Fireworks (8 Devices)

Field Analysis requires the analyst to closely measure and observe the ignition and functioning of individual sub-samples/devices. A summary of the required tests for the various categories of fireworks is shown in **Appendix 3**. Field analysis of fireworks samples requires the following tests (Numbers 1-5) to be performed simultaneously:

1. **Fuse Burn Time**
2. **Functionality of the Fuse**
3. **Function of the Fireworks Device**
4. **Malfunction(s) of the Fireworks Device**
5. **Burnout and Blowout**

A copy of the standard **"Fireworks Field Sheet"** can be found in **Appendix 1,** which contains the various Fireworks Testing Data Forms.

NOTE: Prior to departing for the test site the analyst should check that all of the needed equipment and supplies are present in the van. All of the samples for testing should be loaded into the back of the van in such a manner so as to prevent the samples from tipping over or freely moving around. The van door should also be locked to prevent unwanted entry and tampering with the samples.

1. **Fuse Burn Time (16 CFR 1507.3(A)(2))**

   The fuses on consumer fireworks are required to burn at least 3 seconds and not more than 9 seconds. Measure the Fuse Burn Time (FBT) with a digital stopwatch readable to 0.1 second.

   Place each fireworks device on a hard, level, flat surface. The fuse on most fireworks devices is covered by tape, a plastic tube or wrapped in paper that is taped to the device. Expose the tip of the fuse for ignition by either removing the tape or paper.

   NOTE: While testing, the person lighting the fuse (igniter) should stand in a manner that does **NOT** place their head over the device. The igniter should stand with the fireworks device on either the right or left side of their body, and extend an arm out sideways to ignite the fireworks device. Once the fuse ignites, the igniter should move away from the fireworks device.

   To ignite the fuse, the first analyst (igniter) should place the burning tip of a punk stick on the tip of the fuse. The second analyst (time/function recorder) will time the burning of the fuse from the initial ignition (when the fuse sputters and supports combustion) to the time the device starts to function. The second analyst should move away from the fireworks device as it functions. The time at which a device begins to function does not necessarily coincide with the increased production of smoke from a device, or the first spark from a device. The fireworks device "begins to function" when it becomes obvious that combustion of pyrotechnic materials (excluding internal fuses) has begun, that is, the device starts to produce readily visible effects such as the firing of flaming balls or shells, the discharge of a shower of sparks, or audible effects such as whistles, crackle, etc. Conduct the test on samples/devices and record the results on the form entitled "Fireworks Field Sheet".

2. Functionality of the Fuse

There are common fuse functionalities that need to be noted on the "Fireworks Field Sheet", while determining fuse burn times:

a. If the fuse ignites, but fails to cause the device to function after 20 seconds, stop timing the FBT, and enter "20.0" as the FBT for the device. Also, on the "Fireworks Field Sheet" record the number of fuses that ignited, but failed to ignite the devices on the line:

"__ of __ fuses burned but device failed to function."

b. All other abnormalities regarding the functionality of a fuse should be placed under the "Fuse Burn Comment" section. If the fuse fails to ignite after the analyst has made repeated attempts to ignite the fuse, record the fuse burn time as "0.0" seconds. Record on the "Fireworks Field Sheet" under the "Fuse Burn Comment" the following statement:

"__ of __ fuses failed to ignite after repeated attempts."

c. On most '**Reloadable Tube Aerial Shell**" devices, the safety fuse has a black or gray colored ignition aid on the fuse tip. If the ignition aid burns, but fails to ignite the fuse, stop timing. Allow sufficient time for the second analyst to reset the stopwatch. When the second analyst is ready, attempt to re-light the fuse with the punk in the usual manner. Measure and record the fuse burn time. Also, record on the "Fireworks Field Sheet" under the "Fuse Burn Comment" the following statement:

"__ of __ fuse ignition aids burned, but failed to ignite the fuse."

d. Some fireworks devices have two fuses. When this is observed, make a note on the "Fuse Burn Comment" line. Additionally, note if the two fuses protrude from the same orifice or if they are located at different positions (specify locations) on the fireworks device.

e. On some fireworks devices there are fuses that consist of two components. The end fuse component is safety fuse that is attached to a very fast burning fuse called "Quick Match". Note in the "Fuse Burn Comment" if the fuse is a two-component fuse, and if the safety fuse is detached.

***CAUTION*: "Quick Match" burns at a very fast rate. It is less than 0.5 seconds per foot.**

3. Function of the Fireworks Device

During the field-testing portion of the analysis, it is important for the analyst to be concise and accurate in describing how the device functioned during the test. After the fuse has burned, the analyst must observe what the device does and record these observations in the "**FUNCTION**" section of the "Fireworks Field Sheet". An example of a function statement for a Reloadable Tube Aerial Shell follows:

"Shoots shell that emits a whistle, 50 to greater than 100 feet into the air, which bursts releasing stars that emit crackle, and releases multiple aerial reports."

When a shell is propelled into the air by the lift charge and reaches its apogee, the shell normally bursts with a muffled popping noise. The bursting shell releases a shower of multi-colored flaming stars and sparks. Sometimes, single or multiple aerial reports may be heard.

Appendix 4 lists basic generic function statements for the various types of fireworks devices. Actual "Function Statements" will vary during field-testing depending upon what effects are present, and the construction of the device.

NOTE: Rockets are *ALWAYS* tested inverted in a drum, and Missiles are *ALWAYS* tested in the Fireworks Testing Cage, unless otherwise instructed. As a general rule, rockets and missiles fly erratically. Both can cause field fires at the test site or strike the staff conducting the testing. Rockets and Missiles are ONLY fired upward when a special request from Compliance (CRC) is made.

NOTE: When field-testing conditions (wind) do not allow for open testing, all testing is performed in the Fireworks Testing Cage. In the "Function Statement" the phrase "feet" is omitted. At the end of the "Function Statement" the phrase "TESTED IN THE FIREWORKS TESTING CAGE." is added.

4. Malfunction(s) of the Fireworks Device

It is very important to observe and record any malfunction(s) of a fireworks device. Below is a list of the most common malfunctions that are observed while testing fireworks:

a. Ground spinner flying in the air
b. Aerial reports discharging on the ground
c. Tip-over while functioning
d. Burning debris falling to the ground
e. Ignition of grass fires from burning debris
f. Device casing continuing to burn after functioning

g. Incomplete functioning of the fireworks device
h. Effects behaving in an unusual manner
i. The nozzle (restricted orifice) or clay end-plug in a tube ruptures or is expelled. This is called "Blowout". **(See Section on Burnout and Blowout 16 CFR 1507.6)**
j. The sidewall of a tube ruptures. This is called "Blowout". **(See Section on Burnout and Blowout 16 CFR 1507.6)**
k. When burning pyrotechnic material burns a hole through the sidewall of a tube in a fountain device. This is called "Burnout". **(See Section on Burnout and Blowout 16 CFR 1507.6)**
l. Blowout Special Cases (Rockets, Mines and Shells, and Reloadable Aerial Shells). **(See Section on Burnout and Blowout 16 CFR 1507.6)**

Record these observations in the "Details Section" of the "Fireworks Field Sheet." Indicate how many of the eight devices tested, experienced a malfunction. If additional comments are necessary, place them in the "Function Statement Section."

NOTE: When testing fireworks samples in the open and one or two of the devices function erratically **(specifically tip-over, blowout, and burning debris starting grass fires)**, perform **ALL** further testing of that sample in the "Fireworks Testing Cage".

5. Burnout and Blowout 16 CFR 1507.6

The pyrotechnic chambers of fireworks devices must be constructed in such a manner that functioning of the device occurs in a normal manner. Any burning through the bottom or sides or any unintended rupture of the casing through the bottom or side of an item constitutes a burnout or blowout. The entire pyrotechnic effect must occur from the intended orifice(s).

Burnout generally occurs in fountains. It may appear as sparks, flame and/or smoke coming out of the side or bottom of the device. If sparks, flame, and/or smoke are observed, examine the device after it has functioned to determine if the sparks, flame or smoke are a result of burnout, from the burning of the fuse, from flames, sparks, or smoke escaping through the fuse orifices. Unless the side of the tube(s) shows evidence of having burned through, burnout has not occurred.

Blowout (when the walls of the device rupture or the nozzles and/or end plugs in the tubes are ejected while the device is functioning) is more common in rockets, mines and shells, reloadable tube aerial shells, roman candles, smokes, novelty devices, and missiles than in other devices. Occasionally, it occurs in fountains.

Blowout is determined by either observing the device as it functions, or by examining the spent device. Record the Burnout/Blowout observations on the "Fireworks Field Sheet."

Include the number of devices of the eight tested that exhibited the defect and whether the burnout or blowout occurred on the bottom or the side of the device. In the case of multiple tube devices, record the total number of tubes per device, and how many tubes for each failing device that experienced burnout or blowout. This may require disassembly of the spent device.

In addition to the above definition for burnout/blowout, Rockets, Mines and Shells, and Reloadable Tube Aerial Shells are also classified as suffering blowout if they produce their main effect (report, star burst, etc.) at a height less than is normal for such an item (i.e. – below a height of 20 feet).

The category called "Rockets" includes the following items:

a. Bottle Rockets,
b. Stick Rockets,
c. Spin Stabilized Rockets (i.e. - Spinning Type Missiles without Fins), and
d. Fin Stabilized Rockets (i.e. - Fin Type Missiles)

B. Additional Field Testing Requirements for Smoke Devices 16 CFR 1507.9(a)

In addition to the five standard field tests, fireworks smoke devices involve additional time measurements concerning the functioning of the device.

Smoke devices generally contain three pyrotechnic components: 1.) The Safety Fuse; 2.) The First Fire Starter Composition (a pyrotechnic primer for the ignition of the internal pyrotechnic smoke composition); and 3.) The Internal Pyrotechnic Smoke Composition.

Smoke devices require four (4) time measurements during the "Field" testing process. When a smoke device functions correctly, the fourth time measurement (d) will always be zero (0.0) seconds, that is, there is no flame production during the smoke production time. These time measurements are:

1. **Fuse Burn Time (FBT),**
2. **First Fire Flame Time (FFFT),**
3. **Smoke Production Time (SPT),**
4. **External Fire Flame Time (XFFT).**

In a general sense, a smoke device functions in the following manner:

1. **Primary fuse is ignited and burns (FBT).**
2. **"First Fire Starter Composition" is ignited, and the composition emits a short burst of flame or "First Fire Flame", and self-extinguishes (FFFT).**
3. **Smoke production begins and ends (SPT).**

The following “Time Line” represents the various function times of a smoke device:

FBT	FFFT	SPT
(a)	(b)	(c)

However, there are two malfunctions that are sometimes observed while testing smoke devices: A.) Excessive First Fire Flaming (EFFF), and B.) External Fire Flame (XFF).

The first malfunction called “Excessive First Fire Flaming” occurs when the smoke device continues to produce flame after the "First Fire Starter Composition" has burned, but prior to the beginning of smoke production. The following “Time Line” provides a representation of where the “Excessive First Fire Flaming Time” (EFFFT) time period occurs during the function time of a smoke device:

FBT	FFFT + **EFFFT**	SPT
(a)	(b) (b2)	(c)

NOTE: When measuring the “First Fire Flame Time” and the “Excessive First Fire Flaming Time”, if the analyst cannot distinguish when the “First Fire Flame” ends, and the “Excessive First Fire Flame” begins, the two time measurements should be recorded as one time.

The second malfunction called “External Fire Flame” (XFF) occurs while the smoke device is producing smoke. This malfunction is caused by a temperature increase of the smoke being expelled. This temperature increase causes the organic component of the smoke to ignite and burst into flame. As the temperature of the expelled gases decreases, the flame self-extinguishes, and smoke production resumes.

NOTE: CPSC staff practice regarding “External Fire Flame” is: Small “brief” or “mild” bursts of flame accompanying the combustion of the smoke composition are regarded as part of the normal operation of a smoke device.

The following “Time Line” provides a representation of where the “External Fire Flame” time period occurs during the function time of a smoke device. “External Fire Flame” can occur more than once during the functioning of a smoke device. Individual “External Fire Flame Times” for a smoke device are measured, but they are recorded as a **CUMULATIVE** time.

FBT	FFFT	SPT + **XFFT** + SPT
(a)	(b)	(c) (d) (c)

NOTE: When the measurement of “Smoke Production Time” begins, continue until smoke production has stopped. “Smoke Production Time” is a continuous

measurement. *DO NOT* stop timing "Smoke Production Time" if "External Fire Flaming" occurs. "Smoke Production Time" is recorded as the total smoke production time *NOT* "Smoke Production Time" minus "External Fire Flaming Time". Use separate stop watches to measure the four times: "Fuse Burn Time", "First Fire Flame Time", "Smoke Production Time", and "External Fire Flaming Time".

C. Laboratory Analysis (8-10 Devices)

Each of the following tests shall be conducted on eight sub-samples (8) with the exception of Report Charge Powder Weights. These are obtained from either five (5) or ten (10) sub-samples, as discussed below. The following measurements and observations are conducted in the laboratory:

1. Pyrotechnic Leakage and Ignition of Leakage
2. Fuse Support
3. Fuse Side Ignition
4. Height and Base Dimensions and Device Stability (12-degree Tilt Test)
5. Diameter of Reloadable Tube Aerial Shells
6. Handles [Handle Attachment, Handle Length, Tip Measurement (Diameter or Side Length)]
7. Spikes [Spike Attachment, Spike Length, Tip Measurement (Diameter or Side Length)]
8. Wheels & Axles (Driver & Axle Support)
9. Smoke and Flitter Devices
10. Rockets with Sticks (Stick Straightness, Stick Rigidity, Total Rocket Length, and Driver/Rocket Motor Attachment)
11. Firecracker or Aerial Report Powder Weights
12. Powder Weight in Party Poppers
13. Large Multiple Tube Mine and Shell Fireworks Devices (Display Racks) & 60-degree Tilt Test
14. Label Exhibits

NOTE: Handles and Spikes; Wheels and Axles; Smoke and Flitter Devices; and Large Multiple Tube Mine and Shell Fireworks Devices (Display Racks) have their own laboratory work sheet (See Appendix 1) with observations that are specific to that type of fireworks device.

1. **Pyrotechnic Leakage 16 CFR 1507.5**

   Any additional pyrotechnic leakage that collects in the plastic storage bags (Lab and Field samples) while handling the sample, should be collected, consolidated, weighed, and tested for ignitability as previously described in Section III.B. Again, attempt to identify how many of the units leaked. Regardless of composition (clay, pyrotechnic material, or a combination of the two), if the amount of pyrotechnic leakage is too small to gather and weigh, the leakage is recorded as "Light Dusting". If more than a "Light Dusting" is present, gently

repeat the shaking process. Any additional material should be collected, weighed and checked for ignitability (See Section III.B.). Record the test results on the "Fireworks Laboratory Sheet". **(All pyrotechnic leakage weights are added together.)**

NOTE: DO NOT TEST FOR IGNITABILITY IN THE FIREWORKS TESTING LAB. OPEN FLAMES ARE FORBIDDEN. TEST FOR IGNITABILITY USING A HOOD IN THE CHEMISTRY LABORATORY BUILDING OR TEST IT OUTSIDE ON THE GROUND.

2. Fuse Support (8 Subs) 16 CFR 1507.3(b)

If the sub-sample/device weighs **less than 8-ounces (227 grams)**, fasten two of the sub-samples/devices together with either a piece of tape, string, or a rubber band, and grasp the fuse by the tip, and lift. The fuse should not separate from the device.

If the sub-sample/device weighs **8-ounces (227 grams) or more**, attach an 8-ounce weight to the sub-sample/device, and grasp the fuse by the tip, and lift. The fuse should not separate from the device.

Test a total of eight (8) sub-samples/devices for fuse support. Record the number of fuses that **supported** the weight of two sub-samples/devices or one sub-sample/device plus 8-ounces on the "Fireworks Laboratory Sheet".

In addition to the above single fuse tests, when a device has two or more fuses that are NOT taped or tied together, but are protruding from the same hole, or located at different points on the device, each fuse should be tested for fuse support using the appropriate test as described above. Record the results in the "Sample Comment" section.

NOTE: FUSES COVERED BY PAPER/PLASTIC WRAP AND/OR TAPE

a. If two fuses are taped together, tied together, or wrapped inside a flame retardant covering, consider the two fuses as being one fuse. DO NOT SEPARATE THEM.

b. When the fuse(s) are wrapped with a paper or foil covering and/or taped to the device, do not unwrap the paper or foil from around the fuse(s), or remove the tape unless the paper and/or the tape prevents you from grasping the fuse. In this case, cut the tape or paper down to a point where the fuse can be grasped (expose the fuse to a length of about 1/8-inch to 1/4-inch). Hemostats, forceps, or pliers can be used for grasping the fuse and performing the "Fuse Support Test."

3. Fuse Side Ignition (8 Subs) 16 CFR 1507.3(a)(1)

Prior to removing the fuse from the fireworks device for side ignition testing, confirm that the "Fuse Support" test has been performed. The "Side Ignition" test requires cutting the fuse at the point where the fuse enters the fireworks device. (See **"NOTE: FUSE SIDE IGNITION TEST"**) If the fuse is wrapped in paper, plastic, or taped to the device, ***remove the fuse with the paper, plastic, and/or tape, intact.*** Collect eight (8) fuses where possible, and place them in one of the plastic pouches for later testing. Either attach the pouch to the completed lab form or attach to the pouch a sticky label with the sample number written on it. Testing fuses for side ignition is performed in a location where pyrotechnic and other flammable materials are not present, or outdoors if weather permits.

In a fume hood, lay a large sheet of aluminum foil on the flat interior counter top of the fume hood. Lay the fuse on the aluminum foil, with any tape, plastic, or paper wrapping facing upward. Place the glowing tip of a lit cigarette (use only unfiltered Pall Mall cigarettes) directly on the fuse, or the paper, plastic wrapping and/or tape that is either around or covering the fuse (**not the fuse tip or end**). Using a stopwatch begin timing when the glowing tip of the cigarette first touches the fuse, paper or plastic wrapping, or tape. Continue timing until ignition of the fuse occurs or a **maximum** of five (5) seconds. If the fuse ignites in less than 5 seconds, record the measured time on the "Fireworks Laboratory Sheet." If the fuse does not ignite in 5 seconds, stop the test, and record the measured time as 5 seconds on the "Fireworks Laboratory Sheet." Make any additional comments either in the "Side Ignition Comment" section or in the "Fuse Comment" section.

Certain smaller fireworks devices are exempt from the side ignition requirement. Firecrackers are exempt from this requirement, along with devices which contain less than 6 grams of pyrotechnic composition and require a restricted orifice to properly function. Such products include small bottle rockets, small smoke devices, small ground spinners (Jumping Jacks), small helicopters, small missiles, etc. For these products mark the **"Exempt"** box on the "Fireworks Laboratory Sheet" in the "Side Ignition" section.

NOTE: FUSE SIDE IGNITION TEST

a. Some fireworks devices only have a small piece of fuse protruding from the device. When the protruding fuse length is ½-inch or greater, proceed with the standard side ignition test. However, the side ignition test cannot be conducted on short fuses, that is, fuses less than ½-inch, because of the possibility of igniting the end of the fuse with the cigarette. When the fuse length is less than ½-inch, record on the "Fireworks Laboratory Sheet" the following statements in their respective comment block:

1.) **Side Ignition Comment:** ***"Insufficient fuse to test for Side Ignition; because of the possibility of igniting the end of the fuse with the cigarette."***

2.) **General Fuse Comment:** ***"Less than ½-inch of fuse protrudes from the device."***

b. In situations where: 1.) Only part of the fuse is wrapped leaving at least ½-inch of the fuse exposed; or 2.) Where some of the fuses in the sample are wrapped and others are not, test both the wrapped and unwrapped fuses. Record the results of either situation on a "Laboratory Continuation Sheet." The laboratory report should note these results for each test (wrapped and unwrapped) separately.

1.) **At least 1/2-inch of the fuse is exposed while the remainder of the fuse is covered with flame retardant wrapping. Test all of the fuses for side ignition on the flame retardant wrapping material first, and record the results on a "Laboratory Continuation Sheet." Second, test the exposed portion (the portion not covered by the flame retardant wrapping material) of the fuses for side ignition, and record the results on the same "Laboratory Continuation Sheet" above.**

2.) **Some of the fuses in the sample are wrapped with a flame retardant covering and others are not. Test both the wrapped and unwrapped fuses, and record the results for each test (wrapped and unwrapped) separately on a "Laboratory Continuation Sheet."**

4. Bases (8 Subs) 16 CFR 1507.4

Fireworks devices that operate standing in an upright position are required to have a stable base. This reduces the likelihood that the device will tip over during normal operation and emit a horizontal shower of sparks or shoot burning pyrotechnic material horizontally in the direction of the user or onlookers.

a. Height and Base Measurements

The base or bottom of fireworks devices that are operated in a standing position must have a horizontal base dimension or the base diameter equal to at least one-third the overall height of the device (excluding any fuse or twisted paper at the top of the device), but including any base or cap affixed to the device.

NOTE: HEIGHT TO BASE MEASUREMENT TEST
Firecrackers, Bottle Rockets, Stick Rockets, Roman Candles, Handles & Spikes, Smoke Devices, and Wheels & Axles are exempt from the Height to Base Measurement test.

Perform the Height to Base Measurement test on the device by measuring the height and the horizontal base dimension as indicated by the arrows in the drawings of the various bases as shown in Appendix 6 or the diameter of the base when the device is cylindrical. Record the findings on the "Fireworks Laboratory Sheet". It is necessary for the analyst to calculate the height to base ratio in the lab to determine if the ratio is less than, equal to, or greater than 3. If the height to base ratio is equal to or greater than 3, perform the 12-Degree Block Tilt Test (Section b. below). There is one exception to this test. This exception applies to Large Multiple-Tube Mine and Shell Fireworks Devices (Display Racks). These devices consist of two or more tubes, where at least one of the functioning tubes has an inside diameter measuring 1.5 inches (3.8 cm) or greater. There is a specialized test for these devices in Section IV.c.13.a & b

If the fireworks devices in the sample have one or more bases that are detached or if the sample has bases that are packaged separately, make a notation of this in the Sample Comment Section of the Split Sheet. Perform the Height to Base Measurement test on the devices **with and without** the bases attached. Record the findings of both tests on a **"Laboratory Continuation Sheet."** If the Height:Base Ratio is less than 3 with the base attached, but equal to or greater than 3 when the base is detached, perform the 12-Degree Block Tilt Test on the sample with the bases detached and record the results.

When measuring the base dimension, always remember to measure the horizontal dimension as indicated by the arrows in the drawings of the various bases as shown in Appendix 6 or the diameter of the base when the device is cylindrical. When a device is constructed of small multiple tubes, and the device does not have a "distinct" side, measure the diameter of the device. This is used to calculate the height to base ratio. The ratio (quotient) is calculated by dividing the height measurement (dividend) by the base measurement (divisor). Three examples follow:

1.) The height of a device is 4-inches, and the base is rectangular, measuring 2-inches by 4-inches. A height of 4-inches is recorded, and the base dimension of 2-inches is recorded. The height to base ratio of 2 is calculated as follows:

$$4" \div 2" = 2$$

2.) The height of a device is 10-inches, and the base is hexagonal, measuring 6-inches across from side to side and 3 1/2-inches on a side. A height of

10-inches is recorded, and the base dimension of 6-inches is recorded. The height to base ratio of 1.67 is calculated as follows:

$$10" \div 6" = 1.67$$

3.) The height of a device is 13-inches, and is constructed of multiple 3/8-inch tubes bunched together to form a "circular" device. Since the base is "circular" in appearance, measurement of the base diameter is 4-inches. A height of 13-inches is recorded, and the base dimension (in this case the diameter of 4-inches) is recorded. The height to base ratio is calculated as follows:

$$13" \div 4" = 3.25$$

In this situation, it would be necessary to perform the 12-Degree Block Tilt Test on the sample.

b. 12-Degree Block Tilt Test

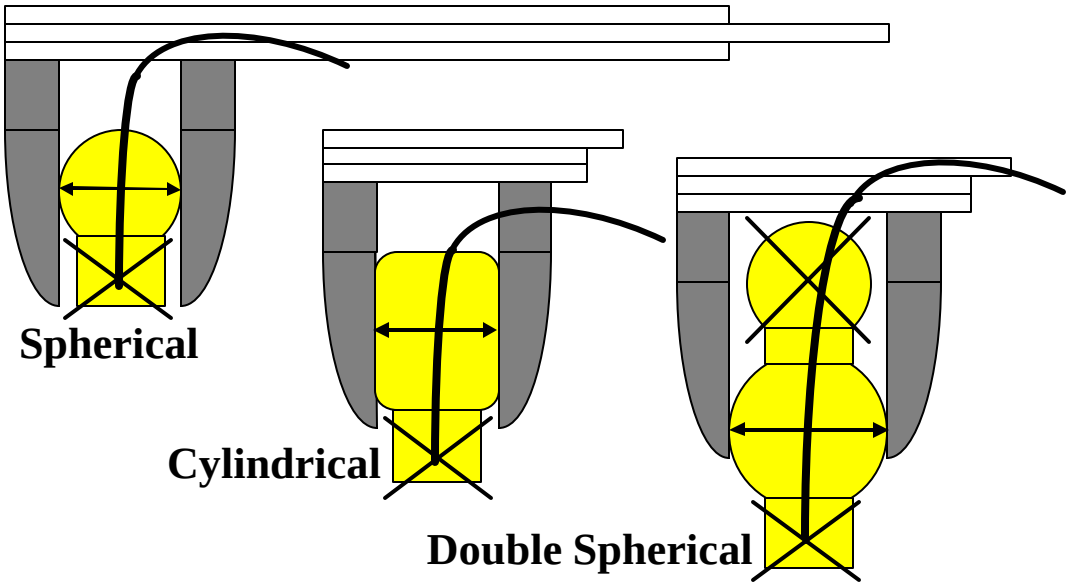
Prior to testing, check the work surface to ensure that it has a tilt angle of 0-degrees, since the test block is a pre-cut 12-degree angle. The 12-Degree Block Tilt Test is performed by gently placing the device, with neither a downward force nor by making an effort to either stabilize or tip the device, on a wooden block that is cut at a 12-degree angle to the horizontal. Always place the device on the block in the position it is most likely to tip, that is, the largest base dimension is parallel to the bottom edge of the testing block. Rotate the device such that each distinct base dimension is parallel to the bottom edge of the testing block. For devices with a round base or "nearly round base", rotate the device in small increments through a full 360 degrees and gently place the device, with neither downward force nor making an effort to either stabilize or tip the device, on the block with each rotation. Test 8 sub-samples and record the results on the "Fireworks Laboratory Sheet".

__ of _8_ tipped over on a 12-degree block.

5. <u>Reloadable Tube Aerial Shell Diameter Test (8 Subs) 16 CFR 1500.17(a)(11)(i)</u>

The maximum outside diameter of Reloadable Tube Aerial Shell fireworks devices is 1.75 inches. This test involves measuring the diameter of a reloadable tube aerial shell. Using the 6-inch metal caliper, place the exterior measurement jaws around the largest portion of the shell's exterior. Adjust the caliper and determine the outside diameter of the shell (Figure 1). When the shell appears to be spherical, make several measurements to ensure that the maximum diameter of the sphere (ball), not the lift charge chamber, is reported. When the shell is cylindrical, make several measurements of the shell diameter, not the shell height or

Figure 1. Reloadable Tube Aerial Shell Diameter Measurement



lift charge chamber. When the shell is a multiple break shell, make several measurements of the largest diameter sphere (ball) only. Record the maximum diameter measurement on the "Fireworks Laboratory Sheet".

6. Handles on Hand-held Devices (8 Subs) 16 CFR 1507.7

Hand-held fireworks devices, except sparklers, are required to have a handle at least four inches in length, which must be securely attached or be an integral part of the device. To determine the handle length, use the following procedure.

Measure the length of the exposed handle. If the length of the exposed handle is less than four inches, and the handle extends into the tube of the fireworks device, the handle is then considered an integral part of the device. Empty the pyrotechnic chamber, or use a spent device, and slide a ruler, rod, or a straight rigid object into the empty pyrotechnic chamber to measure the length of pyrotechnic chamber. ***The handle length is equal to the total length of the device (tube end where the fuse is, to the exposed tip of the handle) minus the chamber length***. The handle length includes the length of any clay plug that may be present below the pyrotechnic chamber. Record the two length results on the "Fireworks Handle/Spikes Lab Sheet", and calculate the handle length.

To check for secure attachment of the handle to the device, test 8 devices by applying a reasonable twisting force at the attachment joint. Report the number of separations (if any) on the "Fireworks Handle/Spikes Lab Sheet".

___ of _8_ handles detached when twisted.

7. Devices with Ground Spikes (8 Subs) 16 CFR 1507.7

This test is for devices that are to be held upright in the ground by means of a spike. The spike on the fireworks device is required to protrude at least two inches from the base, have a blunt tip not less than one eighth of an inch in diameter or one eighth of an inch on the side of a rod with a rectangular cross section, and be securely attached.
Measure the length of the exposed ground spike and the spike's blunt tip diameter or side length and record the measurements on the "Fireworks Handle/Spikes Lab Sheet".

To check for secure attachment of the Spike to the device, test 8 devices by applying a reasonable twisting force at the attachment joint. If there is a separation of the Spike section, report the number of separations on the "Fireworks Handle/Spikes Lab Sheet".

External Spike Length: _____inches.
Blunt Tip Measurement: _____inches.
___ of _8_ spikes detached when twisted.

8. Wheel Devices (8 Subs) 16 CFR 1507.8

Wheel type fireworks devices are required to have drivers (pyrotechnic filled component) and axles, which are securely attached so that they will not come apart during shipping, handling and normal operation. Wheel devices are intended to operate in fixed locations.

Indicate on the report, the number of drivers that are attached to each wheel device.

_____ drivers attached to each sub-sample/device.

To test for driver attachment, attach an eight-ounce weight to the driver (using string or a small clip tied to the weight), and let the weight hang down. Test eight (8) sub-samples/devices. Record the number of the drivers that separate from the device on the "Fireworks Wheel/Axles Lab Sheet".

_____ drivers of _____ supported 8 ounces without separation.

In a like manner, attach an eight-ounce weight to the axle. Test eight (8) sub-samples/devices. Record the number of the axles that separate from the device on the

"Fireworks Wheel/Axles Lab Sheet".

_____ axles of __8__ supported 8 ounces without separation.

In cases where the axle is a separate nail or spike that passes through a bearing such as an eyelet, tube, or ball bearing, these axle substitutes should also be securely attached to the wheel device. In these cases, check for secure attachment of the eyelet, tube, or ball bearing by attaching the eight-ounce weight to the nail (or axle), which has been put through the bearing. Test eight (8) sub-samples/devices. Record the number of the bearings that separate from the device on the "Fireworks Wheels/Axles Lab Sheet." Indicate on the report whether or not the nail or spike was provided.

Nail or spike provided with retail sample? ___ Yes ___ No

9. <u>Smoke Devices or Flitter Devices (8 Subs) 16 CFR 1507.9(b)(c)</u>

Smoke and flitter devices shall not be of a color and configuration so as to be confused with banned fireworks such as M-80's, silver salutes or cherry bombs. Examine the laboratory analysis portion of the sample, and determine if the device appears to be similar in color and in configuration to a banned item. Record the results on the "Fireworks Smoke Sheet." In the extremely rare occasion when the sample appears to be similar in color to, and in the configuration of a banned item, photograph a few of the devices in the sample, and send a copy of the picture with an explanation to the Compliance Officer that is responsible for the sample. Also included a photo of what the banned item looks like for comparison.

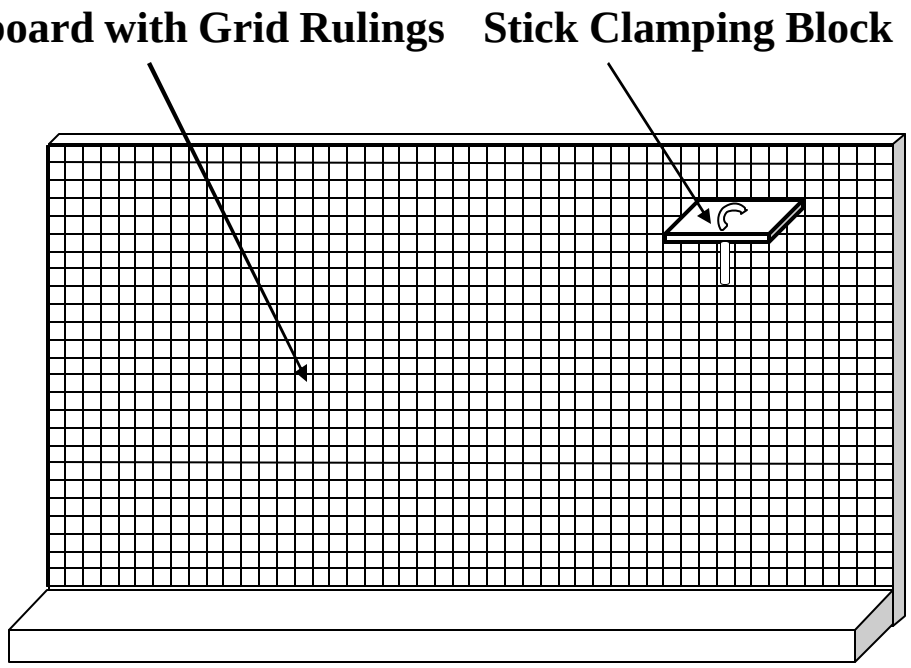
Smoke devices must not incorporate plastic materials, which make direct contact with pyrotechnic composition. Dissect a device to determine if plastic materials are in contact with the pyrotechnic composition. If the device has plastic material in contact with pyrotechnic material, examine the remaining seven devices, and record the results on the "Fireworks Smoke Sheet."

10. <u>Rockets with Sticks (10 Subs) 16 CFR 1507.10</u>

Rockets with sticks (including sky rockets and bottle rockets) are required to have a straight and rigid stick to provide a direct and stable flight. Rocket sticks should be protected from damage (breakage, and/or detachment) during transportation, normal handling, and normal operation.

Check 10 rockets for stick rigidity, 10 rockets for stick straightness, and 10 rockets for stick attachment and 10 rockets for any other tests. The tests for rigidity and straightness are performed using a Fireworks Rocket Test Stand (Figure 2). Chart recorder paper is

Figure 2. Fireworks Rocket Test Stand



attached to the Fireworks Rocket Test Stand to provide the necessary grid ruling for measuring rigidity and stick straightness. The chart paper grid ruling are: 1 block per millimeter (minor blocks) or 10 minor blocks per centimeter (**major blocks are designated by bold lines**). Minor block grid rulings are not displayed on Figures 2, 3, and 4.

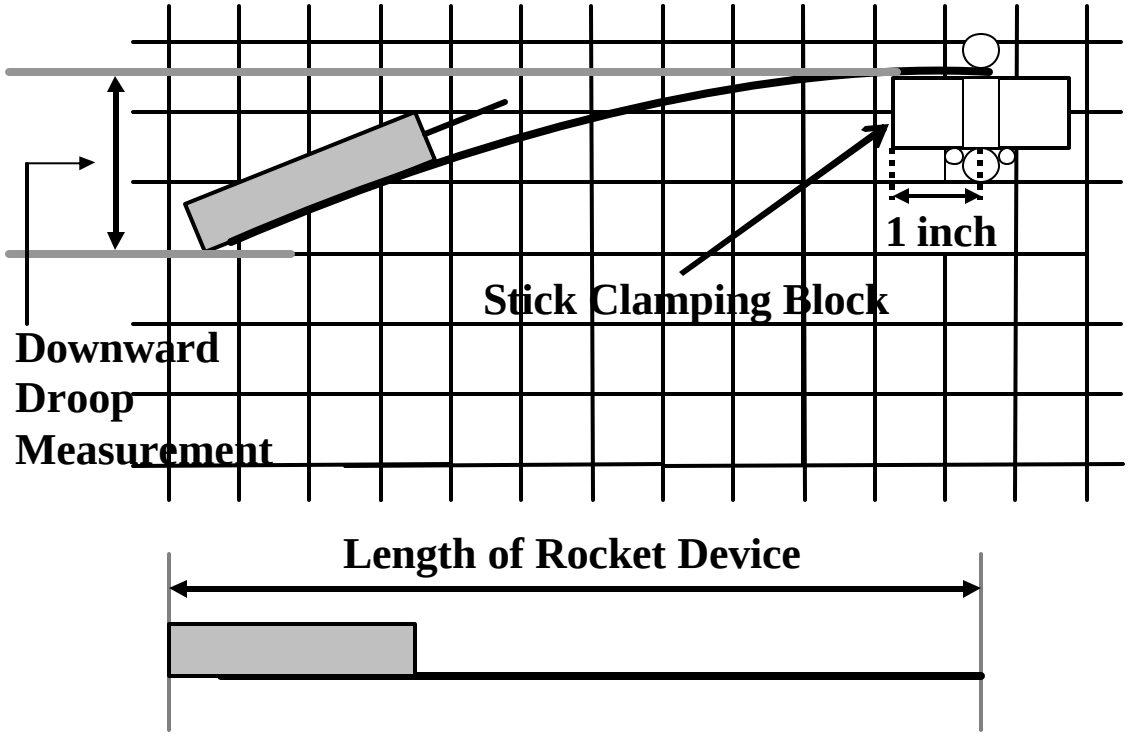
a. Stick Rigidity Test (10 devices):

Rigidity is evaluated by clamping a 1" section of the rocket stick's end, furthest from the driver, to the flat surface of the stick-clamping block.

Measure the downward distance that the end of the rocket driver droops (Figure 3), by counting the number of blocks (major and minor blocks) that the driver has drooped. Next, measure the total length of the rocket (Figure 3).

The results from the downward droop measurements and the length measurements are recorded in **centimeters** on the "Fireworks Laboratory Sheet". The fireworks database program uses the metric system in calculating the droop ratio (rigidity measurement)

Figure 3. Fireworks Rocket Stick Rigidity Measurement



Rigidity Measurement = Rocket Droop / Rocket Length

when the data is entered. The droop ratio is calculated by dividing the droop measurement by the rocket length.

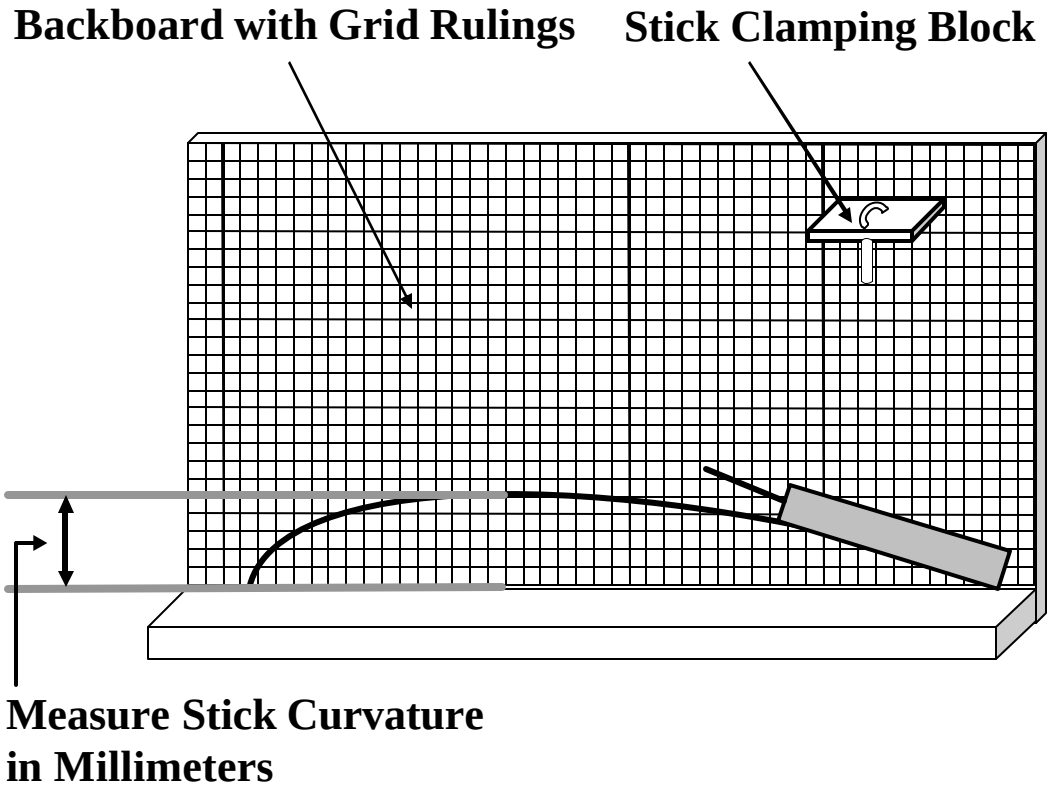
b. Stick Straightness Test (10 devices):

The Fireworks Rocket Test Stand (Figure 2) is laid flat on the table and the rocket is laid on the flat grid surface of the test stand. Roll the rocket stick to determine the greatest arch or bow (Figure 4). Count the number of blocks (Major and minor blocks) and record the results in **millimeters** on the "Fireworks Laboratory Sheet". The fireworks database program uses the metric system to perform calculations.

c. Stick Attachment Test (10 devices):

Lift the rocket device by grasping the end of the stick. Holding it vertically with the driver pointed downward; attach an eight-ounce weight to the rocket driver/motor. Test

Figure 4. Fireworks Rocket Stick Straightness Measurements



ten rockets in this manner. Record the number of devices that supported an eight-ounce weight without driver/stick separation on the "Fireworks Laboratory Sheet."

11. <u>Firecrackers and Aerial Reports 16 CFR 1500.17(A)(3)&(8)</u>

NOTE: Work in a Fume Hood. Use surgical gloves, dust masks and <u>care</u> when handling flash powder.

Firecrackers are allowed no more than a 50 milligrams (0.772 grains) charge of pyrotechnic composition. Reports in aerial devices that rise into the air more than 10 feet are allowed no more than a 129.6 mg (2 grains) charge of pyrotechnic composition.

a. Firecrackers

The charge of pyrotechnic composition in firecrackers is often “flash powder”, which is

gray in color. However, some firecrackers contain a pyrotechnic composition powder that is not gray. Carefully dissect one firecracker from each of five sub-samples. More than one firecracker from each sub-sample may be used if insufficient sub-samples were collected.

After the powder from 5 firecrackers has been weighed, calculate the average weight. If the average weight is less than 30 mg the analysis is complete. However, if the average powder weight is 30 mg or more, weigh the powder from an additional five firecrackers for a total of 10 firecrackers.

The dissection of firecrackers can best be performed by gently cutting the report longitudinally with a scalpel, hobby knife, or razor blade. The cuts should be shallow until only several layers of paper cover the powder. Unroll the remaining paper and with gentle tapping transfer the report powder to a piece of weighing paper that was previously folded into quarters. Keep as much of the clay material (if present) from transferring to the weighing paper. Use a small spatula to remove any large piles or pieces of clay, or fuse material from the weighing paper.

In order to separate any remaining clay material from the pyrotechnic composition, place and hold the centerfold of one of the sides between the first three fingers. The thumb and middle finger are located below the paper, while the index finger is located above the paper in the fold. Slightly tilt the end of the paper furthest from your fingers in a downward angle. With the other hand, gently tap or swing the index or middle finger in a back and forth motion so that side of the fingertip gently brushes against or taps the bottom of the paper in the area of the centerfold. This gentle tapping motion will cause the clay and report powder to separate. The clay will migrate away from the fingers holding the paper. Remove the clay and any foreign matter from the weighing paper and discard. Repeat this procedure until the report powder is free of clay or foreign material.

Transfer the clean report powder to a tared weighing dish on the balance. Record the powder weight in milligrams (mg) on the “Fireworks Laboratory Sheet”.

b. Aerial Reports (Paper Firecracker Type)

As a general rule, aerial reports are a collection of one or more firecrackers inside an aerial shell or rocket. The report powder in aerial reports is generally gray as with firecrackers. At times, however, black, pink, or white powder has been observed as the report charge. Carefully dissect the device and remove the report(s). If the aerial reports are similar to firecrackers, dissect the aerial report in a manner similar to that used with firecrackers.

After the powder from 5 aerial reports has been weighed, calculate the average weight. If the average weight is less than 100 mg the analysis is complete. However, if the average powder weight is 100 mg or more, weigh the powder from an additional five aerial reports for a total of 10 aerial reports. Record the powder weight in milligrams (mg) on the "Fireworks Laboratory Sheet". This applies to **ALL** types and sizes of aerial reports.

c. Aerial Reports (Paper Firecracker Type with Different Sizes)

Some firework devices contain aerial reports of two or more physical sizes. All sizes of reports need to be weighed as if they were from different devices. For example, a device may contain large and small aerial reports. Weigh the powder from five of the larger reports and five of the small reports. If the average of 5 aerial reports is less than 100 mg for either size, the analysis is complete for that particular size. If the powder weights average 100 mg or more for either size, an additional five reports are needed for a total of 10. Record the powder weight in milligrams (mg) on the "Fireworks Laboratory Sheet".

d. Aerial Reports (Plastic Projectile or Bottle Rocket)

If the aerial report is not a paper firecracker type, but a pyrotechnic composition in the device that is separated by layers of clay or some other material, carefully dissect the aerial effects casing and remove the report charge. The best way to open a plastic cylindrical projectile is to cut off the sealed end and remove the component layers until the report charge is removed. Clean and separate the report charge and record the weight. If the average of 5 aerial reports is less than 100 mg the analysis is complete. If the average of 5 aerial reports is 100 mg or more then an additional 5 aerial report weights are needed for a total of 10 report weights. Record the powder weight in milligrams (mg) on the "Fireworks Laboratory Sheet".

e. Aerial Reports (Aerial Shell is the Report Casing)

When the field function indicates that a loud report was observed during testing, examine the aerial shell(s) of the device. Open the paper shells by cutting through the paper (cylindrical shells should be cut longitudinally and spherical shells should be cut along the center seam of the shell). When plastic spherical shells are encountered, the best way to open them up is by cracking them open with a "C" clamp or vise, and separating the shell into two halves. (Care must be taken to prevent loss of contents when the sphere cracks open.) The best way to open a plastic cylindrical shell is to cut off the sealed end and remove the component layers until the report charge is removed. The report charge is then screened through a 100-mesh sieve. The screening process is performed by shaking the sieve contents back and forth, and tapping the sieve's side.

No instruments should be used to stir or mix the ingredients. If stars are present in the shell, such actions may fragment the stars.

A "loud report" indicates that the aerial report is overloaded. Ten aerial shells from different devices will be needed to determine the 10 report weights. Record the powder weight in milligrams (mg) on the "Fireworks Laboratory Sheet".

12. Party Poppers 16 CFR 1507.11

NOTE: DO NOT DISSECT PARTY POPPERS IN THE FIREWORKS LAB. DUE TO THE SENSITIVITY OF THE PYROTECHNIC COMPOSITION, FLAME AND/OR AN EXPLOSION CAN OCCUR.

Party poppers are not allowed more than 0.25 grains (16.2 mg) of powder. Further the cloth or soft paper insert must not ignite during operation. The powder in party poppers is very sensitive to friction, which is the mode of its operation.

Carefully dissect one. The powder may be somewhat loosely bound to the string; remove by gentle scraping with a spatula or a scalpel and weigh. Use at least one party popper per sub-sample. After 5 devices are analyzed, calculate the average weight. If the average weight of 5 devices is 10 mg or less, the analysis is complete, record the weights. If the average weight of 5 devices is more than 10 mg, a total of 10 devices need to be analyzed and the weights recorded. After the powder from 5 party poppers has been weighed, calculate the average weight. If the average weight is 10 mg or less, the analysis is complete. However, if the average powder weight is more than 10 mg, weigh the powder from an additional five party poppers for a total of 10 party poppers. Record the powder weight in milligrams (mg) on the "Fireworks Laboratory Sheet".

NOTE: EXERCISE GREAT CARE, USE SAFETY GOGGLES OR A FACE SHIELD; IT IS ALMOST CERTAIN THAT SOME PARTY POPPERS WILL IGNITE DURING THE REMOVAL OF THE PYROTECHNIC COMPOSITION. REPORT IF IT IS NOT POSSIBLE TO WEIGH THE COMPOSITION BECAUSE OF ITS SENSITIVITY TO FRICTION OR SHOCK.

13. Large Multiple-Tube Mine and Shell Fireworks Devices

A **"Display Rack"** is officially called a **"Large Multiple-Tube Mine and Shell Fireworks Device".** This test **ONLY** applies to Large Multiple-Tube Mine and Shell Fireworks Devices with any functioning tube measuring 1.5 inches (3.8 cm) or more in inside diameter. These devices are subject to 16 CFR 1500.17(a) (12) and 16 CFR

1507.12 and shall not tip over when subjected to the 60-Degree Tilt Angle Test as described in this section.

a. General Device Measurements and Observations

When testing "Display Racks" the following tests are performed: 1.) Height Measurement; 2.) Base Measurement; 3.) Inside Tube Diameter Measurement; 4.) Base Detachment; 5.) Number of Tubes per Device; and 6.) Number of Sides to the Base. Numbers 4, 5, and 6 are observations only, but they must be recorded.

To determine the Inside Tube Diameter, place a spring-loaded ID caliper inside of the launch tube, and expand the caliper until the two caliper tips are touching the inside walls of the tube. Remove the caliper and determine the distance between the two caliper tips, and record the results.

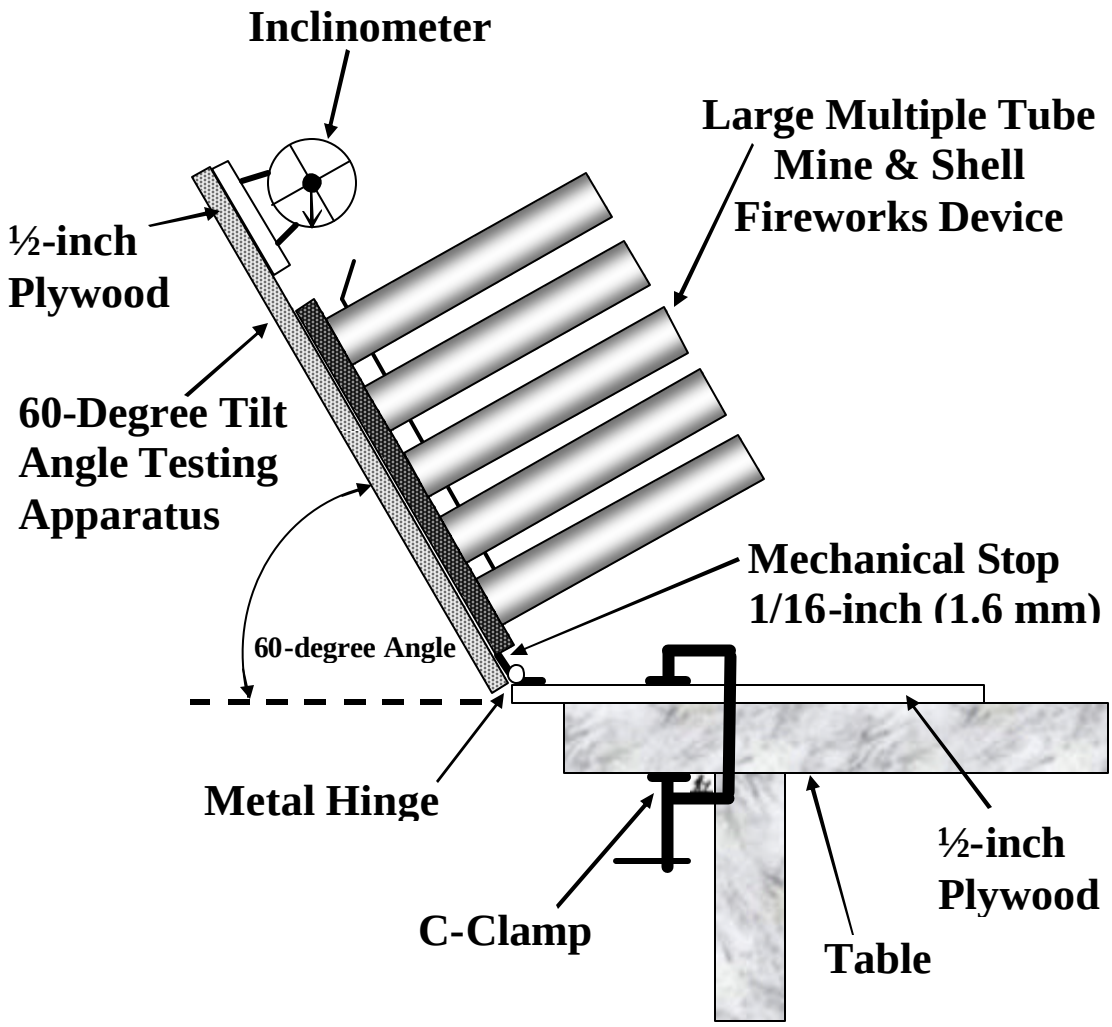
b. 60-Degree Tilt Angle Testing Procedure

The fireworks device shall be placed on a smooth surface that can be inclined to 60-degrees from the horizontal, as shown in the Figure 5. The height and width of the inclined plane (not including the portion of the plane below the mechanical stop) shall be at least 1 inch (2.54 cm) greater than the largest dimension of the base of the fireworks device to be tested. The test shall be conducted on a smooth, hard surface that is horizontal as measured by a spirit level or equivalent instrument. The mechanical stop on the inclined plane shall be 1/16 inch (1.6 mm) in height and perpendicular to the inclined plane. The stop shall be positioned parallel to the bottom edge of the inclined plane and so that no portion of the device to be tested or its base touches the horizontal surface. The device shall not tip over when the plane is inclined to 60-degrees from the horizontal. The procedure shall be repeated for each edge of the device. If the base of the device is circular, rotate the device in 90-degree increments as if the device were rectangular, to obtain 4 measurements.

14. Label Exhibits

Remove the label from one of the sub-samples and prepare a Label Exhibit. Place the label on an 8.5" X 11" piece of lined paper. A second label exhibit (if not done during the split procedure) should be made of the retail package, and/or box (if the product is packaged in multiple units). When the exhibits have been mounted, the analyst must identify the labels and mounting papers, by recording the Sample Number, Date, and analyst's initials on them in the top right corner. These are attached to the laboratory report.

Figure 5. 60-Degree Tilt Angle Tester



V. COMPLETION OF REPORTS

After the completion of field analysis and laboratory analysis, the analyst should access the LSC Fireworks Database and confirm that all of the data are entered in correctly from the three forms (Split Sheet, Field Sheet, and corresponding Laboratory Sheet depending upon the fireworks sample type). When the data are confirmed correct, the analyst reviewing the reports gives the first approval in the database by entering their initials into the database, which signifies the analyst has "Signed Off" on the analysis.

Forward the sample folder to the Laboratory Division Director (DD) who will review the data again and make corrections if necessary. The DD will then give their second approval and enter their initials into the database, which signifies that the DD has “Signed Off” on the report; and the report is saved in the database, preventing additional changes from being made to the approved version of the report.

APPENDICES INDEX

Appendix 1

General Fireworks Testing Data Forms

1.) Fireworks Split Sheet

2.) Fireworks Tracking Sheet

3.) Fireworks Field Sheet

4.) Fireworks Laboratory Sheet

5.) Fireworks Smoke Device Sheet

6.) Fireworks Handles/Spikes Lab Sheet

7.) Fireworks Wheels/Axles Lab Sheet

8.) Fireworks Display Rack Lab Sheet

9.) Fireworks Pyro-Comp Lab Sheet

FIREWORKS SPLIT SHEET

Sample Number: _____.
Product Name: _____.
Date Sample Received: _____.
Date Sample Split: _____.
Received By: _____.
Sample Condition: ❒Good ❒Torn ❒Leaking ❒Protruding ❒Crushed
Class: ❒Not Classified ❒Fireworks Import ❒Domestic Fireworks
❒Routine Compliance
Number of Containers: _____.
Container Type: ❒Cardboard Box ❒Plastic Bag ❒Paper Bag ❒Other:
Seal Break Date: _____.
Seal Broken By (Analyst's Initials): _____.
Seal Condition: ❒Intact ❒Broken ❒None
Number of Subs: _____ Units/Sub: _____.
Sub IDs: _____.
# of Devices Analyzed: _____ # of Devices Reserved: _____.
Seal Date: _____.
Location of reserve: ❒LS Seatainer ❒Bldg. F ❒Other
Sample Sealed By (Full Name): _____.

❒FIRECRACKER	**❒ROMAN CANDLE**	**❒WHEELS & AXLES**	**❒SPARKLERS**
❒STICK ROCKET	**❒HANDLES & SPIKES**	**❒MISSILES**	**❒KIT CHEMICALS**
❒MINES/SHELL	**❒SMOKE DEVICES**	**❒FOUNTAINS**	**❒OTHER PYROTECHNICS**
❒TUBE MORTAR	**❒NOVELTY DEVICES**	**❒DISPLAY RACK**	**❒NONE OF THE ABOVE**

Sample Comment: _____.
_____.
_____.

PYROTECHNIC LEAKAGE: ❒Yes ❒No ❒Light dusting
If yes: _____ mg leaked from ____ of ____ devices.
Leakage Ignites: ❒Yes ❒No
Type of Leakage: ❒Pyro ❒Clay ❒Mix of Pyro/Clay
BASE ATTACHMENT: N/A ❒ (***Enter information into Sample Comment***.)
_____ of _____ device bases were detached from the device.
_____ of _____ device bases were cracked.
_____ of _____ device bases were broken into pieces.
Base Assembly Required: ❒Yes ❒No
Analyst: _____ Date: _____.

SAMPLE NUMBER FY-_____.	PRODUCT NAME	TYPE	QUAN	RECD BY	SPLIT DATE	L/T DATE	F/T DATE	REV1 DATE	REV2 DATE

FIREWORKS FIELD SHEET

Sample Number: _____.
Product Name: _____.

❒FIRECRACKER	❒ROMAN CANDLE	❒WHEELS & AXLES	❒SPARKLERS
❒ROCKET	❒HANDLES & SPIKES	❒MISSILES	❒KIT CHEMICALS
❒MINES/SHELL	❒SMOKE DEVICES	❒FOUNTAINS	❒OTHER PYROTECHNICS
❒TUBE MORTAR	❒NOVELTY DEVICES	❒DISPLAY RACK	❒NONE OF THE ABOVE

FUSE BURN TIME (to nearest 0.1 sec)

_____ _____ _____ _____ _____ _____ _____ _____.

Number of Devices Tested: _____.

Number of Devices that Functioned: _____.

_____ of _____ fuses burned but device failed to function.

Fuse Burn Comment:

BURNOUT AND BLOWOUT

_____ of _____ devices exhibited ❒ burnout ❒ blowout

Comment: ❒ Burnout/Blowout Not Applicable, or

_____ of _____ tubes, _____ of _____ tubes, _____ of _____ tubes,
_____ of _____ tubes, _____ of _____ tubes, _____ of _____ tubes,
_____ of _____ tubes, _____ of _____ tubes, exhibited burnout or blowout.

FUNCTION:

_____ of _____ ground spinners had air travel
_____ of _____ devices had reports discharge on the ground
_____ of _____ devices tipped over while functioning
_____ of _____ devices had burning debris fall to the ground
_____ of _____ devices ignited grass fires
_____ of _____ devices continued to burn after functioning
_____ of _____ devices did not fully function

Analyst: _____ Date: _____.

FIREWORKS LABORATORY SHEET

Sample Number: _____.

Product Name: _____.

❒FIRECRACKER	❒ROMAN CANDLE	❒WHEELS & AXLES	❒SPARKLERS
❒ROCKET	❒HANDLES & SPIKES	❒MISSILES	❒KIT CHEMICALS
❒MINES/SHELL	❒SMOKE DEVICES	❒FOUNTAINS	❒OTHER PYROTECHNICS
❒TUBE MORTAR	❒NOVELTY DEVICES	❒DISPLAY RACK	❒NONE OF THE ABOVE

PYROTECHNIC LEAKAGE

Amount: _____ mg.

Comment: ❒Light dusting

❒ _____ of _____ devices leaked. ❒Leakage ignites.

Analyst: _____ Date: _____.

FUSE SUPPORT

_____ of _____ supported ❒2 devices ❒device+8oz.

Analyst: _____ Date: _____.

SIDE IGNITION(seconds) ❒*EXEMPT*

_____ _____ _____ _____ _____ _____ _____ _____.

Side Ignition Comment: _____.

Fuse Comment: _____.

Analyst: _____ Date: _____.

HEIGHT/BASE (inches)

Tube Diameter: _____ Shell Diameter: _____.

Height: _____ Base: _____.

_____ of _____ tipped over on a 12 degree block.

Comment: _____.

Analyst: _____ Date: _____.

ROCKETS

Stick Straightness in Millimeters:

_____ _____ _____ _____ _____ _____ _____ _____ _____ _____.

Stick Rigidity in Centimeters: Rocket length: _____ cm

_____ _____ _____ _____ _____ _____ _____ _____ _____ _____.

Stick attachment: _____ of _____ devices support 8 oz.

Analyst: _____ Date: _____.

REPORT WEIGHTS (mg)

1.) ____ ____ ____ ____ ____ ____ ____ ____ ____ ____.

Report Comment: _____.

2.) ____ ____ ____ ____ ____ ____ ____ ____ ____ ____.

Report Comment: _____.

3.) ____ ____ ____ ____ ____ ____ ____ ____ ____ ____.

Report Comment: _____.

Analyst: _____ Date: _____.

FIREWORKS SMOKE DEVICE SHEET

Sample Number: _____.

Product Name: _____.

FUSE BURN TIME (to nearest 0.1 sec)

_____ _____ _____ _____ _____ _____ _____ _____.

Number of Devices Tested: _____.

Number of Devices that Functioned: _____.

_____ of _____ fuses burned but device failed to function.

Fuse Burn Comment:

First Fire Flame Times:

_____ _____ _____ _____ _____ _____ _____ _____.

Smoke Times:

_____ _____ _____ _____ _____ _____ _____ _____.

External Fire Flame Times:

_____ _____ _____ _____ _____ _____ _____ _____.

Analyst: _____ Date: _____.

BURNOUT AND BLOWOUT

_____ of _____ devices exhibited ❒ burnout ❒ blowout

Comment:

Analyst: _____ Date: _____.

FUNCTION:

Emits first fire flame _____ inches long, produces smoke.

Analyst: _____ Date: _____.

PYROTECHNIC LEAKAGE

Amount: _____ mg.

Comment: ❒Light dusting

❒ _____ of _____ devices leaked. ❒Leakage ignites.

Analyst: _____ Date: _____.

FUSE SUPPORT

_____ of _____ supported ❒2 devices ❒device+8oz.

Analyst: _____ Date: _____.

SIDE IGNITION(seconds) ❒*EXEMPT*

_____ _____ _____ _____ _____ _____ _____ _____.

Side Ignition Comment: _____.

Fuse Comment: _____.

Plastic-Pyro Contact: ____ of _____ had plastic in contact with pyrotechnic.

May be confused with a banned item. ❒Yes ❒No

Analyst: _____ Date: _____.

FIREWORKS HANDLES/SPIKES LAB SHEET

Sample Number: _____.
Product Name: _____.

PYROTECHNIC LEAKAGE

Amount: _____ mg.
Comment: ❒Light dusting
❒ _____ of _____ devices leaked. ❒Leakage ignites.
Analyst: _____ Date: _____.

FUSE SUPPORT

_____ of _____ supported ❒2 devices ❒device+8oz.
Analyst: _____ Date: _____.

SIDE IGNITION(seconds)

_____ _____ _____ _____ _____ _____ _____ _____.
Side Ignition Comment: _____.
Fuse Comment: _____.
Analyst: _____ Date: _____.

HANDLES

___ of ___ Handles detached when twisted.
Handle Length:
1.) Total device length = _____ inch
2.) Empty pyrotechnic chamber length = _____ inch
3.) Handle length = Total length - Chamber Length = _____ inch
Handle tip diameter or side measurement: _____ inch
Analyst: _____ Date: _____.

GROUND SPIKES

___ of ___ Ground Spikes detached when twisted.
Exposed Ground Spike Length: _____ inch
Ground Spike tip diameter or side measurement: _____ inch
Analyst: _____ Date: _____.

REPORT WEIGHTS (mg)

1.) ____ ____ ____ ____ ____ ____ ____ ____ ____ ____.
Report Comment: _____.
2.) ____ ____ ____ ____ ____ ____ ____ ____ ____ ____.
Report Comment: _____.
Analyst: _____ Date: _____.

FIREWORKS WHEELS/AXLES LAB SHEET

Sample Number: _____.

Product Name: _____.

PYROTECHNIC LEAKAGE Amount: _____ mg.

Comment: ❒Light dusting

❒ _____ of _____ devices leaked. ❒Leakage ignites.

Analyst: _____ Date: _____.

FUSE SUPPORT:

_____ of _____ supported ❒2 devices ❒device+8oz.

DRIVER SUPPORT:

_____ drivers of _____ supported 8 ounces without separation.

AXLE INTEGRITY:

_____ axles of _____ supported 8 ounces without separation.

DRIVER PER DEVICE: ____ devices

Nail or spike provided with retail sample? ❒ Yes ❒ No

Analyst: _____ Date: _____.

SIDE IGNITION(seconds)

_____ _____ _____ _____ _____ _____ _____ _____.

Side Ignition Comment:

Fuse Comment:

Analyst: _____ Date: _____.

FIREWORKS DISPLAY RACK LAB SHEET

Sample Number: _____.

Product Name: _____.

PYROTECHNIC LEAKAGE Amount: _____ mg.

Comment: ❒Light dusting

❒ _____ of _____ devices leaked. ❒Leakage ignites.

Analyst: _____ Date: _____.

FUSE SUPPORT

_____ of _____ supported ❒2 devices ❒device+8oz.

Analyst: _____ Date: _____.

SIDE IGNITION(seconds) ❒*EXEMPT*

_____ _____ _____ _____ _____ _____ _____ _____.

Side Ignition Comment: _____.

Fuse Comment: _____.

Analyst: _____ Date: _____.

STABILITY

Height: _____ Base: _____ Inside Tube Dia.: _____.

# of Tubes per Device: _____ # of Sides to the Base: _____.

_____ of _____ bases were detached.

Base comment: _____.

60-degree Tilt Test:

Device #	Side Tip Angles (Degrees)					
_____	_____	_____	_____	_____	_____	_____.
_____	_____	_____	_____	_____	_____	_____.
_____	_____	_____	_____	_____	_____	_____.
_____	_____	_____	_____	_____	_____	_____.
_____	_____	_____	_____	_____	_____	_____.
_____	_____	_____	_____	_____	_____	_____.
_____	_____	_____	_____	_____	_____	_____.
_____	_____	_____	_____	_____	_____	_____.

Analyst: _____ Date: _____.

REPORT WEIGHTS (mg)

1.) _____ _____ _____ _____ _____ _____ _____ _____ _____ _____.

2.) _____ _____ _____ _____ _____ _____ _____ _____ _____ _____.

Report Comment: _____.

Analyst: _____ Date: _____.

FIREWORKS PYRO-COMP LAB SHEET

Sample Number: _____ .

Product Name: _____ .

❒FIRECRACKER	❒ROMAN CANDLE	❒WHEELS & AXLES	❒NONE OF THE ABOVE
❒ROCKET	❒HANDLES & SPIKES	❒MISSILES	
❒MINES/SHELL	❒SMOKE DEVICES	❒FOUNTAINS	
❒TUBE MORTAR	❒NOVELTY DEVICES	❒DISPLAY RACK	

1.) Total Device Weight: _____ (grams)

2.) Weight of Non-report effects from 5 tubes or aerial shells

Type - (Flaming balls, stars, whistle, comets, crackle, seed hulls with pyro. comp., etc.)

_____ a .) _____ _____ _____ _____ _____ (mg.) Average = _____ .

_____ b.) _____ _____ _____ _____ _____ (mg.) Average = _____ .

_____ c.) _____ _____ _____ _____ _____ (mg.) Average = _____ .

_____ d.) _____ _____ _____ _____ _____ (mg.) Average = _____ .

_____ e.) _____ _____ _____ _____ _____ (mg.) Average = _____ .

_____ f.) _____ _____ _____ _____ _____ (mg.) Average = _____ .

_____ g.) _____ _____ _____ _____ _____ (mg.) Average = _____ .

3.) (Circle One)Weight of Burst or Report (excluding paper reports) from aerial shells

_____ _____ _____ _____ _____ (mg.)

_____ _____ _____ _____ _____ (mg.) Average = _____ .

Report Comment:

4.) Weight of Lift Charge from 5 tubes

_____ _____ _____ _____ _____ (mg.) Average = _____ .

5.) Paper Reports Weights Only

_____ _____ _____ _____ _____ (mg.)

_____ _____ _____ _____ _____ (mg.) Average = _____ .

Report Comment:

6.) Number of reports per tube or aerial shell = _____ .

7.) Number of tubes per Sub (device) = _____ .

8.) Number of aerial shells per Sub (retail package) = _____ .

9.) Total pyrotechnic weight per tube or aerial shell = _____ .

10.) Total pyrotechnic weight per Sub (device/retail pkg.) = _____ .

Analyst: _____ Date: _____.

Appendix 2
General Split Information

Fireworks Type	NUMBER OF DEVICES NEEDED FOR FIELD TESTING	NUMBER OF DEVICES NEEDED FOR LAB TESTING [1]
Firecrackers **(A)**	N/A	10
Rockets **(B)**	10	30
Mines & Shells **(C)**	8	8 – 10
Reloadable Tube Aerial Shells **(C)**	8	8 – 10
Roman Candles **(C)**	8	8 – 10
Handles & Spikes **(C)**	8	8 – 10
Toy Smokes **(C)**	8	8
Novelties **(C)**	8	8 – 10
Wheel & Axles **(C)**	8	8
Missiles **(C)**	8	8 – 10
Fountains **(C)**	8	8
Party Poppers **(D)**	N/A	10
*Large Multiple Tube (≥ 1.5") Mine & Shells **(C)**	8	8 – 10
Sparklers **(E)**	N/A	10
Snakes **(F)**	N/A	10

1 – Eight (8) devices are normally used for Lab Analysis, however, when the device contains Aerial Reports, ten (10) devices are used for analysis. One report is removed from each device.

***** – "Large Multiple Tube (≥ 1.5") Mine & Shells" are the same as "Display Racks"

(A.) <u>Firecrackers:</u>

1.) Eleven (11) sub-samples are required for Firecrackers with two exceptions: a.) large or small rolls of firecrackers, or b.) bricks of firecrackers. A sub-sample may consist of one firecracker per retail package, loose multiple firecrackers in a box, or multiple firecrackers braided together to form a short or long string, which is sold as a retail package. One firecracker is removed from each sub-sample for a total of 10 firecrackers for analysis. If there are less than 11 sub-samples, divide the 10 count equally between the sub-samples. A minimum of one intact sub-sample is set-aside as the reserve. Any remaining firecrackers are placed in reserve.

2.) **Exception:** If only one or two sub-samples were sent and they are "large rolls" or "Bricks", remove 10 firecrackers from one of the sub-samples for analysis. When "large rolls" of firecrackers have different size firecrackers, remove 10 firecrackers of each size for analysis. A "Brick" of firecrackers is a large retail package consisting of multiple smaller retail packages of short or long strings of braided firecrackers. When collecting firecrackers for analysis from a "Brick", remove one (1) firecracker from ten of the smaller internal retail packages, or if there are less than 10 internal retail packages, divide the 10 count

Appendix 2 cont.

equally between the number of smaller internal retail packages. Any remaining firecrackers are placed reserve.

(B.) Rockets:

Forty (40) rockets are required for analysis. Ten (10) rockets for **Stick Rigidity**; ten (10) rockets for **Stick Straightness**; ten (10) rockets for **Stick Attachment to rocket motor/driver, fuse attachment, rocket length, side ignition, and aerial report weights**; and ten (10) rockets for **Field Testing**. The following criteria **MUST** be used in selecting rockets for the various tests.

NOTE:

1. **STICK RIGIDITY - When selecting rockets for the stick rigidity test, only select the thinnest, and most flimsy rocket sticks. Select one rocket from each of the ten sub-samples for a total of ten rockets (10).**
2. **STICK STRAIGHTNESS - When selecting rockets for the stick straightness test, only select rocket sticks that are the most crooked, or have the greatest bow. Select one rocket from each of the ten sub-samples for a total of ten rockets (10).**
3. **STICK ATTACHMENT, ETC. - When selecting the ten (10) rockets that will be used for stick attachment to rocket motor/driver, fuse attachment, rocket length, side ignition, and aerial report weights, randomly select the rocket. Select one rocket from each of the ten sub-samples for a total of ten rockets (10).**
4. **FIELD TESTING - When selecting rockets for Field Testing, randomly select the rocket. Select one rocket from each of the ten sub-samples for a total of ten rockets (10).**

Typically, rockets come in retail packages that contain 1, 2, 4, 6, 8, 10, 12, 16, 24, 36, or 144 (a Gross) rockets. Generally, a "Gross" consists of 12 small retail packages with 12 rockets per package.

EXAMPLE: Eleven sub-samples will normally be sent to the lab when a retail package contains 4 rockets or more. Four rockets from each sub-sample (a retail package) must be removed (three for laboratory analysis, and the fourth for field analysis). Thus, a total of ten rockets are selected for field analysis, and thirty rockets are selected for laboratory analysis. The eleventh sub-sample is for reserve.

Exception for Rockets: When there are two (2) or more rockets in a retail package, and the labels indicate that some or all of the rockets have **"different and distinct functions"**; the total number of sub-samples should be such that each **"different and distinct function"** in the retail package has 40 rockets for analysis.

NOTE: If the labels are identical except for color, this exception **DOES NOT APPLY.**

EXAMPLE: The retail package has 6 rockets. The labels indicate there are 4 **"different and distinct functions"** (three of the six rockets have the same function). A total of 41 retail packages should have been collected.

Appendix 2 cont.

(C.) Mines/Shells, Reloadable Tube Aerial Shells, Roman Candles, Handles & Spikes, Toy Smokes, Novelty Items, Wheels & Axles, Missiles, Fountains, and Display Racks:

1.) Eight sub-samples are required for field analysis, and eight sub-samples are required for laboratory analysis. If the sample indicates that explosive reports are present, ten sub-samples are then required for laboratory analysis. Therefore, 17 - 19 sub-samples should have been collected for items packed as single or individual units for retail sales. Any extra sub-sample(s) are resealed and placed in reserve.

2.) When retail packages are collected containing two (2) or more devices, each retail package is generally considered a sub-sample. In this situation, only 11 sub-samples should have been collected. Two devices from each sub-sample (a retail package) shall be removed for analysis. The first device is for laboratory analysis and the second device is for field analysis. Thus a total of eight devices are for field analysis, and eight devices are for laboratory analysis. If the sample indicates that explosive reports are present, ten devices are then required for laboratory analysis. These two additional devices that will be used for report analysis are collected from different sub-samples if possible. The intact eleventh sub-sample and any remaining individual devices are sealed and placed in reserve.

3.) **Exception for Roman Candles, Handles or Spikes:** When there are two (2) or more devices in a retail package, and the labels indicate that some or all of the devices have **"different and distinct functions"**; the total number of sub-samples that should have been collected would be such that each **"different and distinct function"** in the retail package would have either 17 devices for functions that do not have aerial reports, and 19 devices for functions that have aerial reports. Any extra sub-sample(s) or remaining individual devices are resealed and placed in reserve.

EXAMPLE-1: 1 retail package has 6 devices. Labels indicate there are four (4) **"different and distinct functions"** with one of the four functions indicating that aerial reports are present (three of the six devices have the same function, but no aerial reports). A total of 19 retail packages would need to be collected (17 retail packages if aerial reports are not present). The sample would be split into four parts (A, B, C, and D). Any extra sub-sample(s) or remaining individual devices are resealed and placed in reserve.

EXAMPLE-2: 1 retail package has 6 devices. Labels indicate there are three (3) **"different and distinct functions"** with one of the three functions indicating that aerial reports are present (three sets of two devices that have the same function). A total of 11 retail packages would need to be collected (9 retail packages if aerial reports are not present). The sample would be split into three parts (A, B, and C). Any extra sub-sample(s) or remaining individual devices are resealed and placed in reserve.

(D.) Party Poppers:

One Party Popper will be removed from each of 10 sub-samples for analysis. The intact eleventh sub-sample and any remaining individual devices are repackaged, sealed and placed in reserve.

(E.) Sparklers (Dipped Wire & Wooden Handles, Morning Glories) :

Two sparklers are removed from each of the 10 sub-samples for field and chemical laboratory analysis. The intact eleventh sub-sample and any remaining individual devices are repackaged, sealed and placed in reserve.

Appendix 2 cont.

(F.) Snakes:

One snake pellet is removed from each of the 10 sub-samples for chemical laboratory analysis. The intact eleventh sub-sample and any remaining individual devices are repackaged, sealed and placed in reserve.

Appendix 3
Fireworks Field Tests

Fireworks Field Test / Fireworks Type	Fuse Burn Time	Functionality of the Fuse	Device Function	Burnout Blowout	Device Malfunctions
Firecrackers	N/A	N/A	N/A	N/A	N/A
Rockets **(1)**	X	X	X **(2)**	N/A **(4)**	N/A **(5)**
Mines & Shells	X	X	X	X	X
Reloadable Tube Aerial Shells	X	X	X	X	X
Roman Candles	X	X	X	X	X
Handles & Spikes	X	X	X	X	X
Smoke Devices **(7)**	X	X	X	X	X
Novelties	X	X	X	X	X
Wheels & Axles	X	X	X	X	X
Missiles **(1)**	X	X	X **(3)**	N/A **(4)**	N/A **(5)**
Fountains	X	X	X	X	X
Party Poppers	N/A	N/A	X	X	X
Display Racks **(6)**	X	X	X	X	X
Sparklers	N/A	N/A	N/A	N/A	N/A
Snakes	N/A	N/A	N/A	N/A	N/A

X – Required Test
N/A – Not Applicable

NOTE: Numbers 1 –6 represent additional tests, exceptions, or exclusions to that particular test.
(1) – Rockets are always tested inverted in a drum, while Missiles are always tested in the Fireworks Testing Cage. Rockets and Missiles are ***ONLY*** fired upward into the open air when a special request has been made by the Office of Compliance.
(2) – Reference to the device shooting into the air and the height description are excluded from the function statement when the device is tested inverted in a drum.
(3) – When testing Missiles, the height description is excluded from the function statement.
(4) – The ***ONLY*** time that blowout is applicable to an ***INVERTED ROCKET OR MISSILE***; is when the pyrotechnic driver causes an unintended rupture of the casing through the bottom or side of the item (i.e. - the driver blows up or blows the nozzle out). The rule is "The entire pyrotechnic effect (in this cause the "effect" is the propellant burning to create propulsion) must occur from the intended orifice(s)."
(5) – Additional "Device Malfunctions" are not applicable (outside of Burnout/Blowout) since these devices are tested inverted in a steel drum or in the Fireworks Testing Cage.
(6) – Large Multiple Tube Mines & Shells (One or more functioning tubes are ≥ 1.5-inches in diameter).
NOTE: This excludes Large Tube Single Shot Mines & Shells (Tube size does not matter).
(7) – Additional time measurements with regards to the functioning of the device are required:
a.) First Fire Flame Time **(FFFT)**, b.) Smoke Production Time **(SPT)**, c.) External Fire Flame Time **(XFFT)**.

APPENDIX 4

GENERIC FIREWORKS FUNCTION STATEMENTS

Rocket: 1.) Tested inverted in a drum. Bursts releasing stars.
(or)
2.) Shoots upward ___ feet into the air, which bursts releasing stars.

Mine Shells and Display Racks:
Shoots flaming balls ___ feet into the air, which burst releasing stars.

Saturn Missile Battery: **(Specific Function Statement)**
Shoots plastic projectiles ___ feet into the air, which emit a whistle, and gives report.

Victory Celebration: (Specific Function Statement)
Shoots flaming balls ___ feet into the air, which burst releasing stars and a parachute with a flaming ball attached, and gives multiple reports.

Combination Mine Shells:
Emits a shower of sparks ___ feet into the air. Shoots flaming balls __ feet into the air, which burst releasing stars.

Reloadable Tube Aerial Shells: **[Specific Function Statement (Effects will vary)]**
Shoots shell ___ feet into the air, which bursts releasing stars.

Roman Candles: Shoots flaming balls __ feet into the air.

Handle/Spike: Emits a shower of sparks.

Smoke Device: Emits first fire flame __ inches long, produces smoke.

NOTE: ***Only small smoke ball devices are tested in the lab hood. Large smoke devices are tested in the field.***

Novelty Item: The function description varies depending upon the device. However, the description will be similar to one of the various types of fireworks devices.

Strobe Light: **(Special Novelty Function Statement)**
Emits a __ inch long flame. Device flashes a brilliant light.

Helicopters: Spins upward __ feet into the air emitting a shower of sparks.

Ground Spinners: Multiple spinners, spin on the ground, which emit a flame, and a shower of sparks. (Airborne spinners traveled __ feet upward and ____ feet outward.)

Wheel/Axle: Spins on axle. Emits a flame __ inches long, and emits a shower of sparks.

APPENDIX 4 Cont.

Missiles: **(For Fin and Spin Stabilized Missiles)**

1. Tested in the fireworks testing cage, or inverted in a drum. Missile spins upward, which bursts releasing stars.
2. Tested in the fireworks testing cage, or inverted in a drum. Shoots missile upward, which bursts releasing stars.
3. Missile spins upward __ feet into the air, which bursts releasing stars.
4. Shoots missile upward __ feet into the air, which bursts releasing stars.

Fountains: Emits a flame __ inches into the air. Emits a shower of sparks __ feet into the air.

Sparklers: Emits a shower of sparks.

Appendix 5

Fireworks Laboratory Tests

Device Type / Lab Test	Fire-cracker	Rocket	Mines & Shells	Mortar	Roman Candle	Handle & Spike	Smoke & Flitter	Novelty Devices	Wheels & Axles	Missile	Fountain	Party Popper	Display Racks	Sparkler	Snake
Pyrotechnic Leakage & Ignition	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Fuse Attachment		X	X	X	X	X	X	X	X	X	X		X		
Fuse Side Ignition		X **1**	X	X	X	X	X **1**	X **1**	X **1**	X **1**	X **1**		X		
Height:Base Measurement			X **4**	X **4**			**4,8**	X **4**		X **4**	X **4**		X **4**		
12-degree Tilt Test			X **5**	X **5**			**5**	X **5**		X **5**	X **5**				
Report Powder Weight	X **2**	X **3**	X **3**	X **3**	X **3,6**	X **3,6**		X **3**		X **3**			X **3**		
Diameter of Reloadable Aerial Shells				X											
Stick Straightness		X													
Stick Rigidity		X													
Stick Attachment		X													
Total Rocket Length		X													
Handle\Spike Attachment					X	X									
Handle\Spike Length					X	X									
Tip Dia. or Side Length					X	X									
Driver Support									X						
Axle Support									X						
Powder Weight												X			
Tube Inside Diameter			X **7**										X **7**		
60-degree Tilt Test													X		
Chemical Analysis on Specified Components	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**	**9**

X – Required Test

Appendix 5 Cont.

NOTE: Numbers 1 – 9 represent additional tests or exceptions to that particular test.

1 – If the device requires a restricted orifice for proper thrust and contains less than 6 grams of pyrotechnic composition, the device is EXEMPT from the Side Ignition Test.

2 – If the average powder weight of 5 firecrackers is greater than 30 mg., obtain the powder weights of 5 additional firecrackers for a total of 10 powder weights.

3 – If the average powder weight of 5 aerial reports is greater than 100 mg., obtain the powder weights of 5 additional aerial reports for a total of 10 powder weights.

4 – If any of the eight device bases are detached, determine the height and base measurements of the device with and without the base attached.

5 – If the ratio of the Height:Base is greater than 3, perform the 12-Degree Tilt Test.

6 – If the Field Test indicates that the reports are contained inside of the stars, determine the report weights by dissection of the star.

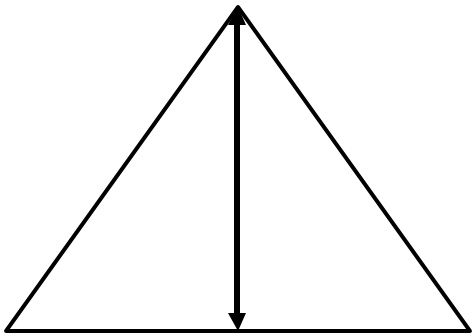
7 – Mine & Shell devices with "Large" tubes, measure the tube's Inside Diameter (I.D.). If the I.D. is 1.5-inches or greater the device is classified as a Display Rack. Record the tube I.D.

8 – Height/Base measurements are only made if the device can be stood on end.

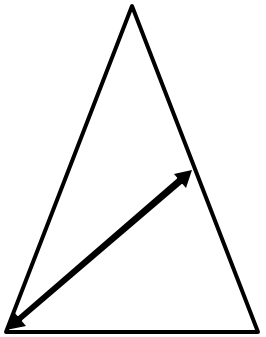
9 – Chemical Analysis upon Request from CRC

Appendix 6.
Fireworks Base Measurement Pictorial Directions

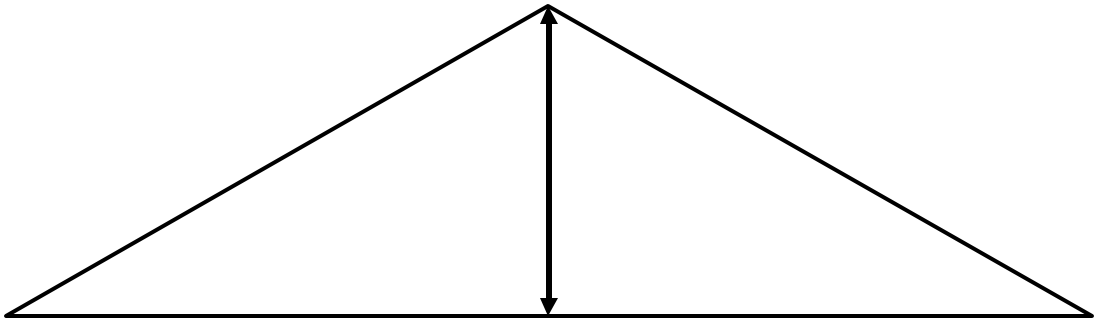
Base Measurement - Equilateral Triangle



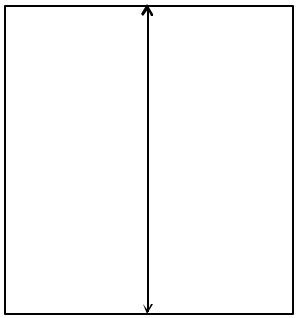
Base Measurement - Acute Triangle



Base Measurement - Obtuse Triangle

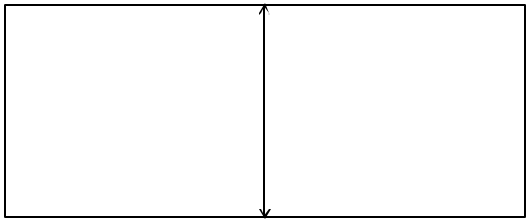


Base Measurement - Square

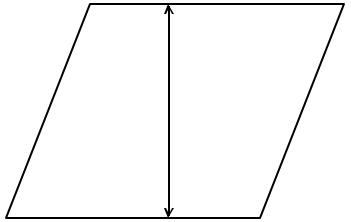


Appendix 6. Cont.

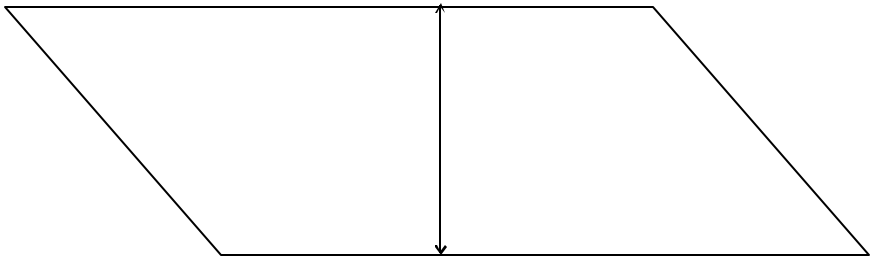
Base Measurement - Rectangle



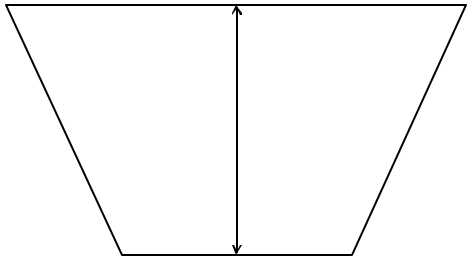
Base Measurement - Equilateral Parallelogram



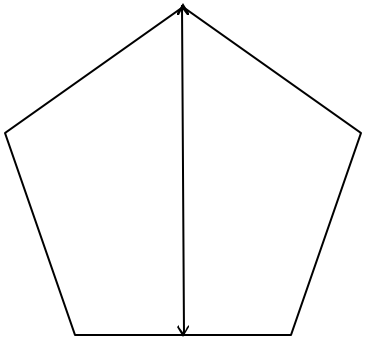
Base Measurement - Parallelogram



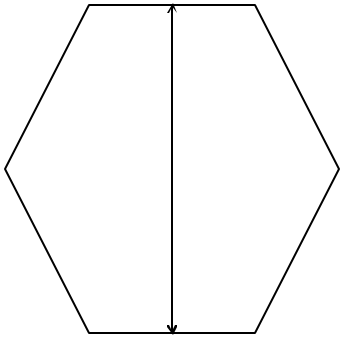
Base Measurement - Trapezoid



Base Measurement - Pentagon

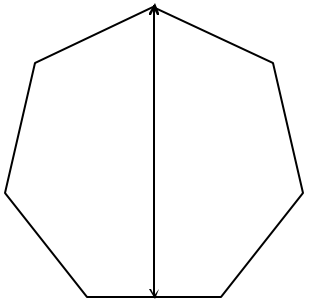


Base Measurement - Hexagon

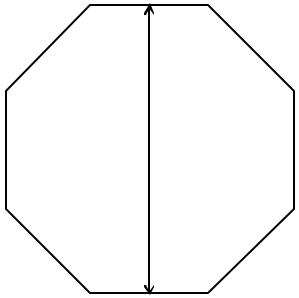


Appendix 6. Cont.

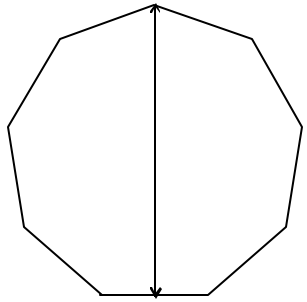
Base Measurement - Heptagon



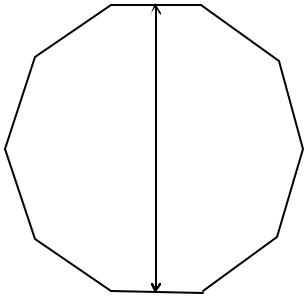
Base Measurement - Octagon



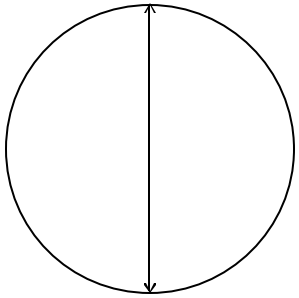
Base Measurement - Nonagon



Base Measurement - Decagon



Base Measurement - Circle



Base Measurement - Ellipse