



UAHuntsville Propulsion Research Center
 OPERATING PROCEDURE FOR:
Black Powder Testing

SOP #: PRC-SOP-USLI-005
 Revision: C
 Version: 0
 Test Location: PRC Test Cell Facility

Test Date: _____

Test Team

NAME	ROLE

This Procedure Contains the following Hazards

<input type="checkbox"/>	Human Subjects	<input type="checkbox"/>	Animal Subjects
<input type="checkbox"/>	Highly Toxic Chemicals	<input type="checkbox"/>	Toxins or toxin products
<input type="checkbox"/>	Pressurized gases	<input checked="" type="checkbox"/>	Explosives/Propellants
<input type="checkbox"/>	Microbial agents/products	<input type="checkbox"/>	Cell or tissue culture
<input type="checkbox"/>	Lasers	<input type="checkbox"/>	Selected Agents
<input type="checkbox"/>	Radioisotopes or x-ray generating equipment	<input type="checkbox"/>	Carcinogenic/mutagenic/teratogenic chemicals
<input type="checkbox"/>	Human blood, body fluid, tissue	<input type="checkbox"/>	Recombinant DNA/RNA molecules



REVISION BLOCK

Operating Procedures may be modified either through a Revision or a Version increment. Revision Increments require a new Signoff Sheet and full approval. Version increments are for minor corrections or additions to Red Team members. Version increments only require new Red Team signature and a single approval from PRC Staff.

<i>0</i>	<i>Revised SOP, To update Red Team and Template, for 2018-2019 ULSI</i>	<i>See Signature Page</i>	

ACTIVE WAIVERS

The following waivers have been reviewed by the procedure approval team and are accepted based on assessment of additional mitigations put into effect for conducting the test

1	<i>N/A</i>			



PROCEDURE REVISION APPROVAL:

I have personally reviewed each of the operational steps of the SOP and have no questions that the operation can be performed safely and efficiently. I approve all red team personnel assigned in this document and verify that they have proper training to act in the prescribed test roles outlined in this procedure.

Hope Cash: _____ **Date:** _____

Author

William Hankins: _____ **Date:** _____

Vehicle Lead

Jade Kirkwood: _____ **Date:** _____

Vehicle Safety Lead

Marcus Shelton: _____ **Date:** _____

Chief Engineer

Zachary Ruta: _____ **Date:** _____

Program Manager

Jason Winningham: _____ **Date:** _____

Mentor

Dr. David Lineberry: _____ **Date:** _____

Course Instructor



Dr. Robert Frederick: _____ **Date:** _____

PRC Director

Reviewed By:

UAH OEHS Director: _____ **Date:** _____



AUTHORIZED RED TEAM MEMBERS

Individuals identified below are authorized to participate in test operations as *Red Team Members* through the SOP approval signatures. By signing the document below, the individuals acknowledge that they have reviewed the procedure and understand the general and specific safety requirements, personnel limits, and work descriptions necessary to accomplish their part of the operation.

Additional Red Team Members may be added to this document without a procedure revision pending approval of the PRC Director or Laboratory Supervisor or Facility Engineer prior to participating in the experiment. Additional members require signatures of both the individual to be added and the approver.

Authorized test individuals agree to abide by and follow the procedure outlined in this document for conducting the described experiment. At a minimum, Red Team Members must maintain active First Aid/CPR/AED certification.

Red Team Members	Affiliation	First Aid/ CPR-AED Cert Date	PRC Safety Quiz	Signature	Approval Initials
David Lineberry	PRC Staff	9/20/2017	Feb 2018		
Jason Wunningham	Mentor	6/8/2018	Feb 2018		
Hope Cash	MAE 490 Student	10/5/2018	Sept 2018		
William Hankins	MAE 490 Student	10/4/2018	Sept 2018		
Benjamin Channell	MAE 490 Student	10/4/2018	Sept 2018		
Kyle DeGreen	MAE 490 Student	10/5/2018	Sept 2018		
Tanner Schmitt	MAE 490 Student	10/5/2018	Sept 2018		
Vivian Braswell	Mentor	9/13/2018	Feb 2018		



SECTION I. DECLARATIONS.

1. Objective

This SOP establishes procedures and defines safety precautions that will be used to verify black powder testing used in separation and parachute deployment. Success will be defined as clean separation and the parachutes are fully ejected from the body tube. Two consecutive, successful tests are required.

2. Test Location

The PRC Test Stand at the Johnson Research Center on the UAH campus will be the location of testing. This provides a secured and controlled access area. Procedure allows for testing at alternate locations such as testing at NAR/TRA controlled flight ranges pending approval of the field RSO. For testing, personnel must be at least 30ft away from the test article and only one container of black powder is allowed at the prep area.

3. Roles and Responsibilities

This procedure requires a minimum of 2 test operators one of which must be designated PRC staff or mentor. Black powder charges will only be handled by the Team Mentors or Faculty Advisor. Operator roles will be assigned on the day of testing. Each operator will be assigned a role and that role will be identified on the procedure cover sheet (pg 1). Test operator roles are identified below:

Safety Monitor: is responsible for monitoring safety. Will read procedures during testing and be responsible for the igniter key.

Test Conductor: is responsible for directly conducting the test and assembly

4. Observer Policy

Observers will be allowed under this test procedure at the discretion of the test team. The occupation limitations of the room apply to observers as well as test participants. Any observer must be briefed on the experiment hazards, emergency procedures prior to test operations, and listed on the title page of the procedure.

5. Safety Policy

All PRC test operations require a minimum of two operators with First Aid, CPR, and AED training. Test operations are carried out according to the PRC Facility Usage Policy outlined in PRC-SOP-001-R01. A copy of the facility usage policy may be found on the PRC website <http://UAH.edu/prc>. All personnel involved with this operation have been empowered to stop any portion of this operation at any time if they feel it is not proceeding in a safe manner. The PRC Director, PRC Research Engineer/Laboratory Supervisor, PRC Facility Engineer, and other required personnel will be notified and a decision on whether to continue the operation will be made at that time. No safety interlock will be modified, bypassed, or defeated unless the test team has concurred and are aware of the inherent risks associated with the change. Otherwise, the offender will be permanently expelled from the PRC and all of its facilities.



6. Personal Protective Equipment (PPE)

Test personnel must wear safety glasses at all times during test operations. Long pants and closed toed shoes are also required for testing. Approved hearing protection for firing procedures is recommended but not required. When handling Black Powder, Nitrile gloves must be worn. Nearby Fire Extinguisher must be on hand or locations identified prior to testing.

7. Procedure Deviations

At any point during the execution of this SOP any team member may call for a stand down of test operations to discuss any concern related to safety. Additionally, during the execution of the SOP any deviation to the procedures outlined in this document must be noted on the procedure and it must be identified on the cover page that deviations were conducted. Revisions to the procedure may be required prior to the next test operation. Prior to each test, verify that the procedures do not require modification due to specific test plan requirements. In the event that redlines are required during execution, ensure that the redlines present no safety, efficiency, or environmental concerns.

8. Materials Needed

Assembled Rocket Air Frame	Table
Safety Glasses	Pliers
Black Powder	Wrench
E-Match	Channel lock
Black Powder Cap	Phillips screwdriver
Long wire	Flathead screwdriver
Fire Extinguisher (verify availability at site)	Wire strippers
Wire cutters	Shear pins box (#4-40)
E-match Ignition Circuit	Rocket Stand
Volumetric measuring device	Mass Simulation
Electrical tape	Wadding
Ear plugs	Gorilla Tape
Battery(s)	Masking tape
Parachute	Painter's tape
Shock cord	Dog barf
Measuring tape	Brush
Multimeter	Ethanol alcohol
Nitrile gloves	Paper towels



SECTION II. TEST PROCEDURES.

PRETEST LABORATORY PREPARATION

- 1 Inform all guests of emergency exits and other pertinent safety information.
- 2 Identify nearest AED location to team and guests.
- 3 Place all jewelry and electronic devices, including cell phones, tablets, and radios in an approved location.
- 4 Make sure all personnel are wearing the proper PPE, e.g., safety glasses, goggles, face shield, hearing protection (if needed).
- 5 If testing at the JRC,
 - The 'Warning' barricades should be set up at each corner of the test area.
 - Turn warning light to YELLOW during the set-up procedure and throughout the experiment.
 - Verify with facility personnel that the test area is clear.
 - Verify gate is locked.
- 6 If testing at a launch field
 - Get Permission from RSO to test.
- 7 Setup camera to record test (optional).

IGNITION CIRCUIT SETUP (WIRED CIRCUIT)

- 8 Verify Safety Monitor is in possession of arm key
- 9 Ensure ignition circuit is disconnected from battery
- 10 Shunt ends of Ignition Circuit Extension Cord leads at test stand.
- 11 Connect Ignition Circuit Battery Leads to multi-meter to perform continuity check on ignition circuit.

See Figure 2 for Circuit Box definition

- 12 Hold control circuit arm key in ignition and press "fire" button to perform continuity check.
- 13 Remove control circuit arm key and hand to Safety Monitor
- 14 Disconnect battery leads from multi-meter.
- 15 Shunt Ignition Circuit Battery leads



Figure 1: Ignition Circuit Control Box

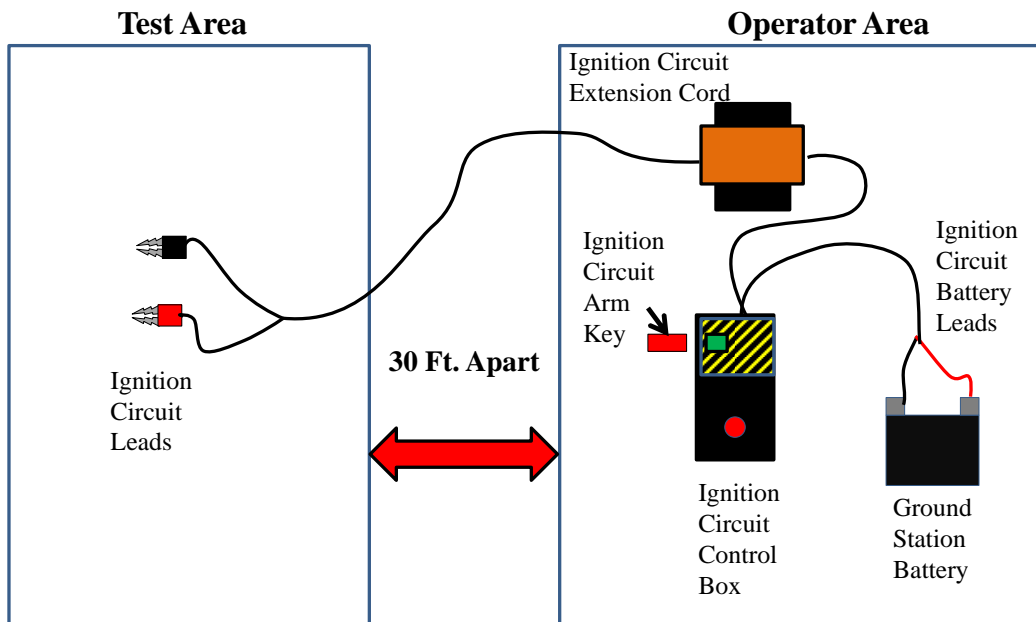


Figure 2: Wired Firing Circuit Setup Schematic



PREPARING THE BLACK POWDER CHARGE

	TEST 1	TEST 2	TEST 3	TEST 4	TEST 5
Only Team Mentor may handle black powder.					
17. Confirm light is Yellow					
18. Verify non-Red Team members have vacated the testing area.					
19. Inspect E-Match for frayed wires.					
20. Secure E-Match into charge container and seal with electrical tape.					
21. Twist e-match leads together to short the circuit.					
22. NITRILE GLOVES MUST BE WORN WHEN HANDLING BLACK POWDER.					
23. Remove black powder from designated container.					
24. Measure specified amount of black powder to be tested in a volumetric measuring device.					
25. Record the volume of the black powder					
26. Insert specified amount of black powder into charge container.					
27. Pack charge container with wadding material.					
28. Close charge container and ensure seal.					
29. Return black powder to designated container and move container away from test area.					
30. Ensure ematch leads are accessible from the outside of the rocket body.					
31. Ensure charge ematch leads are twisted together to short the circuit.					
32. Install charge in rocket.					



33. Give Ejection Charge lead wires a slight tug to ensure they are firmly connected to the Terminal Blocks					
34. Assemble rocket components to be tested for separation.					
35. If necessary, insert shear pins into rocket halves to be tested for proper shear.					
36. Place rocket on designated test stand.					

TESTING PROCEDURES

	TEST 1	TEST 2	TEST 3	TEST 4	TEST 5
37. Verify Safety Monitor is in possession of firing circuit arm key.					
38. Ensure ignition circuit is disconnected from battery.					
39. Connect E-Match leads to ignition circuit.					
40. Remove all attending personnel at least thirty (30) feet radius from test article.					
41. Return to Operator Area.					
42. Take one last observation to ensure that no personnel are near test area.					
43. Verify that the battery is disconnected from igniter circuit.					
44. Verify that the Safety Monitor has possession of the control circuit arm key.					
45. Announce "CLEAR AREA."					
46. Confirm that test fire is a "GO."					
47. Connect Battery to Ignition Circuit.					
48. Insert control circuit arm key into control box					
49. Perform continuity check (by holding in the arm key for the Wired Ignition system.					
50. Perform a countdown of 5,4,3,2,1, FIRING CHARGE.					
51. Press and hold the fire button for 5 seconds or until ignition.					



	TEST 1	TEST 2	TEST 3	TEST 4	TEST 5
52. If the charge fails to fire skip to Hang Fire Procedure Steps (step 67).					
53. Wait for charge to burn completely.					
54. Remove control circuit arm key and hand to Safety Monitor.					
55. Disconnect Battery at ground station.					
56. Wait 60 seconds.					
57. All attendees should then remain in their safe zone until given the go ahead from Safety Monitor.					
58. Test operator should then approach the E-Match charges and ensure that all black powder was expelled from the E-Match charge and detonated.					
59. It is now safe for all attendees to return to the test area to examine the results of the tests.					
60. Record all results.					
61. Inspect all components for damage.					
62. Clean components of black powder residue.					
63. Return to step 17 for continued Testing (if Required)					

SHUTDOWN AND PROCEDURE CLOSEOUT

- 60 If testing at the JRC,
 - The ‘Warning’ barricades should be stored.
 - Warning light should be turned to Green.
- 61 Return Black powder to approved storage location.
- 62 Return Multimeter to storage location.
- 63 Return batteries to storage location.



- 64 Return ignition system to approved storage location.

ADMINISTRATIVE & DOCUMENTATION TASKS

- 65 Update black powder inventory after a successful test or relocation of propellant.
- 66 Upon completion, the SOP needs to be signed by the participating Red Team members, scanned, and provided to the Safety Officer.

HANG FIRE PROCEDURE (REPEATED FAILURE)

Hang Fire Procedure (Repeated Failure)	TEST 1	TEST 2	TEST 3	TEST 4	TEST 5
67. Remove arm key from control box					
68. Hand Arm Key to Safety Monitor					
69. Disconnect Ground Station battery.					
70. Wait 60 seconds					
71. Proceed to Test Area					
72. Assess setup to determine if rocket should be removed or if debugging the system could resolve issue. (If issue can be resolved, note any actions taken.)					
73. Disconnect E-match leads from ignition cable.					
74. Twist E-match leads together.					
75. Remove rocket frame from test stand.					
76. Ensure proper disposal of black powder and E-Match.					



SECTION III. APPENDICES.

APPENDIX A. Cross Referenced Procedures

The following procedures are referenced in this SOP and are required for verification purposes.

#	SOP Doc #	Description
1	PRC-SOP-001	UAH Propulsion Research Center – Facility Usage Policy, 1-Apr-2012.
2	PRC-SOP-002	PRC Safety Plan
3	CRW-RAC	Charger Rocket Works Risk and Hazard Assessment



APPENDIX B. Risk Assessment

RAC				
Probability Level	Severity Level			
	1 Catastrophic	2 Critical	3 Marginal	4 Negligible
A – Highly Probable	1A	2A	3A	4A
B – Likely	1B	2B	3B	4B
C – Moderate	1C	2C	3C	4C
D – Unlikely	1D	2D	3D	4D
E – Improbable	1E	2E	3E	4E

Severity Level	
Description	Criteria
1 – Catastrophic	Loss of life or permanent injury, irreparable major damage to facilities or hardware, complete project failure.
2 – Critical	Severe personal injury, significant damage to hardware or facilities, significant impact on overall schedule.
3 – Marginal	Minor personal injury, reparable damage to facilities or hardware, significant impact on immediate schedule.
4 – Negligible	Minor personal injury, little to no damage to hardware, little impact on immediate schedule.

Probability Level		
Description	Criteria	
	Qualitative	Quantitative
A – Highly Probable	Highly expected to occur or to occur frequently during project duration.	85% < Probability
B – Likely	Expected to occur or to occur several times during project duration.	50% < Probability < 85%
C – Moderate	Potential to occur multiple times during project duration.	25% < Probability < 50%
D – Unlikely	Remote potential to occur with exception of rare occasion during project duration.	1% < Probability < 25%
E – Improbable	Highly unexpected to occur during project duration.	Probability < 1%



ITEM #	FAILURE MODE	FAILURE CAUSE	POTENTIAL EFFECTS	RAC	MITIGATIONS	RAC	VERIFICATIONS
1a	Uncontrolled Ignition of Black Powder	Ignition due to ESD	<ul style="list-style-type: none"> • Damage to facility • Injury from debris • Hardware Damage • Fire 	3D	<ul style="list-style-type: none"> • Wires are shorted together to prevent buildup • Access to test area is restricted when testing • Arm key provides physical break in igniter circuit • Always point rocket away from all personnel 	3E	<ul style="list-style-type: none"> • SOP steps 10, 15, 21, 31, 74. • SOP steps 5, 17, 18, 37, 39. • SOP steps 13, 41, 52, 67. • Setup will be done in accordance with safe testing practices.
1b		Ignition during connecting or disconnecting battery	<ul style="list-style-type: none"> • Damage to facility • Injury from debris • Hardware Damage • Fire 	3D	<ul style="list-style-type: none"> • Wires are shorted together to prevent buildup • Access to test area is restricted when testing • Arm key provides physical break in igniter circuit • Always point rocket away from all personnel 	3E	<ul style="list-style-type: none"> • SOP steps 10, 15, 21, 31, 74. • SOP steps 5, 17, 18, 37, 39. • SOP steps 13, 41, 52, 67. • Setup will be done in accordance with safe testing practices.
2a	Personnel exposed to live circuit	Uninsulated wires/worn insulation	<ul style="list-style-type: none"> • Electric Shock 	3C	<ul style="list-style-type: none"> • Arm key provides physical break in igniter circuit • Trained personnel will be making battery connections 	3D	<ul style="list-style-type: none"> • SOP steps 13, 41, 52, 67. • Only Test Conductor will be authorized to connect the battery under the discretion of the Safety Monitor.



Hazard Assessment and Mitigation						
Chemical Handling: Black Powder, Loose						
Hazard	Cause	Effect	Pre-MA	Mitigation	Verification	Post-MA
Unintentional Detonation	Friction, heat, outside sources of energy, improperly handled.	Fire or explosion. Immediate physical danger potentially resulting in severe injury or death. Minor damage to facilities.	1B	Safe handling by trained personnel. Correct PPE including impervious rubber gloves and non-static producing clothing.	Only Red Team members will be allowed to conduct test. PPE is covered in the SOP. MSDS is included in Appendix E of SOP.	1D
Damage respiratory system.	Chronic exposure without PPE. Inhalation or Skin Contact with Powder.	Severe irritation. Choking hazard, permanent respiratory damage.	2C	Use in well ventilated areas.	SOP states that tests will occur in either the PRC or at a launch field. MSDS is included in Appendix E of SOP.	2E
Damage to skin	Chronic exposure without PPE. Inhalation or Skin Contact with Powder.	Severe irritation.	2C	Ensure safe work practices. Correct PPE and covering clothing, long pants.	PPE is covered in the SOP. MSDS is included in Appendix E of SOP.	2E



APPENDIX C. UAH PRC Facility Usage Policy



Propulsion Research Center

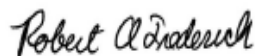
S225 Technology Hall
Huntsville, Alabama 35899
Phone: (256) 824-7200
Fax: (256) 824-7205

UAH Propulsion Research Center - Facility Usage Policy - April 1, 2012

The Propulsion Research Center (PRC) conducts research, produces publications, and mentors students in advanced propulsion technologies and their applications. The PRC connects the academic research community and propulsion community through interdisciplinary collaboration. Use of the facility requires prior written approval of the PRC Director.

The Propulsion Research Center laboratories were established to provide UAHuntsville faculty, staff, and students, state-of-the-art facilities for conducting basic and applied research on propulsion systems and related sciences. The PRC was established to provide students a "hands-on" education in propulsion. The facilities may be used for sponsored research projects, PRC staff and Graduate Student research projects, and approved UAHuntsville undergraduate research projects. The Propulsion Research Center acknowledges that hazards are inherent to the nature of the research conducted in the facilities that require strict adherence to facility rules and protocols for anyone engaged in research in the PRC laboratories. PRC facility protocol is as follows:

1. All PRC Test operations are under the authority of the PRC Director and UAH campus safety practices.
2. All personnel involved in testing are UAH employees, UAH students under PRC supervision, customers with an active contract with UAH, or those with other formal arrangements agreed to in writing by the University.
3. All tests involving pressures over 100 psi, high voltage, combustion, or other sources of possibly injury require a Standard Operating Procedure (SOP), reviewed and signed by the test Red Team (see below), and approved by the PRC Director.
4. The tests are conducted by a designated Red Team who has at least one UAH staff member and has at least two members who are Red Cross Safety and CPR/AED Certified.
5. After any major test anomaly, all PRC test operations are automatically suspended until a determination of the basic cause of the incident is determined and all active SOPs are reviewed in light of the findings of the incident before resuming testing. A verbal report of the incident will be given to the V.P. of Research and a representative of Campus Safety within 24 hours of the incident.



4/1/2012

Robert Frederick
Interim Director PRC



APPENDIX D. Emergency Contact Information

In the event of an emergency, respond in accordance with off-nominal procedures defined in this SOP and in accordance with the appropriate section in the UAH PRC Safety Program dated 22-Feb-2013.

Emergency contact numbers are provided below.

Police	911
Fire Department	(256) 824-6911
Hazardous Materials Incident	(6911 from campus phone)
Utility Failure	
Tony Hall	
	Office : (256) 824-2887
David Lineberry	
	Office : (256) 824-2888
	Cell: (256) 348-8978
Robert Frederick	
	Office : (256) 824-7200
	Cell: (256) 503-4909
PRC Main Office	(256) 824-7209
High Pressure Lab Phone	(256) 824-6031
JRC Test Stand	(256) 824-2857
Kristy Olive/OEHS (Office of Environmental Health and Safety)	(256) 824-2171 (256) 335-3425
Other Emergency Numbers of Interest	
UAH Campus Police Department	(256) 824-6911
Huntsville Police Department	(256) 722-7100
Madison County Sheriff's Office	(256) 722-7181
Alabama State Troopers	(334) 242-4371
Huntsville Hospital	(256) 265-1000

In the event of a non-emergency reportable incident call the numbers below in the following order.

- 1. Dr. Robert Frederick (Dr. David Lineberry as an alternate)**
Office: (256) 824-7200
Cell: (256) 503-4909
- 2. UAHuntsville Police (Non-Emergency)**
(256) 824-6596
6596 (from campus phone)



APPENDIX E. Material Safety Data Sheets



Goex Powder, Inc.

Material Safety Data Sheet

MSDS-BP (Potassium Nitrate)

Revised 3/17/09

PRODUCT INFORMATION	
Product Name	Black Powder
Trade Names and Synonyms	N/A
Manufacturer/Distributor	GOEX Powder, Inc. (DOYLINE, LA) & various international sources
Transportation Emergency	800-255-3924 (24 hrs – CHEM TEL)

PREVENTION OF ACCIDENTS IN THE USE OF EXPLOSIVES

The prevention of accidents in the use of explosives is a result of careful planning and observance of the best known practices. The explosives user must remember that he is dealing with a powerful force and that various devices and methods have been developed to assist him in directing this force. He should realize that this force, if misdirected, may either kill or injure both him and his fellow workers.

WARNING

All explosives are dangerous and must be carefully transported, handled, stored, and used following proper safety procedures either by or under the direction of competent, experienced persons in accordance with all applicable federal, state and local laws, regulations, or ordinances. ALWAYS lock up explosive materials and keep away from children and unauthorized persons. If you have any questions or doubts as to how to use any explosive product, DO NOT USE IT before consulting with your supervisor, or the manufacturer, if you do not have a supervisor. If your supervisor has any questions or doubts, he should consult the manufacturer before use.

HAZARDOUS COMPONENTS				
Material or Components	%	CAS NO.	TLV	PEL
Potassium nitrate	70-76	007757-79-1	NE	NE
Charcoal	8-18	N/A	NE	NE
Sulfur	9-20	007704-34-9	NE	NE
Graphite ¹	Trace	007782-42-5	15 mppct (TWA)	2.5 mg/m ³
N/A = Not assigned NE = Not established				

¹ Not contained in all grades of black powder.

P.O. Box 659, Doyline, LA 71023-0659, (318) 362-0300
www.goexpowder.com



PHYSICAL DATA	
Boiling Point	N/A
Vapor Pressure	N/A
Vapor Density	N/A
Solubility in Water	Good
Specific Gravity	1.70 – 1.82 (mercury method) 1.92 – 2.08 (pycnometer)
PH	6.0 – 8.0
Evaporation Rate	N/A
Appearance and Odor	Black granular powder. No odor detectable.

HAZARDOUS REACTIVITY	
Instability	Keep away from heat, sparks, and open flames. Avoid impact, friction and static electricity.
Incompatibility	<p>When dry, black powder is compatible with most metals; however, it is hygroscopic and when wet, attacks all common metals except stainless steel.</p> <p>Black powder must be tested for compatibility with any material not specified in the production/procurement package with which they may come in contact. Materials include other explosives, solvents, adhesives, metals, plastics, paints, cleaning compounds, floor and table coverings, packing materials, and other similar materials, situations, and equipment.</p>
Hazardous decomposition	Detonation produces hazardous overpressures and fragments (if confined). Gases produced may be toxic if exposed in areas with inadequate ventilation.
Polymerization	Polymerization will not occur.

FIRE AND EXPLOSION DATA	
Flashpoint	Not applicable
Auto Ignition Temperature	Approx. Range: 392°F-867°F / 200°C-464°C
Explosive temperature (5 sec)	Ignites @ approx. 427°C (801°F)
Extinguishing media	Water
Special fire fighting procedures	<p>ALL EXPLOSIVES: DO NOT FIGHT EXPLOSIVES FIRES. Try to keep fire from reaching explosives. Isolate area. Guard against intruders.</p> <p>Division 1.1 Explosives (heavily encased): Evacuate the area for 5,000 feet (approximately 1 mile) if explosives are heavily encased.</p> <p>Division 1.1 Explosives (not heavily encased): Evacuate the area for 2,500 feet (approximately ½ mile) if explosives are not heavily encased.</p> <p>Division 1.1 Explosives (all): Consult U.S. DOT Emergency Response Guide 112 for further details.</p>



Unusual fire and explosion hazards	Black powder is a deflagrating explosive. It is very sensitive to flame and spark and can also be ignited by friction and impact. When ignited unconfined, it burns with explosive violence and will explode if ignited under even slight confinement.
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HEALTH HAZARDS	
General	Black powder is a Division 1.1 Explosive, and detonation may cause severe physical injury, including death. All explosives are dangerous and must be handled carefully and used following approved safety procedures under the direction of competent, experienced persons in accordance with all applicable federal, state and local laws, regulation and ordinances.
Carcinogenicity	None of the components of Black Powder are listed as a carcinogen by NTP, IARC, or OSHA.

FIRST AID	
Inhalation	Not a likely route of exposure. If inhaled, remove to fresh air. If not breathing give artificial respiration, preferably by mouth-to-mouth. If breathing is difficult, give oxygen. Seek prompt medical attention. Avoid when possible.
Eye and skin contact	Not a likely route of exposure. Flush eyes with water. Wash skin with soap and water.
Ingestion	Not a likely route of exposure. If ingested, dilute by giving two glasses of water and induce vomiting. Avoid when possible.
Injury from detonation	Seek prompt medical attention.

SPILL OR LEAK PROCEDURES	
Spill/leak response	Use appropriate personal protective equipment. Isolate area and remove sources of friction, impact, heat, low level electrical current, electrostatic or RF energy. Only competent, experienced persons should be involved in clean up procedures. Carefully pick up spills with non-sparking and non-static producing tools.
Waste disposal	Desensitize by diluting in water. Open train burning, by qualified personnel, may be used for disposal of small unconfined quantities. Dispose of in compliance with Federal Regulations under the authority of the Resource Conservation and Recovery Act (40 CFR Parts 260-271).

SPECIAL PROTECTION INFORMATION	
Ventilation	Use only with adequate ventilation. (If required)
Respiratory	None
Eye	None
Gloves	Impervious rubber gloves. (If required)
Other	Metal-free and/non-static producing clothes



SPECIAL PRECAUTIONS	
<ul style="list-style-type: none"> • Keep away from friction, impact, and heat and open flame. Do not consume food, drink, or tobacco in areas where they may become contaminated with these materials. • Contaminated equipment must be thoroughly water cleaned before attempting repairs. • Use only non-spark producing tools. • No smoking. 	

STORAGE CONDITIONS	
Store in a cool, dry place in accordance with the requirements of Subpart K, ATF: Explosives Law and Regulations (27 CFR 55.201-55.219).	

SHIPPING INFORMATION		
Proper shipping name	Black Powder	
Hazard class	1.1D	
UN Number	UN0027	
DOT Label & Placard	DOT Label	EXPLOSIVES 1.1D
	DOT Placard	EXPLOSIVES 1.1
Alternate shipping	Limited quantities of GOEX black powder (1# cans only) may be transported as "Black powder for small arms – flammable solid" pursuant to U.S. Department of Transportation 49 CFR.	

The information contained in this Material Safety Data Sheet is based upon available data and believed to be correct; however, as such has been obtained from various sources, including the manufacturer, military and independent laboratories, it is given without warranty or representation that it is complete, accurate, and can be relied upon. GOEX, Incorporated, has not attempted to conceal in any manner the deleterious aspects of the product listed herein, but makes no warranty as to such. Further, GOEX, Incorporated, cannot anticipate nor control the many situations in which the product or this information may be used; there is no guarantee that the health and safety precautions suggested will be proper under all conditions. It is the sole responsibility of each user of the product to determine and comply with the requirements of all applicable laws and regulations regarding its use. This information is given solely for the purposes of safety to persons and property. Any other use of this information is expressly prohibited.

For further information contact: GOEX Powder, Incorporated
P. O. Box 659
Doyline, LA 71023-0659
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BLACK POWDER

FRICTION TEST
PA

Steel – Snaps
Fiber – Unaffected

IMPACT TEST
PA

16 Inches (10% Point)

ELECTROSTATIC DISCHARGE TEST

Bureau of Mines
0.8 Joules (Confined)
12.5 Joules Unconfined)

STABILITY

75° C International Heat Test – 0.31% Loss
Vacuum Stability – 0.5cc @ 100° C

BRISANCE – Sand Test 8 gm.

VELOCITY

In the open, trains of black powder burn very slowly, measurable in seconds per foot. Confined, as in steel pipe, speeds of explosions have been timed at values from 560 feet per second for very coarse granulations to 2,070 feet per second for the finer granulations. Confinement and granulation will affect the values.

CHEMICAL DECOMPOSITION

Use water to dissolve the potassium nitrate. By leeching out the potassium nitrate, the residue of sulfur and charcoal is non-explosive but combustible when dry – dispose separately.

SPECIAL REQUIREMENTS:

Black Powder is very sensitive to flame and spark and can also be ignited by friction and impact. When ignited unconfined, it burns with explosive violence and will explode if ignited under even slight confinement.

When dry, it is compatible with most metals. However, it is hygroscopic and when wet, attacks all common metals except stainless steel.

CAUTION: Explosives must be tested for compatibility with any material not specified in the production/procurement package with which they may come in contact. Materials include other explosives, solvents, adhesives, metals, plastics, paints, cleaning compounds, floor and table coverings, packing materials and other similar materials, situations and equipment. Explosives include propellants and pyrotechnics.

APPENDIX F: WARNING BARRICADE PLACEMENT

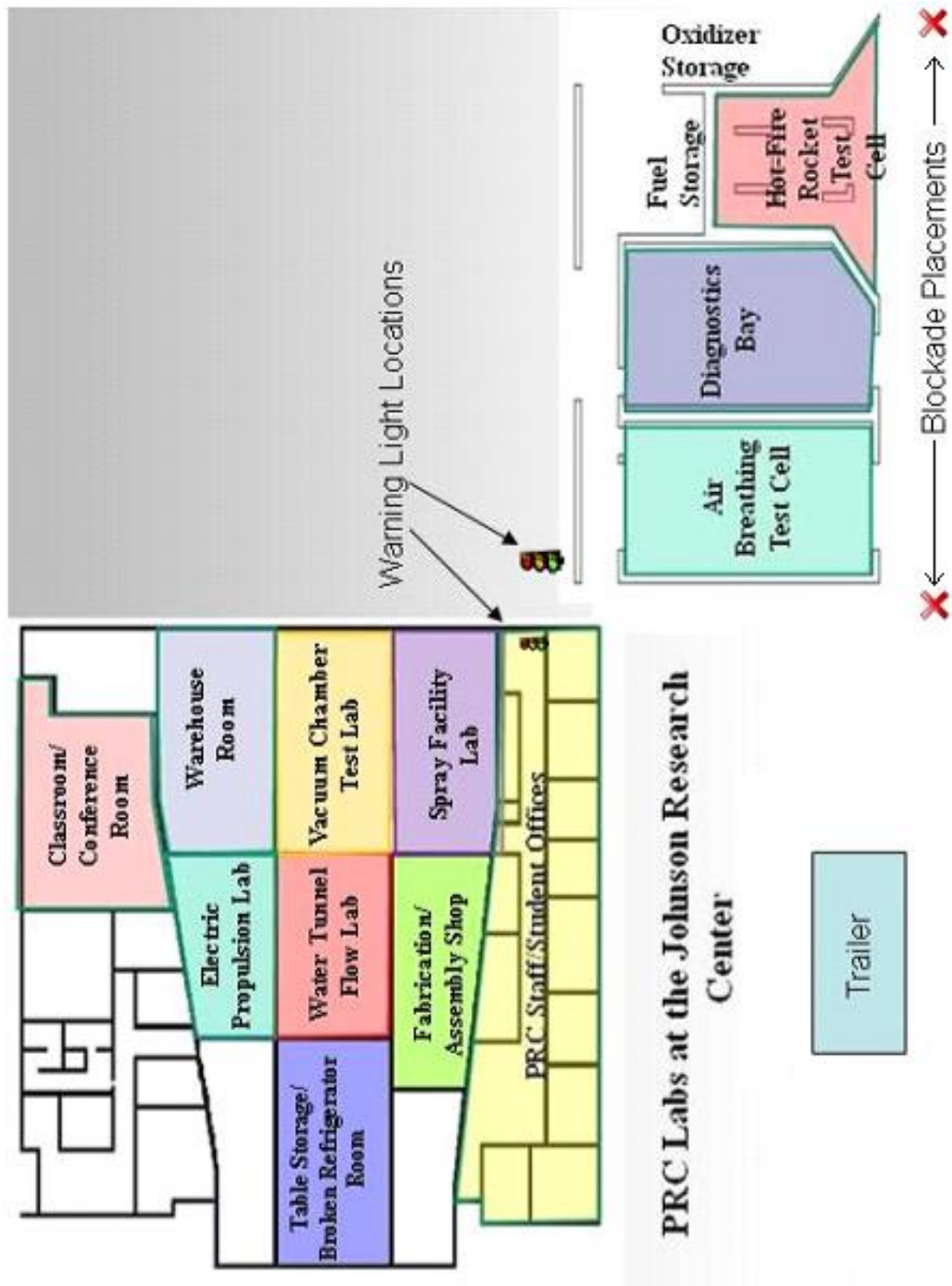


Figure 3: Warning Barricade Location Schematic