Touch Paper, Self Igniting Mixtures, Percussion Explosives

This is part of a series of files on pyrotechnics and explosives. It's serious stuff, and can be really dangerous if you don't treat it seriously. For you kids out there who watch too many cartoons, remember that if a part of your body gets blown away in the REAL world, it STAYS blown away. If you can't treat this stuff with respect, don't screw around with it.

Each file will start with a set of safety rules. Don't skip over them. Read 'em and MEMORIZE 'em!! At the beginning, there will be a set of general rules that always apply. Then there will be some things that you HAVE TO KNOW about the materials you will be using and making this time. Read it thoroughly before starting anything.

Pyrotechnic preparations and explosives are, by their very nature, unstable, and subject to ignition by explosion or heat, shock, or friction. A clear understanding of their dangerous properties and due care in the handling of ingredients or finished products is necessary if accidents are to be avoided. Always observe all possible precautions, particularly the following:

1. Mix only small batches at one time. This means a few grams, or at most, an ounce or so. Don't go for big mixes -- they only make for bigger accidents. The power of an explosive cubes itself with every ounce. (9 Ounces is 729 times as powerful as one ounce.)

2. When weighing chemicals, use a clean piece of paper on the scale pan for each item. Then discard the used paper into a bucket of water before weighing the next ingredient.

3. Be a safe worker. Dispose of any chemicals spilled on the workbench or equipment between weighings. Don't keep open containers of chemicals on your table, since accidental spillage or mixing may occur. When finished with a container, close it, and replace it on the storage shelf. Use only clean equipment.

4. Where chemicals are to be ground, grind them separately, NEVER TOGETHER. Thoroughly wash and clean equipment before grinding another ingredient.

5. Mixing of batches should be done outdoors, away from flammable structures, such as buildings, barns, garages, etc. Mixes should also be made in NON METALLIC containers to avoid sparks. Glass also should not be used since it will shatter in case of an accident. Handy small containers can be made by cutting off the top of a plastic bottle three or four inches from the bottom. Some mixes may most conveniently be made by placing the ingredients in a plastic bottle and rolling around until the mixture is uniform. In all cases, point the open end of the container away from

yourself. Never hold your body or face over the container. Any stirring should be done with a wooden paddle or stick to avoid sparks or static.

Powdered or ground materials may also be mixed by placing them on a large sheet of paper on a flat surface and then rolling them across the sheet by lifting the sides and corners one at a time.

6. Never ram or tamp mixes into paper or cardboard tubes. Pour the material in and gently tap or shake the tube to settle the contents down.

7. Store ingredients and finished mixes where they will not be a fire hazard away from heat and flame. Finished preparations may be stored in plastic bottles which will not shatter in case of an accident. Since many of the ingredients and mixes are poisonous, they should be stored out of reach of children or pets, preferably locked away.

8. Be sure threads of screw top containers and caps are thoroughly cleaned. This applies also to containers with stoppers of rubber or cork and to all other types of closures. Traces of mixture caught between the container and closure may be ignited by the friction of opening or closing the container. Throughout any procedure, WORK WITH CLEAN CONDITIONS.

9. ALWAYS WEAR A FACE SHIELD OR AT LEAST SHATTERPROOF SAFETY GLASSES. Any careful worker does when handling dangerous materials. Be sure lenses and frames are not flammable.

10. Always wear a dust respirator when handling chemicals in dust form. These small particles gather in your lungs and stay there. They may cause serious illnesses later on in life.

11. Always wear gloves when working with chemicals.

12. Always wear a waterproof lab apron.

13. If you must work indoors, have a good ventilation system.

14. Never smoke anywhere near where you are working.

15. Make sure there are NO open flames present, and NO MOTORS (they produce sparks inside.) No hot water heaters, furnaces, or pilot lights in stoves!! Sparks have been known to very readily explode dust floating in the air.

16. ALWAYS work with someone. Two heads are better than one.

17. Have a source of water READILY available. (Fire extinguisher, hose, etc.)

18. Never, under any circumstances, use any metal to load chemicals or put chemicals in. Fireworks with metal casings are worse to handle than a live hand grenade. Never use any metal container or can. This includes the very dangerous CO2 cartridges. Many people have been KILLED because of flying fragments from metal casings. Again, please do not use metal in any circumstance.

19. Always be thoroughly familiar with the chemicals you are using. Some information will be included in each file, but look for whatever extra information you can. Materials that were once thought to be safe can later be found out to be dangerous stuff.

20. Wash your hands and face thoroughly after using chemicals. Don't forget to wash your EARS AND YOUR NOSE.

21. If any device you've built fails to work, leave it alone. After a half hour or so, you may try to bury it, but never try to unload or reuse any dud.

22. If dust particles start to form in the air, stop what you are doing and leave until it settles.

23. Read the entire file before trying to do anything.

24. NEVER strike any mixture containing Chlorates, Nitrates, Perchlorates, Permanganates, Bichromates, or powdered metals don't drop them, or even handle them roughly.

These rules may all look like a lot of silly nonsense, but let's look at one example. When the move "The Wizard of OZ" was made, the actress who played the good witch was severely burned when one of the exploding special effects got out of hand. The actress who played the bad witch got really messed up by the green coloring used on her face, and the original actor who played the Tin Man got his lungs destroyed by the aluminum dust used to color his face. The actor we know of as the tin man was actually a replacement. The point is, these chemicals were being used under the direction of people a lot more knowlegable of chemicals than you are, and terrible accidents still happened. Don't take this stuff lightly.

We will be using many more chemicals this time, and some can be quite dangerous. Please read the following information carefully.

Sodium Azide - NaN

3
This white powder is very poisonous. It is also a bit unstable, so treat it gently.

Lead Nitrate - Pb(NO)
3 2
This contains poisonous lead and is very water soluble so your body will absorb it quickly, given the chance. The government has banned leaded paints and is phasing out leaded gasoline because the stuff slowly accumulates in your body and can screw up all sorts of important innards. If you are careless with Lead Nitrate you can do a few lifetimes' worth of damage in one afternoon.

Ammonium Nitrate - NH NO
4 3
Commonly used as fertilizer, this stuff is somewhat dangerous in large quantities, particularly if it gets very hot. (Entire shiploads of this material have been known to go up all at once.) When heated gently, it decomposes into water and nitrous oxide (laughing gas). Farmers sometimes use it to blow up tree stumps by mixing it with fuel oil and setting the gunk off with a detonator. We'll have a very different use for it here.

Potassium Nitrate - KNO
3
Also known as saltpeter, this is commercially used as a diuretic for animals. It also works as an oxidizing agent in various pyrotechnic mixtures. That is, when heated it provides the oxygen needed to make the rest of the mixture burn.

Potassium Potassium
Nitrate Nitrite Oxygen

2KNO ---> 2KNO + O
3 2 2

Potassium Chlorate - KClO
3
A much more spectacular oxidizing agent than Potassium Nitrate. It not only yields more oxygen than Potassium Nitrate, it does so more easily. Pyrotechnic mixtures containing this chemical will require much less of it, and yet burn more fiercely. Even percussion can readily set the mixtures off. This can be useful, but it sometimes makes the mixtures more sensitive than you'd like. Mixtures containing this chemical must be handled carefully. Potassium Chlorate is also poisonous.

Potassium Potassium

Chlorate Chloride Oxygen

$$2KClO_3 \rightarrow 2KCl + 3O_2$$

Aluminum Dust

Very finely divided aluminum. When put in a glass jar, it almost looks like a solid piece of grey metal. In this form it is flammable. Also, it can seriously damage your lungs if you inhale it. Be careful not to stir up any clouds of dust, and it goes without saying that you shouldn't use it near an open flame.

Zinc Dust

Very finely divided zinc. Not quite as flammable as Aluminum Dust, but still worth handling carefully. Can also damage your lungs if inhaled.

Lampblack

This is very finely divided carbon, usually obtained as a soot from other manufacturing processes. It is much more effective in pyrotechnic mixtures than powdered charcoal. Tiny spots of this are almost unnoticeable, but they stick to your hands and smear incredibly far. If you're not very tidy you should expect to find black smears all over your face and hands after using this.

Sulfur

A yellow powder used as a reducing agent in many pyrotechnic mixtures. Buy this in the finely powdered form. You can also get it in hard lumps, but these will just waste extra time as you have to grind them yourself.

Potassium Permanganate

An oxidizing agent that's somewhat less vigorous than others mentioned here. Not usually used in pyrotechnic mixtures because it's more expensive and less effective than some of the alternatives. There are a few cases when it's just the right thing. Don't let this accidentally come in contact with glycerine. If such an accident happens, the resulting mess should be immediately wiped up with wet paper towels and buried or flushed down a toilet. It should NOT be thrown away in a dry waste receptacle!!!

Gum Arabic

A white powder which is mixed with water to make a glue like substance. Useful for coating various mixtures or binding them together into a solid mass.

Sodium Peroxide

A very strange and dangerous oxidizer. Don't let it get wet and don't let it touch your skin.

Glycerine

A thick liquid, chemically similar to rubbing alcohol. Though harder to get burning, it will burn in the right circumstances. Fairly safe stuff.

Iodine Crystals

Pure Iodine is a steel grey solid, which is poisonous and which produses poisonous vapors when heated. Smells similar to the chlorine used in bleaches and swimming pools. If you accidentally should drop some on a hot surface and notice the odor, you should leave the area.

Touch Paper

This is an easily made material that acts like a slow burning fuse and is ideal for testing small amounts of a pyrotechnic mixture. It is made by soaking a piece of absorbent paper, like a paper towel, in a saturated solution of Potassium Nitrate. (A saturated solution means that you have dissolved as much of the chemical in water as is possible.) Hang the paper up to dry, and be sure to wipe up any drips. When dry it is ready. Cut off a small strip and light the edge to see how different it acts from ordinary paper. This will ignite all but the most stubborn mixtures, and will ignite gunpowder, which will in turn ignite most anything else.

Don't dip the towel in the Potassium Nitrate solution a second time to try to make it "stronger". This will actually make it less effective. Some of the fancier paper towels don't work too well for this. Best results are obtained from the cheap folded paper towels found in public restrooms everywhere.

Self Igniting Mixtures

Pulverize 1 gram of Potassium Permanganate crystals and place them on an asbestos board or in an earthenware vessel. Let 2-3 drops of glycerine fall onto the Potassium Permanganate. The mixture will eventually sizzle and then flare. Potassium Permanganate is the oxidizing agent. The glycerine is oxidized so quickly that heat is generated faster than it can be dissipated. Consequently, the glycerine is ignited. Because this mixture takes so long to catch on fire, it is sometimes useful when a time delay is needed to set off some other mixture. If you lose patience with this test, DO NOT THROW THE

MIXTURE AWAY IN A WASTEBASKET!!! Either bury it or flush it down a toilet. I know of at least one house fire that was started because this was not done. Given time, this stuff WILL start to burn.

This demonstration produces a very nice effect, but sends out a lot of poisonous fumes, so do it outside. Make a mound of equal volumes of iodine crystals and aluminum dust. Make a small indentation at the top of the mound and add a drop or two of water and move away. It will hiss and burst into flame, generating thick purple smoke. The fumes are Iodine vapor which is very caustic, so make sure you are upwind of the fire. Since this is set off by moisture, you should not store the mixed material. Mix it immediately before you plan to use it.

Shred a small piece of newspaper and place on it a small amount of sodium peroxide. Add two drops of hot water. The paper will be ignited. CAUTION: Keep Sodium Peroxide from moisture and out of contact with organic materials (your skin, for example.)

Ammonium Nitrate, 5 grams, 1 gram of Ammonium Chloride. Grind these SEPARATELY, and add 1/4 gram of zinc dust. Form a cone and add 2-4 drops of water. A bright blue flame with large volumes of smoke forms. Depending on the quality of your zinc dust, you may need to increase the quantity of zinc. Since this is ignited by moisture, you should not attempt to store this mixture.

Percussion Explosives

This section will not only introduce a couple of mixtures with interesting possibilities, but it will also demonstrate how sensitive mixtures containing Potassium Chlorate can be. Keep in mind that Chlorate mixtures can be a LOT more sensitive than the ones shown here.

Mix 1 part by weight of Sulfur, and 3 parts Potassium Chlorate. Each should be ground separately in a mortar. They should be mixed lightly without any pressure on a sheet of paper. A small amount of this mixture (less than one gram!!) placed on a hard surface and struck with a hammer will explode with a loud report.

Mix the following parts by weight, the same way as above,

Potassium Chlorate	6
Lampblack	4
Sulfur	1

Both of these mixtures are flammable. Mix small quantities only.

Lead Azide $Pb(N_3)_2$

Unlike many explosives that must be enclosed in a casing to explode, and others that require a detonator to set them off, Lead Azide will explode in open air, either due to heat or percussion. Mixed with gum arabic glue, tiny dots of it are placed under match heads to make trick exploding matches. The same mixture coated onto 1/2 " wood splinters are used to "load" cigars. In larger amounts, it is used as a detonator. A moderately light tap will set it off, making it much more sensitive than the percussion explosives already mentioned. It is very easy to make.

Take about 1.3 grams of sodium azide and dissolve it in water. It's best not to use any more water than necessary. In a separate container, dissolve about 3.3 grams of Lead Nitrate, again only using as much water as needed to get it to dissolve. When the two clear liquids are mixed, a white precipitate of Lead Azide will settle out of the mixture. Add the Lead Nitrate solution, while stirring, until no more Lead Azide precipitates out. You may not need to use it all. Note that the above weights are given only for your convenience if you have the necessary scales, and give the approximate proportions needed. You need only continue to mix the solutions until no more precipitate forms.

The precipitate is filtered out and rinsed several times with distilled water. It is a good idea to store this in its wet form, as it is less sensitive this way. It's best not to store it if possible, but if you do, you should keep it in a flexible plastic container that wont produce sharp fragments in case of an explosion. (NO MORE THAN A GRAM AT A TIME !!!!) Also, make sure that the mouth of the container is wiped CLEAN before putting the lid on. Just the shock of removing the lid is enough to set off the dry powder if it is wedged between the container and the stopper. Don't forget that after you've removed the precipitate from the filter paper, there will still be enough left to make the filter paper explosive.

Lead Azide is very powerful as well as very sensitive. Never make more than a couple of grams at one time.

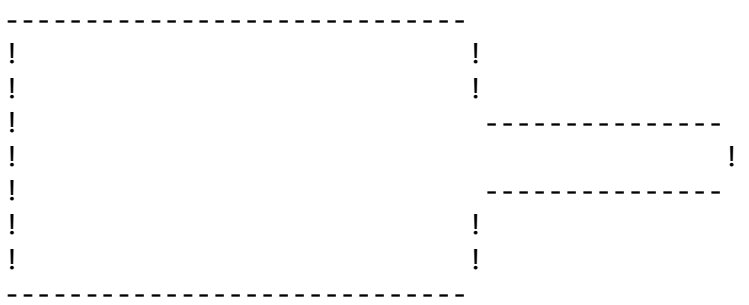
Reaction Equations

Lead Nitrate	Sodium Azide		Lead Azide	Sodium Nitrate
$Pb(NO_3)_2$	+ $2NaN_3$	--->	$Pb(N_3)_2$	+ $2NaNO_3$

Don't try to salvage the Sodium Nitrate that's left over (dissolved in the water). Sodium nitrate is cheap, not really useful for good pyrotechnics, and

this batch will be contaminated with poisonous lead. It's worthless stuff. Dump it out.

To demonstrate the power of a little bit of Lead Azide, cut out a piece of touch paper in the following shape



Where the size of the wide rectangle is no more than one inch x 1/2 inch, and the length of the little fuse is at least 3/4 inch. Apply a thin layer of wet Lead Azide to the large rectangle with a paint brush and let it dry thoroughly. When done, set this tester out in the open, light the fuse at the very tip and step back. If done properly, the tiny bit of white powder will produce a fairly loud explosion.

A Lead Azide Booby Trap

Get some string that's heavy enough so that it won't break when jerked hard. A couple of feet is enough to test this out. You may want to use a longer piece depending on what you plan to do with this. Fold a small "Z" shape in the center of the string, as shown in figure 1. The middle section of the "Z" should be about one inch long.

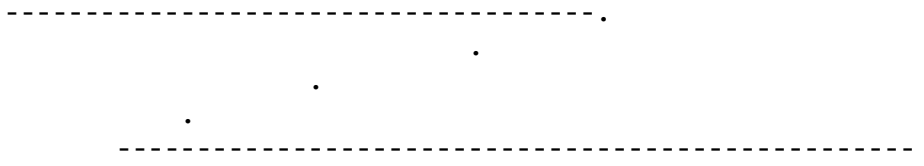


Figure 1. Fold string into a small Z

Next, twist the Z portion together as tightly as you can. Don't worry if it unwinds a bit when you let go, but it should still stay twisted closely together. If it doesn't, you will need a different kind of string. Figure 2 tries to show what this will look like.

Figure 2. Twist the Z portion tightly

Next, apply some wet Lead Azide to the twisted portion with a paint brush. The Lead Azide should have a bit of Gum Arabic in it to make it sticky. Cut out a piece of paper, two inches by 6 inches long, wrap it around the twisted portion, and glue the end on so that it stays put. You should now have a two inch narrow paper tube with a string sticking out each end, as shown in figure 3.

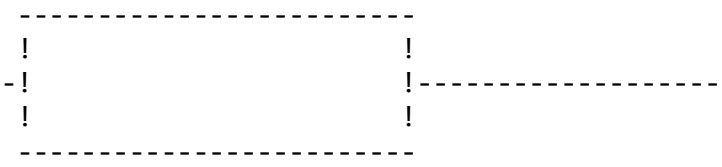


Figure 3. The completed Booby Trap

You should now set the booby trap aside for at least two weeks so that the Lead Azide inside can dry completely. Don't try to speed up the process by heating it. When the two ends of the string are jerked hard, the friction in the wound up string will set off the Lead Azide. The booby trap can be attatched to doors, strung out as tripwires, or set up in any other situation that will cause a quick pull on the strings. Be careful not to use too much Lead Azide. A little will go a long way. Before trying this on an unsuspecting soul, make a test booby trap as explained here, tie one end to a long rope, and set it off from a distance.

The paper wound around the booby trap serves two purposes. It keeps the Lead Azide from flaking off, and it pads the stuff so it will be less likely to get set off accidentally. A good vigorous swat will still set it off though, so store these separately and keep them padded well.

Getting The Chemicals

As always, be sure to use your brains when ordering chemicals from a lab supply house. Those people KNOW what Sodium Azide and Lead Nitrate make when mixed together. They also know that someone who orders a bunch of chlorates, nitrates, metal dusts, sulfur, and the like, probably has mischeif in mind, and they keep records. So break your orders up, order from different supply houses, get some friends to order some of the materials, and try to order the things long before you plan do do anything with them. It's a pain, and the multiple orders cost a lot in extra shipping charges, but that's what it costs to cover your tracks. DO it!