

# **THE FIRECRACKER COOKBOOK**



A MANUAL FOR THE  
SAFE CONSTRUCTION AND  
USE OF HOMEMADE  
PYROTECHNICS

**BY EDWIN LOUGH**

**FIREPOWER**  
PUBLICATIONS

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CORNVILLE, ARIZONA 86325

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# COOKBOOK

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	<b>DEDICATION</b>
	<i>To John and Dave for adding the element of insanity to some classic Fourth of July parties. And to those anonymous but very helpful friends who volunteered their time as well as their neighbors' sanity for testing the items in this manual. And to my own neighbors who put up with (most of) my many pyrotechnic efforts. And last, but certainly not least, to the kindly officer from the Los Angeles Police Department Bomb Squad.</i>
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## Introduction

The purpose of this manual is not to encourage people to get out and break the law by making and setting off potentially dangerous exploding fireworks. Enough people do that already, and no amount of legislation is going to make them stop.

Banning fireworks in an effort to eliminate injuries and fires is much like trying to ban the ownership of handguns to prevent crime and violence. It sounds good, it looks real nice on paper, but in the real world? No way!

As a general rule, most fire departments consider fireworks to be a colossal pain in the neck, and would like to see them ALL banned. However, they know that if their city did ban their sale and use, residents would simply go to areas in which they are legal and buy them there. Or they might order their stuff by mail from out of state, or even make the fireworks themselves. This is happening right now, and the practice will surely increase as the fireworks laws get more restrictive.

I agree that fireworks are dangerous if handled carelessly or misused. They are also a definite hazard if set off in dry, high fire risk areas. It is foolish to underestimate fireworks and not realize the potential for injury and damage that is possible if they are not used properly. This goes for the "safe and sane" variety as well as the real stuff.

Actually, the "safe and sane" fireworks can be even more dangerous than the more powerful types. Sparklers, smoke devices and similar stuff have decisive incendiary properties when handled carelessly (such as by throwing them).

Sparklers, for example, can be very dangerous. Some varieties can burn as hot as 5,000<sup>o</sup>, and a lot of fires and injuries have resulted from their use. Children will throw them at each other and in the air, try to touch the glowing hot wire, and even stand directly over a box bulging with the family assortment of fireworks while waving them around. I have seen this happen on many occasions.

The common pop bottle rocket, while not a "safe and sane" item, is very popular and easy to get. It, too, is dangerous if used carelessly. People tend to shoot these off from their yards, not realizing that they can land on a nearby roof and burn a house down in minutes. We had a small roof fire caused by careless neighbors who were shooting off these rockets, and our home could have been severely damaged had I not smelled the smoke and gone outside. These rockets can also land in dry brushy areas and destroy them, as any fire department can tell you.

By contrast, most people are aware of the damage that the larger exploding and flying fire-

## THE FIRECRACKER COOKBOOK

works can inflict, and so are usually more careful with them.

“Safe and sane” fireworks are designated as such by the State Fire Marshal. The Department Of Transportation (D.O.T.) labels these as Class C (common) fireworks. These “safe and sane” fireworks will have such a label on each device.

To be classified as “safe and sane”, the fireworks must not be of the exploding variety, cannot discharge any type of projectile, and cannot fly or leave the ground. Common “safe and sane” fireworks include the various cone and box fountains, smoke devices, toy snake pellets (not containing mercury), sparklers, pinwheels, caps, whistling devices and carbide cannons. How “safe” these are depends on how “sane” you are.

Some of the illegal stuff is also labeled as Class C, but is not legally “safe and sane”. These include firecrackers, lady fingers, Roman candles, pop bottle rockets, skyrockets, buzz bombs, etc. Under this classification, each device cannot contain more than 50 milligrams of exploding composition. This classification means that these can be shipped just like the “safe and sane” types, usually by freight or UPS, to the few remaining states where they are still legal.

Next comes the Class B stuff. These are illegal just about everywhere, and contain a large amount of exploding composition. This group includes M-80 salutes, cherry bombs, silver salutes, half sticks and various heavy tube salutes.

These goodies are sometimes brought back from foreign countries, and are made in incredible amounts in this country by bootleg factories. Now and then you will read of a major bust of such factories, and the police confiscate enormous quantities of chemicals, components and truckloads of finished stuff.

Even one person with enough chemicals, fuse and casings can become a factory and make and sell thousands of illegal fireworks. The initial cost is low, and there can be a lucrative profit margin. On the other hand, there are hundreds of people who just make enough goodies for the Fourth for themselves and a few friends, as well as to explore the field of creative chemistry without any profit motive.

You should know that the Consumer Product Safety Commission (C.P.S.C.) has been trying for some time to ban the import of all exploding fireworks into the U.S. (Cherry bombs, silver salutes and M-80's have been banned since 1966.) So far, their efforts to ban the other stuff have failed, and these are still available. Even so, exploding fire-

works, and especially large firecrackers and heavy salutes, are illegal in most states. But since they are so popular, there is little trouble in finding them in many of these areas.

If the C.P.S.C.'s ban on the other fireworks ever went into effect, the rate of fireworks-related injuries and deaths would probably increase drastically due to more people experimenting around trying to make their own fireworks. It would also make the black market in bootleg boomers grow even bigger and more profitable than it is now. It seems that a large majority of these exploding fireworks from lady fingers to half sticks and God knows what else show up most often in areas where ALL fireworks are forbidden. This is proven quite audibly every year.

So, regardless of the laws, people who choose to use fireworks are going to continue to do so. They will either buy their stuff illegally or make it themselves. As for those who try to make their own, some will succeed, and some will fail — and with disastrous results.

Hundreds of people are injured annually by homemade fireworks, and some are even killed. This is proven every year in the newspapers. It can safely be said that if you experiment around without knowing what you are doing, the chances are extremely good that you will blow your head off. Any police or fire department will be happy to show any would-be “Pyro-Expert” some pictures of the less fortunate who have blown themselves to pieces.

This will undoubtedly upset countless police and fire departments worldwide, but I believe it is useless to simply say, “Don't make fireworks.” Such a statement would only fall on deaf (or deafened) ears, and will not accomplish anything except to literally encourage the practice.

I think it is far better to provide as much information on the subject as possible, as well as thoroughly researched and tested methods of construction, safe handling of the chemicals involved, and the safe and considerate use of the finished products without causing injuries and property damage.

I also think that the fireworks laws should be revised so as to allow people to enjoy fireworks on the Fourth Of July in specially designated areas such as beaches, large open parks, and fields that provide no fire risk, where they are presently illegal. This would be far safer than setting of fireworks in residential areas where the danger of fires is always present.

If people are taught the safe manufacture and

## THE FIRECRACKER COOKBOOK

use of fireworks, and if some of the presently illegal fireworks are legalized, I predict the risk of personal injury and property damage would decrease rapidly.

I have been making and handling just about every type of fireworks for about 9 years at this writing. I am not claiming to be an expert, but am simply showing what I have researched and what has worked well for me. I haven't suffered an injury worse than a fuse burn and ringing ears, and if this manual prevents even one injury the whole thing is worthwhile to me.

I consider pyrotechnics to be one of the highest forms of art where one can make ground displays and the sky can be your canvas. When one gains experience, the variations and possibilities are endless. This is the reason I wrote *The Firecracker Cookbook*.

I offer sources for some excellent literature at the end of the text. I feel that this is an important feature, as their offerings deal with making all types of fireworks used today as well as in the past. Since *The Firecracker Cookbook* deals primarily with exploding fireworks, it is not intended to be a complete course in fireworks making.

The more information you obtain, the safer fireworks become for you, as you are always learn-

ing new chemical manipulations and related safety procedures. It might even be interesting to take a few courses in chemistry if you really get into this. You may even want to become a licensed pyrotechnician, if this is legal in your state, and shoot off really impressive displays.

You need not be concerned with the legality of this manual. It is perfectly legal to buy and sell, as are any other books at this time. The same goes for the individual chemicals, fuse and related components. Unless you are caught with finished fireworks of the type that are illegal in your area, and showed the intent, ability and the means to make them, you are perfectly within the law. However, you should check your individual state laws and city ordinances before making or setting off any type of pyrotechnic device.

The only advice I can give you is to obey the law. For those of you who live in areas where fireworks are legal, make or buy your stuff cautiously and use it wisely and safely. Since this manual is written for reference and general information purposes only, *neither the author nor the publisher can be responsible for any injuries, property damage or legal action of any kind resulting from the use or misuse of the information contained herein.*

On the next and following pages are reproduced several newspaper accounts of the dangers of the misuse of fireworks and the attempts of police and fire officials to cope with the illegal use of fire-

works in many California communities. The legal picture on fireworks may well have changed by the time you read this, but the strong accident potential from their misuse will never change.

## Fireworks bill blasted

Fire department officials in Los Angeles County blasted a controversial state measure that was introduced into the state Assembly last week, after being blasted earlier by the state Senate, that would prohibit cities from banning the sale of "safe and sane" fireworks.

Safe and sane fireworks are non-explosive.

There are 81 cities in California that currently ban the sale or use of fireworks.

Under the proposed law, cities could regulate but not stop the sale but could prohibit the use of such safe and sane fireworks.

State Sen. William Campbell (R-Whittier), who has a reputation of championing firefighters' causes, hesitated for weeks before

introducing the controversial measure. During that period fire department officials urged him not to reconsider.

Campbell called the issue one of "free commerce" and also said the "tradition" in the United States dictates the use of fireworks in honor of the country's birth.

"If you ban the sale of safe and sane fireworks in the state of California, you dramatically increase the use of illegal fireworks," he said.

Fire department officials were quick to label the measure "ridiculous."

"Why would people buy them if they didn't intend to use them?" Hawthorne Fire Chief Ralph Hardin asked.

Although Hawthorne and many other cities in the surrounding area do allow the sale of "safe and sane" fireworks, Hardin and other officials believe the use of illegal fireworks will increase if there were statewide sales.

Richard Friend, spokesman for the Los Angeles County Fire Department, agreed with Hardin.

Friend also said it was ridiculous for a law to allow the sale of fireworks but also permit cities to ban their use.

Friend said, "I think you are opening a Pandora's Box to say you can sell them but not use them.

"It's like saying you can sell a car in the city of Lawndale, but you can't drive them here.

"If you have fireworks and you increase the use, you're going to have more injuries and fires," he concluded.

Los Angeles City Fire Chief John Gerard echoed what many other officials said: 'The most sinister aspect of the bill is it smacks directly to the heart of local control.'

Gerard was less concerned about the measure than his fellow fire fighters because he felt local laws could be passed to make the sale so difficult and expensive cities could all but ban them.

Campbell has stressed many times "safe and sane" fireworks don't cause the damage attributed to illegal fireworks and rockets. He said the illegal variety, such as bottle rockets, cause most of the fires and injuries.

Charles Masten, president of the Los Angeles County Fire Chiefs Association and fire chief of El Monte, said there is a study under way to determine what type of fireworks are responsible for fires and injuries.

"It's not just the fireworks (safe and sane or illegal) but how they are used," he said.

Masten explained that if safe and sane fireworks are tossed in the air and land on a wooden roof, a fire will start just the same.

"Fireworks are fireworks—and they are all fire," he said.

Culver City Fire Marshal Gary Goover said although his city sells safe and sane, he doesn't like it.

"We'd love to see all safe and sane fireworks discontinued," he said.

# Conflicting laws create enforcement problems

By JOHN NEEDHAM

**B**efore Fourth of July revelers proclaim their exuberance over the nation's birthday by firing a volley of ear-ringing pyrotechnics, they'd better make sure their display of patriotism is legal.

Fireworks without the "safe and sane" label, signifying they have been approved by the state fire marshal, are illegal to use or possess anywhere in California.

However, many cities, including Los Angeles, forbid the possession and detonation of any fireworks. Period. Similar bans are in effect in portions of the San Fernando and San Gabriel valleys. The ordinances even include a prohibition on sparklers, long-time favorites of young children.

According to Cecilia Anderson, spokeswoman for the L.A. Fire Department's Public Service Unit, the city's strictly enforced 40-year ban on fireworks is due to the large number of fires and injuries caused by the devices.

Anderson said last year, in a one-month period from June 13 to July 13, 500 fires were attributed to fireworks, causing about \$2 million in property damage in Los Angeles.

Countywide, 321 injuries were caused by the improper handling of illegal fireworks, she said, in some cases resulting in loss of sight and traumatic amputations.

Thomas Laski, a fire inspector in the department's Legal Division, said penalties vary according to the fireworks used.

Possession of devices containing 7,500 grains of explosive material or more are punishable by up to a

year in state prison and a \$5,000 fine.

Though all fireworks are forbidden in Los Angeles, fines and jail terms for implements not deemed "safe and sane" (legal in some communities) by the state fire marshal carry stiffer penalties. Selling fireworks to minors is also punishable by a fine and jail term.

Laski added that the Los Angeles Fire Department is planning an aggressive enforcement campaign in an effort to prevent a multimillion-dollar loss of property, as well as personal injuries.

But the often-heard lament among fire officials is that codes governing the use of fireworks are a

variable crazy quilt, changing significantly from community to community and creating an enforcement nightmare.

A spokesman for the Van Nuys Police Department said that despite the four-year prohibition on all fireworks in the San Fernando Valley, regulating the flow of fireworks into the area is nearly impossible.

"It's just a hop, skip and a jump to a fireworks stand outside the Valley," the spokesman said. Mike Aviani, battalion chief of LA County Fire Station 28

(Continued on page 6



# Conflicting firework laws

(Continued from page 5)

in Whittier, said in the incorporated area of the city safe and sane fireworks aren't allowed, but in the adjacent unincorporated area they can be sold.

"All people have to do is drive a few miles away to the nearest fireworks stand and load up," Aviani said. "And there's not much we can do about it."

Carl Markmann, administrative chief for the Pasadena Fire Department, said his city's total ban on fireworks is difficult to enforce in light of rules which are more lax in surrounding areas.

Echoing Aviani's frustrations was Fire Capt. Ronald McIntyre of Station 92 in West Los Angeles. "Our enforcement problem is that we're surrounded by county areas, where fireworks can be legally bought and sold, he said.

Jim Auld, sales manager for the Red Devil Fireworks Co. in Anaheim, the West's largest supplier and manufacturer of safe and sane fireworks, said of the 435 California cities, 360 are open to the sale of his company's products.

In the past, the firm has lobbied against the inaction of ordinances banning fireworks within individual municipalities and county areas, maintaining such laws encourage the use of devices not approved by the state's fire marshal.

"The largest bootleg business is in the large metropolitan areas where fireworks are illegal," Auld said. "A Los Angeles Fire Department report says there is a \$2 million annual business in illegal fireworks in the city."

Auld said much illicit trade in fireworks would fall off if legal, safe and sane products were made available, adding that legitimate businesses are being made the "fall guy" by local lawmakers.

He said a major safety feature in fireworks sold by Red Devil, which also markets the Wild Cat line, is that their chemical composition makes it impossible for them to be altered to provide a greater explosive force.

In addition, Auld stressed that, unlike illegal fireworks, sales of Red Devil products benefit non-profit service and community groups.

Such organizations purchase the devices from the firm on consignment, then sell them in sidewalk stalls provided by the company.

To help convince San Gabriel Valley residents to forego purchases of fireworks on the Fourth, the City of Whittier and the Kiwanis Club are co-sponsoring a public fireworks display at the city's York Field.

Admission is \$2 for adults and children under 6 years of age get in free. Food will be available, as well as entertainment beginning at 6 p.m. Visitors are invited to bring along a picnic basket. York Field is located at 9110 Santa Fe Road.

Pasadena's Rose Bowl will be the site of a circus and fireworks display beginning at 6:30 p.m. on July 4. Admission is \$2 for adults and \$1 for children. The event is co-sponsored by the city's Chamber of Commerce and a group of private individuals who donated funds.

The Santa Monica Pier will have a fireworks display beginning just after dark. The fireworks were donated by a group of business owners in the pier area.

Local law enforcement agencies also reported that extra patrols would be called out on the Fourth of July weekend to crack down on drunk drivers. Department spokesmen wished to remind drivers of California's tough new drunk driving laws.

# Firemen give warning on illegal fireworks

'M80s' could blow your finger apart. Firecrackers, cherry bombs and sparklers all add to the potential of personal injury.

Fireworks that are launched — such as the bottle rocket or giant missile and Silver Star — constitute fire hazards.

Fireworks of any type are unlawful to be sold or used within the city limits of Los Angeles. In fact, they have been for the last 40 years. In an effort to reduce the number of fireworks-related injuries and fires this year, the Los Angeles City Fire Department has implemented a massive campaign involving the use of flyers, posters and banners.

The primary message on each is that 'Fireworks are unlawful in the City of Los Angeles.' Banners have been placed over intersections near neighboring communities where fireworks are legally sold. Every city fire station is also displaying the banner until the Fourth of July.

Posters have been placed in community businesses and at all public park entrances.

The purpose of the fire department's efforts are to raise the level of awareness of the public. Many Los Angeles residents are unfamiliar with the ordinance banning fireworks. The fire department

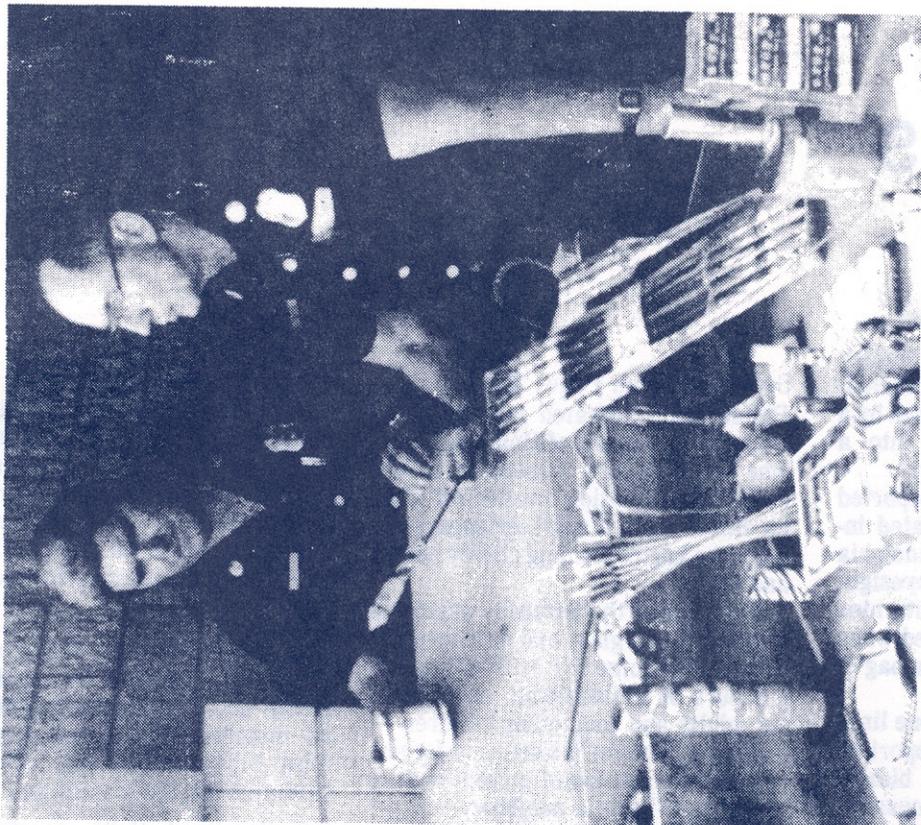
hopes, through this campaign, to educate the public regarding the hazards of fireworks.

And those efforts are needed. In a comprehensive program to identify the fireworks problem and its devastating effect on the community, a comprehensive study was made covering the one-month period of June 13 through July 13, 1981. The study was undertaken by the Los Angeles County Chapter of the California Fire Chiefs Association, in cooperation with the Los Angeles City Fire Department.

The study reveals that countywide there were 321 injuries requiring medical attention during the one-month period. Of those, 17 resulted in some degree of amputation or loss of sight.

There were a total of 500 fires caused by fireworks in the city of Los Angeles with property loss estimated at \$2,169,619. Countywide, the study reveals, there were a total of 1,266 fires with a property loss of \$3,772,901.

Although all fireworks are illegal in the city of Los Angeles, some nearby communities do permit the "safe and sane" fireworks. Among these is Culver City. "Safe and sane" fireworks can only be sold through properly licensed retail outlets from noon on June 28 through noon on July 6.



*DISPLAYING fireworks confiscated by Los Angeles Fire Department, Captains Philip McKay and William Hargett, from left, point out that all fireworks are banned in the City of Los Angeles.*

# July 4th fireworks kill two

United Press International

At least two people died in holiday weekend fireworks accidents, including a spectator hit in the forehead by a metal tube hurled 200 feet into a crowd at a July Fourth display.

Officials across the nation reported an explosion of fireworks-related injuries and doctors in Philadelphia operated Sunday to save the eyesight of a 4-year-old girl injured with nine others in an explosion triggered when a sparkler apparently ignited a bag of fireworks.

Fire officials said their phone lines were clogged with residents reporting a rash of fireworks-sparked blazes, which caused hundreds of thousands of dollars in damages. Three minor injuries to firefighters in California were reported.

An aerial fireworks display at a ballpark in Anderson, Mo., turned to tragedy late Saturday when a metal tube used in setting off fireworks was blown out of the ground by an explosion and flung into a crowd 200 feet away.

A spectator — Delores Bowzer, 58, of Neosho — was hit in the forehead by the tube and pronounced dead at the scene.

In Oak Park, Ill., a homemade firecracker bomb exploded, blowing out the stomach of a teenager and killing him. Two others suffered burns and a shrapnel injuries in the Saturday night explosion.

Officials said Kevin McTigue, 16, died after suffering a "blown-out belly" with injuries to his liver, spleen and intestines.

"They were playing with homemade fireworks," said Sgt. John Beerup. "They probably emptied some gunpowder from fireworks into a can."

Surgeons at Wills Eye Hospital in

Continued From Page 6

Philadelphia operated for two hours on Jennifer Kapper of Holland, Penn., who suffered tiny punctures to her eyes in an explosion touched off when an ember from a sparkler apparently ignited a bag containing cherry bombs and M-80s.

Police said the Saturday explosion "broke all the glass and damaged the porch" of a home in Fort Washington, a suburb of Philadelphia, and burned six adults and four other children — including Jennifer's sister and father.

"We saw and heard a great deal of screaming," said a neighbor.

The girl was reported in fair condition and doctors said they expected the girl to regain her sight, although particles from the exploded firecrackers also caused cataracts. Four of the others injured remained hospitalized in satisfactory condition.

In St. Paul, Minn., police said a youth was in danger of losing an eye from an explosion when a firecracker being hurled out of his car apparently flew back inside and ignited other fireworks.

In suburban Buffalo, N.Y., a youth was injured in his face and hands when someone hurled a lighted firecracker at him.

Firefighters, using helicopters and planes, Sunday contained a 1,400-acre sagebrush fire near Boise, Idaho. Authorities suspect it was touched off Saturday by either fireworks or holiday picnickers.

Other fireworks-related blazes causing hundreds of thousands in damages were reported in Southern California and Los Angeles firefighters received more than 1,000 alarms Saturday — twice the number of a usual weekend. Three firemen suffered minor injuries in Vacaville, Calif.

In Akron, Ohio, two young children face possible charges for accidentally ignited some highly flammable roofing material with firecrackers in a blaze Friday night that caused an estimated \$50,000 in damage.

In Woodland, Calif., spectators to what was billed as an hour-long fireworks display at the Yolo County Fairground got a quicker and more explosive show. A stray spark — from a rocket or possibly unauthorized firecrackers — triggered an explosion of \$6,000 in fireworks in a display that lasted only five seconds and consumed nearly 400 rockets.

No one was hurt, but the blast catapulted a box of rockets over a 9-foot fence, set fire to a stack of old telephone poles and unseated a man sitting 350 yards away.

However, in the true tradition of the Fourth of July, the Woodland Jaycees, the sponsor of the display for 26 years, managed to proceed as scheduled with the event by using the fireworks from a canceled show in Stockton.

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**OPEN HOURS:**  
June 29-July 1 8 AM-10 PM  
July 2-4, 8 am-midnight

SAVE IN  
CULVER CITY

"Fireworks may be legally sold, possessed or discharged only within cities where sale is authorized"

**BUY FIREWORKS IN CULVER CITY**

### State cracks down on fireworks sales

In an effort to combat a yearly increase in fireworks-related injuries throughout California, fire officials announced yesterday that a task force will be cracking down on all levels of illegal firework sales.

"It's big business, there's no question about it. It's a billion-dollar-a-year business in this state," said state Fire Marshal Philip C. Favro.

Due to lax enforcement of fireworks laws, injuries increased to 11,000 nationwide last year, according to the U.S. Consumer Product Safety Commission.

Of those injuries, 6,000 to 7,000 resulted in eye damage suffered in large part by young children. Thirty to 35 percent of those children lost their sight permanently, said ophthalmologist Kenneth Diddie.

Joining fire officials at a news conference at the Los Angeles Children's Museum, Diddie cited the example of a 2½-year-old boy whose eye was "ripped open" last year when a firecracker exploded near him.

Clamping down on out-of-state distributors of illegal fireworks is the key aim of the state task force, which includes fireworks' industry representatives as well as state and local fire officials, Favro said.

### Illegal fireworks

There has been much in the news lately regarding the confiscation of illegal fireworks by the Los Angeles City Fire Department. I am very glad to see the fire department taking action on this matter since it is all too obvious that the Los Angeles Police Department intends to do nothing about it.

This past Fourth of July, I left several messages for my area patrol officer to call me regarding the need for extra patrol on my street, where we have had serious problems with illegal fireworks causing fires in a nearby ravine. I never received a call.

I eventually paid a personal visit to the Hollenbeck police station (the LAPD station with no public parking) to speak to the station commander. I was told in so many words that he was too busy to see me. Finally I put in a formal request for extra patrol. A patrol car never came down my street, and when I called to report the problem, I was told that "fireworks calls are the lowest priority calls."

It was wonderful to see the billboards stating "All fireworks are illegal in the City of Los Angeles," but so sad to find that nothing else would be done.

Los Angeles

## Warning on mail-order fireworks

Customers buying fireworks from out-of-state mail-order distributors are likely to lose both their money and their purchases, the Los Angeles County Fire Department warned Wednesday.

"They're just throwing their money away," Battalion Chief Robert Curtis, said at a news conference, noting that the illegal items are confiscated immediately upon delivery.

Freight companies are required to notify the fire department upon their receipt.

Last year alone, Curtis continued, the county fire department destroyed \$1 million in firecrackers, Roman candles, sky rockets and other illegal fireworks.

A total of 321 people were hospitalized for fireworks-related injuries and there was more than \$4 million in damages because of illegal pyrotechnics last year, he said.

In addition, because the customer is required to pre-pay for his purchases with a money order or certified check, he has no way to collect his money, the chief continued. Losses reportedly average \$100 per purchase.

Be advised that different state and local governments act differently in regards to fireworks. When

ordering fireworks through the mail, be forewarned that authorities in your area may confiscate them.

## Safety, Testing And Use Of Fireworks



This chapter deals with basic safety procedures, and the cautious testing and use of fireworks. I realize that some of you may be bored with safety reminders, but it is better to read and think about them before you do your thing than to risk blowing yourself up due to ignorance. If you think safety is boring, just remember that life in a hospital bed is a lot more boring!

When mixing composition, always wear some type of face and eye protection. A machine operator's face mask is ideal for this. It is superior to simple goggles or safety glasses since it protects the entire face instead of just the eyes. A dust filter mask is also advisable, as some of the chemicals you may use are irritating or toxic and should not be breathed in. These filters can be bought at paint and hardware stores and are cheap. They look somewhat like the masks that surgeons wear and fit over the nose and mouth.

Heavy cloth or leather gloves are important to protect the hands. Special asbestos gloves can also be used, and these are readily available. A small fire extinguisher or at least a can of water should always be kept handy. You may never need it, but it is a good idea to be prepared — just in case.

If possible, work at a table outside or in a clear area in the garage away from anything that is flammable. If you are forced to work inside your house or apartment, you will have to be that much more careful.

Your work table and the floor around the table should be covered with a few layers of newspaper. This can be wet down and thrown away after you are finished working. Only the chemicals and components which you need for a particular project should be out. All others should be stored in an area away from where you are working.

Chemicals should be stored in a sturdy, lockable box in a safe area. An Army foot locker is one example of a suitable storage container. A similar

box should be used to store your finished fireworks and it should be kept in a separate place from the components.

A laboratory gram scale is best for measuring amounts of chemicals, and need not be expensive. Mine cost around \$30.00, has seen several years of use and will undoubtedly still be in use several years from now. A mortar and pestle are great for pulverizing chemicals. It is *imperative* that these be non-metallic to avoid sparks. They can be bought at most hobby shops or any chemical supply house. Buy at least two sets. Use one for pulverizing your oxidizers such as potassium chlorate, perchlorate and nitrates. Use the other for chemicals such as sulfur, charcoal and the like. Mark these and do not get one confused with the other. If you should happen to grind an oxidizer like potassium chlorate in a mortar which had sulfur or sulfide residue in it, the chlorate could very well explode while you were grinding it. It *has* happened!

Follow all formulas exactly, and don't experiment around unless you are sure of what you are doing. That's how injuries occur. Too many people get hold of potentially lethal chemicals and think they're Joe Chemist. The next thing they know, the fire department is scraping them off the walls and ceiling with a spatula.

Do not mix up any more composition than you will need at one time, as some are relatively unstable and could be dangerous to store for long periods of time. Also, it is much better to mix up many small batches of composition rather than one or two large amounts. When mixing flashpowder, mix up only a gram or so at a time and be sure to use the Hand Savers that I describe in the chapter on powder.

Needless to say, when mixing or working with ANY pyrotechnic composition, the smoking lamp is out. The reason should be so obvious as to need no further commentary.

Samples from all batches of fireworks should be tested. Test them in A REMOTE AREA AWAY FROM PEOPLE AND BUILDINGS. Do not test in residential areas. Neighbors do not appreciate a sudden BLLAAAMMM coming from next door, nor do they enjoy watching their house burned to the ground by a rocket that should have gone the OTHER way.

I can speak from personal experience here. As I said in the introduction, we had a small fire caused by a neighbor's rockets. We also had some fireworks buffs besides myself in the neighborhood, and some showed varying degrees of talent.

One such person set off a real thumper that even startled me. All the neighbors came running out of their houses just in time to see a huge cloud of resulting smoke billowing over the area. They stood in a large group, vigilante style, trying to determine who did it. I figured there was about to be a neighborhood hanging if they found out "who the inconsiderate dingbat was who threw that bomb!"

Since I was inside my house reading at the time the goody went off, no suspicion was directed towards me, even though the neighbors knew from acoustic experience that I was known to whip up a little something for the Fourth.

As I found out later, the culprit who lived nearby had simply rigged up his masterpiece with a burning cigarette taped to the fuse as a delayed ignition device. He, too, was inside his house — partying merrily when the thing went off.

The neighbors were understandably ticked off as this was not the first (or last) time such a thing had happened. I figured that the police would surely be called out for this one due to the extreme loudness of the device. It was a biggee! But as it happened, nobody called them at all. However, a couple of the neighbors made it very clear that their patience was wearing thin, and if this kind of thing continued, that the police *would* be involved.

The police got involved with me once as the result of a shell-shocked neighbor. I had made a small cannon, which I had charged with a blank load. I took it outside to the back yard to test it, and it turned out to be a very loud success. The resulting boom got one of my neighbors so horribly upset so as to call the police on me. About two hours later, a cop showed up at my door. Not just a regular cop, but a detective from the LAPD bomb squad! After I explained to him that I had simply fired a small homemade cannon with a blank charge, he was a bit upset (maybe disappointed). Apparently, the neighbor's description



was such that the police thought a real bomb had been set off. In a way, that's a compliment.

The officer then wanted to see my room. I let him in and he noticed my bookshelf with a few Army manuals, my copy of *Chemistry Of Powder And Explosives*, and some other interesting titles. He thumbed through these and probably thought I was nuts. I explained that I had those books for reference use, and that they were legal to own, which he knew. After ascertaining that I was not a crazed militant, mad bomber, or an arsonist, and that my interests were academic, he let me off with a rather stern warning.

When testing and using fireworks, you may encounter some duds. If your goody fails to go off, leave it alone for at least 30 minutes and do not let anyone near it, especially if it is a large device. This goes for all fireworks — not just the home brew variety.

There are infinite reasons why a pyrotechnic device will dud out. Usually it is a problem with the fuse. Maybe it just quit burning, or it could be smouldering and sputtering and waiting to go off at any time — like when you stoop down to pick it up.

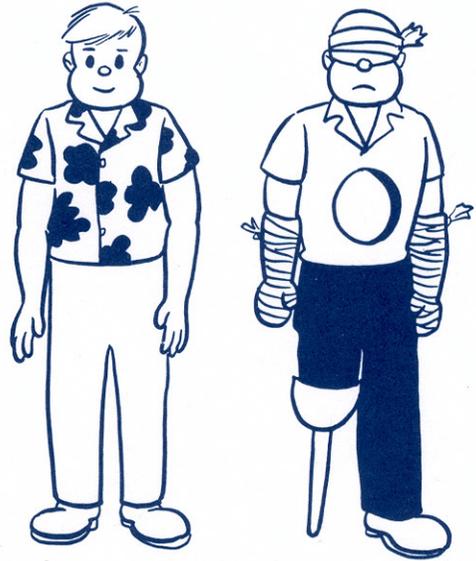
I have heard of firecrackers and salutes that just sat there and smoldered for as long as 10

minutes before suddenly going off. This usually happens more with fireworks that are fused with a piece of string coated with a chemical mixture, such as some firecrackers from Mexico, rather than with those which are fused with the more reliable safety fuse.

After 30 minutes, soak the dud in water if possible and bury it deep in an area where there is little chance of someone else discovering it. NEVER cut open a dud, try to replace the fuse, attempt to use it again, or otherwise mess with it. Many serious injuries have resulted from such practices.

I once saw a foolish kid pick up a Black Cat firecracker that had duded out. He peeled some of the paper back to expose the flashpowder inside and tried to get it to ignite by holding a lit match to it — while holding it in his hand! I tried to tell him that he was really asking for it and warned him of what could happen. The fool ignored my advice and said that he had done this several times before without getting hurt. Sooner or later, he will most likely have plenty of time to reconsider his errors — from a hospital bed.

It is a good idea to obtain a blank lab manual and log your results with homemade fireworks, especially stuff that is new to you. This way, you will have a permanent record. If you make something that you are really pleased with, you can check the book and see how much of what compo-

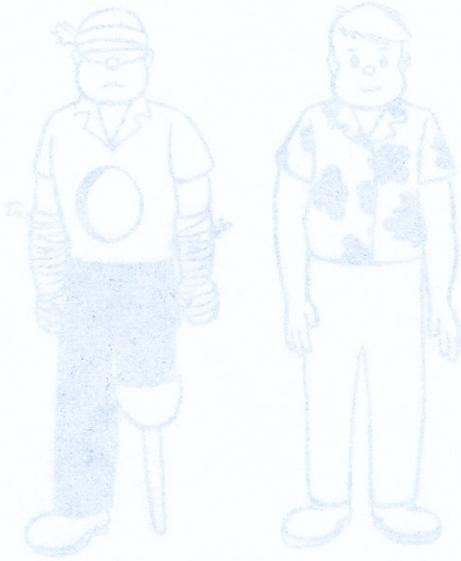


Only one of these men follows standard safety procedures when handling and using fireworks. Guess which one.

sition you used, type and thickness of the casing, etc. On the other hand, if the results are unsatisfactory — or if something unexpected happens, you will be able to see what you did wrong later and so avoid repeating the same mistakes in the future. Consider record keeping one more safety step!

### 7 SAFETY STEPS

1. Enjoy fireworks from a safe distance.
2. Use fireworks outdoors only, in a clear area away from houses and buildings.
3. Never point or throw fireworks at another person.
4. Don't experiment or use homemade fireworks.
5. Don't use in mountains or other wooded areas, particularly vacant lots with dry weeds.
6. Share your celebration with others who keep "safety" first in mind.
7. Please supervise your children at fireworks time! You'll have fun, too!



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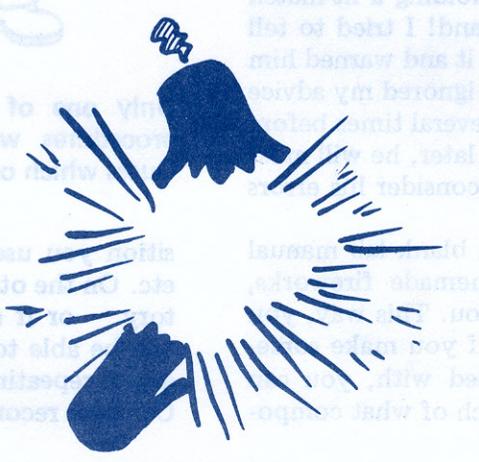
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It is a good idea to obtain a first aid manual and log your results with homemade fireworks especially stuff that is new to you. If you really will have a permanent record. If you really think that you are really pleased with what you check the book and see how much of what you

only one of these men follows standard safety procedures when handling and using fireworks.

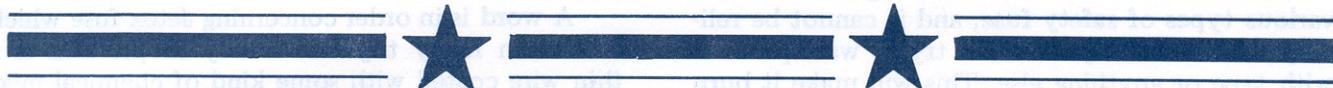
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7 SAFETY STEPS

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4. Don't experiment or use homemade fireworks.
5. Don't use in mountains or other wooded areas, particularly vacant lots with dry weeds.
6. Share your celebration with others who keep "safety" first in mind.
7. Please supervise your children at fireworks. (Time! You'll have fun, too!)

## Fuse



There are some excellent commercially made fuses presently available through mail order. First, there is the standard 3/32" safety fuse. This is much used in M-80 salutes, cherry bombs and many other types of fireworks. It gives good results, is still readily available and is cheap.

There is also a 1/4" blasting (time) fuse. This is the same stuff that is used with non-electric blasting caps and is quite durable. It is used mainly for aerial fireworks such as aerial bombs, single and multiple break shells, etc. It is also used in some mortar tubes. This type of fuse sells for about a dollar a foot at this writing, and it is well worth it. Wonderful stuff!

Next is 3/8" fuse. This is also used for aerial fireworks, and it is good and thick. It does not cost that much more than the 1/4" fuse, and it can be useful.

There are also black match (plain black powder fuse) and quick match, which is plain black match covered with paper "piping" to make it burn instantly from end to end. This is used for setting off many fireworks at once, such as lances, gerbes and other display fireworks. Even the Chinese tissue paper fuse shows up from time to time.

With all this super stuff so easily available, I don't see why people would make their own. The fuse is one of the most important components of fireworks, and is often the difference between a successful masterpiece and a sputtering dud. However, this manual would not be complete without a formula for black match. This one has worked well for me:

### MATERIALS

1. Black powder FFFG grade.
2. Parcel Post wrapping twine (the thick white cotton type).
3. Powdered dextrin.
4. Wood alcohol (methanol).

Black powder is obtained from gun stores, and sells for about \$7.00 per pound at this writing. It is used in muzzleloading arms. There is a black powder substitute called Pyrodex on the market, but I don't think it would give the best results for what we want. Homemade powder usually doesn't work very well, either, so you should stick to the commercially made product.

To make this fuse, you will need what is called "meal powder". This is black powder ground to the consistency of flour. To make it, first put on all the protective equipment mentioned in the previous chapter. Once safely "armored", grind the black powder *one teaspoonful at a time* in a mortar and pestle (*NOT* the one used for oxidizers). Grind it as fine as flour, take your time, and GO EASY. Keep the rest of the powder, both ground and unground, away from that which you are grinding.

After the powder has been ground, measure 1 pint of water and 8 ounces of alcohol into a large bowl. While stirring this mixture, add about two tablespoons of dextrin. Stir until no lumps remain.

Continue stirring while slowly adding the meal powder a little at a time until the mixture assumes the consistency of thin honey or molasses.

Cut a 20 foot length of parcel post twine and boil it in clean water for about 5 minutes to remove any preservatives or other impurities that it might contain.

After washing, stir the string into the black powder slurry, leaving one end out of the bowl so that an end can be found easily. Stir until the string is well saturated. Let soak for approximately three hours.

After it has soaked, hang the fuse up like a clothesline and remove any globs of powder mixture from it. When finished, the fuse cord should be round and uniform in thickness. While it is still wet, dust it well and evenly with some of the pulverized meal powder. Hold a container such as a

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pie pan under the fuse as you do this so you can collect the excess powder that falls away. It can then be saved and used for your next batch of fuse.

Leave the fuse hanging until it is thoroughly dry, then store it in a cool, dry place, well away from any source of heat or fire. A metal can such as a cookie tin is ideal to store fuse in.

Black match fuse is not waterproof like the various types of safety fuse, and it cannot be reliably made that way. NEVER try to waterproof it with tape or anything else. This will make it burn instantly from end to end just like quick match. I once roasted a bunch of fingers while trying to do this. If black match so modified were used in a large salute, you would never have time to get away before it went off.

All fuse should be tested for its burning rate. Measure off a foot and see how long it takes for it to burn from ignition to final burn out. A watch with a second hand is useful here. This test is simple, and should be done every time you make or purchase a new roll of fuse. Different batches of fuse will vary in burning rates. When cutting fuse to use in your fireworks, remember the old saying: "Better a foot too long than an inch too short."

Next comes the water test for safety fuse. Fill a large glass with water. Cut off a foot of safety fuse and attach a piece of modeling clay, shot sinker, etc., to one end. Drop the weighted end of the fuse into the glass and let it sink to the bottom. Ignite and time as before. This is best done outside, as wet, burning fuse gives off an odor that no one would want to have in their home.

A word is in order concerning Jetex fuse which is sold in many toy and hobby shops. This is a thin wire coated with some kind of chemical mixture. It is used in small model jet engines. It is very fragile and quite expensive and totally unsuitable for pyrotechnic purposes. It is best to leave it for its intended purpose.

Sources for many types of fuse as well as additional information for other types of homemade fuse will be given later.

While on the subject of fuse, let me explain why you sometimes see it spelled with an "s" and sometimes with a "z". Some people may feel that the spellings are interchangeable, but they aren't really. Fuse with an "s" applies to the burning type with which we are concerned here. Fuze with a "z" refers to an electrical or mechanical type.

your chapter. Once safety removed, find the black powder one teaspoonful at a time in a mortar and pestle (NOT the one used for analysis). Grind it as fine as you can, and GO EASY. Keep the rest of the powder both ground and unground, away from that which you are grinding. After the powder has been ground, measure 1 pint of water and 8 ounces of alcohol into a large bowl. While stirring this mixture, add about two tablespoons of dextrin. Stir until no lumps remain. Continue stirring while slowly adding the main powder a little at a time until the mixture assumes the consistency of thin honey or molasses. Cut a 30 foot length of parcel post twine and boil it in clean water for about 5 minutes to remove any preservatives or other impurities that it might contain. After washing, stir the string into the black powder slurry, leaving one end out of the bowl so that an end can be found easily. Stir until the string is well saturated. Let soak for approximately three hours. After it has soaked, hang the fuse up like a clothesline and remove any glob of powder mixture from it. When finished, the fuse cord should be round and uniform in thickness. While it is still wet, dust it well and evenly with some of the pulverized meal powder. Hold a container such as a

dollar a foot in this writing, and it is well worth it. Next is 3/4" fuse. This is also used for safety fireworks, and it is good and thick. It does not cost that much more than the 1/4" fuse, and it can be used. I have the also black match (plain black powder) and pink match, which is plain black match covered with paper "piping" to make it burn irregularly from end to end. This is used for setting off early fireworks at once, such as indoor parties and other display fireworks. Even the Chinese fuse paper has shown up from time to time. With all this super stuff so easily available, I don't see why people would make their own. The fuse is one of the most important components of fireworks and is often the difference between a successful masterpiece and a squattering dud. However, this manual would not be complete without a formula for black match. This one has worked well for me.

MATERIALS:  
1. Black powder FFC grade.  
2. Parcel Post wrapping twine (the thick white cotton type).  
3. Powdered dextrin.  
4. Wood alcohol (methanol).

## Flashpowder & Chemite

### Flashpowder

Properly made flashpowder is the only stuff that will work well in firecrackers and salutes. Black powder and the various types of smokeless gunpowders simply don't produce good, loud results. Also, these powders almost always blow the end plugs out of salutes while leaving the casings intact. This is frustrating and no fun at all.

There are two basic types of flashpowders. One type simply burns super fast when lit. This type *deflagrates*. The other type literally explodes by itself when confined and ignited. This *detonates*.

The detonating variety is the loudest and the most powerful. It is used for M-80 salutes and cherry bombs as well as the more powerful tube salutes. A deflagrating mixture would not give the best results in these types of salutes.

The deflagrating compositions are used in less critical fireworks such as old fashioned firecrackers and some novelty fireworks. They are also safer to mix and handle and the materials are often available locally without restrictions. This saves you the wait of ordering the chemicals through the mail.

There are several formulas for flashpowder that give good results. A few are listed below. There are also additional formulas which can be ordered from the Source section of this manual. We will start with some of the deflagrating mixtures which are as follows:

1. One part potassium nitrate (saltpeter), one part magnesium dust.
2. One part strontium nitrate, one part magnesium dust.
3. Two parts potassium permanganate, 1/4 part sulfur, 1/4 part aluminum powder.
4. 2½ parts potassium nitrate, one part aluminum powder, 1½ parts sulfur.

Some of the better detonating compositions would include:

1. Two parts potassium chlorate, one part aluminum powder and one part sulfur FLOUR.
2. Two parts potassium perchlorate, one part aluminum and one part sulfur FLOUR.
3. 3½ parts potassium perchlorate, 2½ parts aluminum powder.
4. Two parts potassium perchlorate, one part aluminum powder.
5. Seven parts potassium perchlorate, three parts aluminum powder.

The parts are measured in fractions of a gram for safety. You can use 1/4, 1/2, etc., just be sure to keep the quantities small. As I said before, it is better to mix several small batches of composition rather than a few large ones.

Be sure to wear the protective equipment mentioned earlier when working with any of these compositions. There is also a device called the Hand Saver which I designed that allows you to mix compositions at a safer distance from your face and body, thus lessening the risk of personal injury. The Hand Saver is shown and described on page 18. Although the one shown was made from a coffee can, it would be an even better idea to make a non-metallic one, such as from a plastic one quart ice cream container. It should be thoroughly washed and dried before use, of course. Non-metallic containers should be used for all grinding, pulverizing and mixing since they won't spark. Plastic or wooden spoons are also in order.

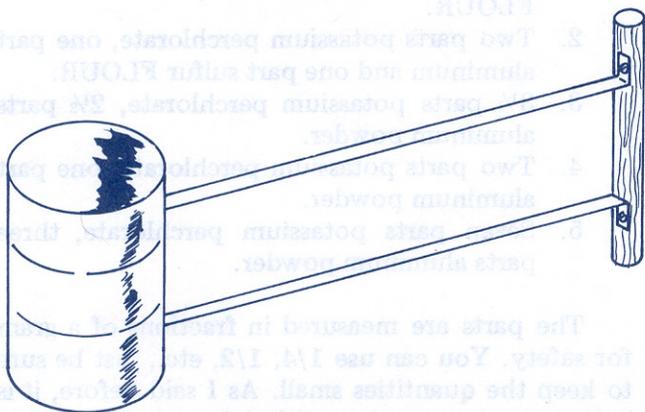
Sulfur flour is a special type of sulfur that contains almost no sulfuric acid. It is the safest type to use with chlorates and perchlorates. Westech Corporation sells it. Like the rest of their chemicals, it is of top quality.

When you mix these compositions, add the oxidizing chemical(s) last. For example, if you mixed a flash composition consisting of potassium

perchlorate, sulfur flour and aluminum, you would first mix the sulfur and the aluminum, then add the potassium slowly and gradually to the mixture while gently swirling the mixing container.

Be sure all chemicals are pulverized to the consistency of flour SEPARATELY before mixing. NEVER grind any chemicals after they have been mixed. For any pyrotechnic mixtures that combine potassium chlorate or perchlorate with sulfur or any sulfides, add a tiny pinch of common baking soda. This helps to neutralize the minute quantities of sulfuric acid that are present in sulfur or sulfides. This will result in a safer and more stable mixture.

A word is in order about aluminum powder. The very best grade you can get is the German black



The Hand Saver consists of a 1 lb. coffee can attached to a handle made from a piece of wooden dowel. It is attached with two strips of sheet metal about 18 inches long. The device can be assembled with small screws through the metal strips. It is a good idea to have a separate mixer for each different composition you plan to mix. Mark them and don't get them confused with one another.

pyrotechnic grade aluminum dust. It is a grayish-black substance that doesn't even resemble common aluminum powder. It sells for around \$12.00 per pound at this writing and is worth every cent. It gives excellent results and is neat and easy to work with. It is available from some chemistry and pyrotechnic supply outlets.

If for some reason you can't find the German stuff, you can always use common paint store aluminum. This is called aluminum bronzing powder, and it's used for making metallic paints. It's cheap and gives fair results. Be sure that the package contains the phrase "chemically pure" or C.P. somewhere on the label.

The paint store aluminum is very difficult to work with. A dust filter mask is definitely in order when working with it. It seems the particles get all over everything, no matter how carefully you work. The German aluminum is a real pleasure to work with in comparison.

To test these flashpowders (fun), put about half a teaspoon full on a brick or other fireproof object, lay a fuse across it, and ignite. Do this outside, as all flashpowder mixtures give off a lot of smoke. Store the finished powder in a covered coffee can in a cool, dry place away from any sources of heat or sparks.

#### Chemite

There is a report intensifier called Chemite which is sold by Westech and it dramatically improves the performance of flashpowder. It increases the surface area of the flashpowder and literally gets between the individual particles of the mixture and sort of fluffs it up so that more surface area of the powder is ignited at one time. This results in a much louder report. Simply add 1/10 of 1% of Chemite by weight to your composition. I have used Chemite in some of my mixtures and have found the results to be spectacular. At the present time, Chemite sells for \$1.00 per ounce, and an ounce is a lot when you consider the small amount used.

#### White Smoke

Westech also has an additive for flashpowder which produces white smoke reports in salutes. Adding a pinch to the flashpowder produces additional smoke. While I have not tried this, it sounds interesting and worthwhile for special effects such as daytime aerial salutes. The price is around \$8.00 per pound.

## Salutes



A salute firecracker consists of a strong, hard cardboard tube which is filled half to three quarters full with a detonating flashpowder mixture. The casing is sealed on both ends with plugs and a length of fuse seated well into the powder for sure ignition. The fuse can be inserted into the side or the end of the casing.

Salutes are simple to make and can be made in any size you want from baby to bionic. The accompanying illustrations will give you the general idea.

Basically, there are three ways to obtain salute casings. The first and best is to simply order them from a pyrotechnic supply house since commercial casings can be bought about as cheaply as home-made ones can be constructed. Commercially made casings are top quality and let you avoid the mess of making them yourself. Sources for casings of all sizes will be given later.

The second way to get casings is to scrounge scrap cardboard tubes, or have someone save them for you. Stores use them for displays and such and are always throwing them away. Most stores will be glad to give you the old tubes just for the asking. You can also check the trash bins in alleys behind stores. You should have no trouble finding more tubes than you can conveniently store. Most of these tubes are either parallel or spiral rolled on machines, just like commercially made salute casings. In most cases, they give equal results.

There are two things to consider when selecting scrap tubes for casings. First, be sure the tubes are clean, strong, dry and hard. Then be sure that you can find a wooden dowel with a diameter that will fit the tubes snugly for the end plugs. If the fit is almost right, but still a bit loose, cut some paper from a shopping bag the length of the dowel (about 12") and wide enough to be rolled around the dowel for two or three turns. Smear the paper with glue and roll it tightly and evenly around the

dowel. Set aside to dry for a few days before using. This will increase the diameter of the dowel slightly to ensure a good, snug fit in the casing. If the fit is just a bit too tight, a little sanding will remedy the situation.

The third way to get salute casings is to make them yourself. This is easy once you get the hang of it. Personally, I consider case making to be messy and boring. However, it's good to know how to make your own rock hard casings that will produce a super report.

To make a strong salute casing similar to those used for the quarter stick (also known as the M-250, whatever that means), you will need a wooden dowel 3/4" in diameter and about three feet long. These can be found at lumber yards and many hobby shops.

Cut the dowel into three one foot lengths. One piece will be used as a case roller and the other two will become stock for end plugs. Treat the case roller by rubbing it with a cake of paraffin wax until the entire surface of the roller has a light coating of wax on it. This will prevent the paper and glue from sticking to the roller when making casings. It's very frustrating to have them stick together and have to throw the whole mess out.

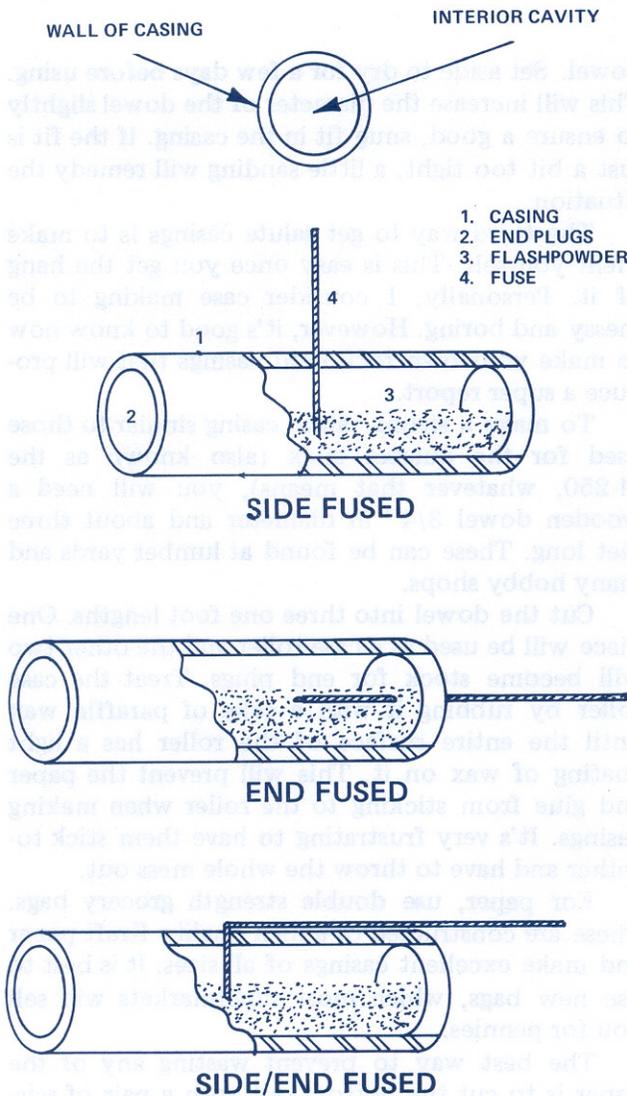
For paper, use double strength grocery bags. These are constructed of a high quality Kraft paper and make excellent casings of all sizes. It is best to use new bags, which most supermarkets will sell you for pennies.

The best way to prevent wasting any of the paper is to cut the bottom out with a pair of scissors and discard it, then gently tear the bag apart along the seam. If the seam won't tear easily, then simply cut it. Cut strips of the desired width lengthwise from the paper. A ruler and a razor blade or X-acto knife can be helpful here.

To make a quarter stick casing, you need two and a half strips 5 1/2" wide. Roll the first strip one

## THE FIRECRACKER COOKBOOK

and a half turns around the dowel *without gluing it*, then smear the strip with glue and roll it tightly and evenly around the dowel until there is only about an inch of paper remaining. Line the second strip up with the first and insert the edge under the remaining inch of paper. Smear the second strip with glue and roll it around the dowel until there is again only about an inch of paper remaining. Take the last half strip and do likewise. You will find it easier to apply the glue with a sponge, brush or a clean, dry cloth.



After rolling the casing, leave it on the dowel. With your fingers and palms, roll the casing back and forth on a smooth, hard surface such as a clean bread board. This will eliminate any air pockets in the casing and help the paper to stick together properly.

With the casing still on the dowel, measure and cut 1" from each end. Use a thin, sharp knife for this purpose, such as an X-acto or a kitchen paring knife honed razor sharp. Cutting the ends off will result in a casing that is universally strong and even. If you don't cut the ends off, the casing will be weaker there. Don't ask me why, it just is!

Slip the casing off the dowel and allow it to dry for about three weeks before using it. You now have a casing 3½" long, with an inside diameter of 3/4" and a wall approximately 1/8" thick.

For a long time I thought it was very dangerous to roll casings with white glue lest the case break into a few large chunks that could cause damage or injuries at a long distance. However, recent tests revealed that casings rolled with white glue instead of mucilage still burst into many small pieces just like commercially made casings do. If the thought of flying projectiles from the casing really bothers you, you could always roll them without any adhesive, but the report is considerably reduced this way.

After the casing is completely dry, it can be painted with watercolors or model airplane dope. Either paint can be purchased at hobby shops. As an alternative, you could wrap a few turns of colored tissue paper around the casing, gluing the first and last half inch of it before punching the hole for the fuse.

Salute casings can be waterproofed easily by simply rubbing them with a cake of paraffin wax until a light coat is deposited. This works quite well and is very inexpensive. Spray-on plastic or acrylic coatings can also be used, but they are far more expensive and don't really work any better than wax, if as well.

Just about any size casing can be made using the above technique. For larger salutes, use more bag strips and cut them wider. For smaller salutes, use less. You can experiment with different casing lengths and wall thicknesses as well as different inside (and corresponding outside) diameters. Keep track of the results in your log book for future reference. Enjoy.

Salutes can be plugged on the ends in a variety of ways such as with clay, paper end discs and plugs, crimping, special pyrotechnic adhesive, plaster of Paris, cork and slices of wooden dowel cut to size.

The wooden dowel method is my favorite. The other methods offer varying degrees of success, and I have used some of them in the past. However, I believe that the wooden dowel plugs offer a somewhat stronger seal since they fit in tightly. A plug

1/4" to 1/2" thick will suffice for most of the salutes that you might want to make. I recommend using a good grade of wood glue to cement the plugs into place. An aliphatic resin glue such as Titebond or any of the carpenter's or woodworking glues are best. These are extra-strong white glues which are available at hardware stores and some hobby shops. In a pinch, though, a common white glue like Elmer's will work well.

Some may feel that the use of wooden plugs is dangerous and fear that it may cause shrapnel when the salute goes off. I say that if you are close enough to a salute when it goes off to be hit by ANY of it, you were too close anyway.

In our field tests, we noticed that the wooden end plugs are blown into many small bits that are relatively harmless. I have been hit by these and they didn't hurt much. I doubt that they would have enough velocity to cause any injuries unless one hits an eye. On the other hand, the plaster and clay plugs ARE dangerous as they don't break up in the explosion. You can always use paper end plugs and discs if you fear injury from the wooden plugs.

Following are some of the more popular salutes. We will start with the construction of the M-80 and go into the method of assembling salutes. With the exception of the cherry bomb, they are all assembled the same way. The only difference is size, and possibly the manner of fusing.

To make the M-80, you use a casing of 1/2" ID, 3/4" OD and 1 1/2" in length. The casing can be commercially made, found as scrap, or homemade.

The end plug stock is 1/2" wooden dowel, which may or may not need a couple of turns of paper glued to it to make it fit snugly. The end plugs are 1/4" thick, so measure off 1/4" sections along the dowel's length and mark them with a pen.

Begin assembly by taking a casing and installing one end plug as follows: Smear the plug dowel lightly with glue all around for the length of one measured section. Insert the dowel into the casing up to the 1/4" mark. Cut the rest of the dowel off flush with the casing using a small coping saw. Turn the dowel as you cut it so the cut will be even. Wipe off the plug stock dowel well after each installation to prevent any sawdust from sticking to it. Repeat for as many casings as desired. If you see any glue on the inside of the casing after installing the first plug, remove it with a Q-tip.

Next, slip the semi-plugged casing onto a scrap piece of 1/2" dowel without paper and punch a hole for the fuse in the center of the side of the

casing. Start the hole with an ice pick, then remove the casing from the dowel, then finish the hole with a small nail or an awl so the fuse will fit firmly but not too tightly. Secure the fuse with a drop of glue, making sure the hole is sealed to prevent a spark from igniting the powder prematurely when the fuse is lit.

Fill each casing about three quarters full with a detonating flashpowder mixture. Seven parts potassium perchlorate and three parts of German black pyrotechnic aluminum powder, along with Chemite (one tenth of one per cent by weight) will give the best and loudest results. Try to maintain even loads in each salute.

Next, remove any powder that may be in the open end with a Q-tip. Take the plug dowel and smear another 1/4" section lightly with glue. Install and saw off evenly as before. Allow the salutes to dry on their sides to prevent any glue from touching the powder. Repeat for as many as you want.

When dry, the finished salutes can be painted with red or orange model airplane dope and waterproofed with a light coating of paraffin wax. The ends can be waterproofed with black tree grafting compound or tar. When this is done, the M-80 is ready to go. Be advised that these are the real thing, so use them cautiously. As I said before, all other tube salutes are assembled the same way. Here are some others:

### Silver Salutes

These are made from the white tubes found on certain types of clothes hangers and are painted silver with model airplane dope. Cut the casing to 1 1/2" long and assemble as before. The end plugs should be 1/4" long.

### Mini Salutes

These use the same coat hanger tubes as the silver salutes, but the casings are only 1" long. They can be painted any color desired. Like the silver salutes and the M-80, the end plugs are 1/4" long.

### Finger Long Salutes

The same casing material as above, only 3" long. These may be end fused if you wish. The casings can be beefed up a bit by rolling a few turns of glued newspaper around them.

### Quarter Sticks

These use a casing about 3 1/2" long, with a wall thickness of about 1/8" and an ID of 3/4". End plugs should be approximately 3/8" thick. Quarter sticks can be fused on the side or the end.

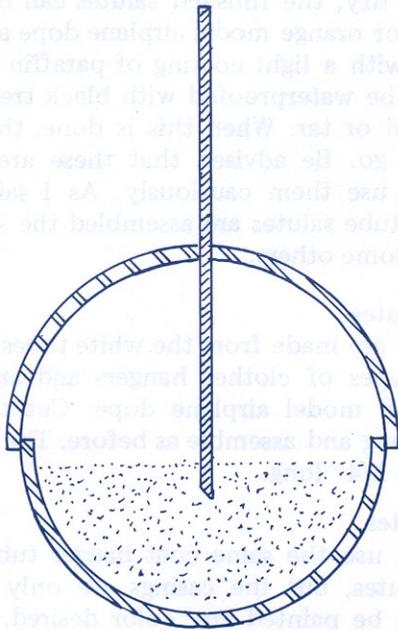
### Atom Bombs

The casings are 6" long, have a wall thickness of about 1/4", an ID of 1" and end plugs 1/2" thick. Atom bombs are usually end fused due to their length. The 1/4" blasting fuse is recommended for these.

All of the above tube salutes can be constructed from commercially made, scrap or homemade casings. Of course, salutes of sizes in between those listed above can be constructed as well.

### Cherry Bombs

Cherry bombs are made differently than the above salutes. These use round casings which are loaded, fused and fit together like a capsule. Cherry bombs are extremely loud and powerful when properly made. I have seen some homemade ones blow bricks to pieces. Quite impressive.



CHERRY BOMB

Commercially made round casing sets can be ordered from pyrotechnic supply outlets. The smaller half is loaded about three quarters full with a detonating flashpowder composition. The mixture previously described for M-80 salutes is also best for these.

A 1/8" hole is punched in the top half of the casing for the fuse and a 2" length of fuse is inserted into the hole and secured with a drop of glue. Make certain the fuse protrudes about 1/4" into the inside of the casing to insure reliable igni-

tion of the powder. When the casing has been loaded and fused, fit the two halves together like a capsule, using a light coating of glue on the outside edge of the smaller half. This is repeated for as many as you wish to make. Allow to dry overnight.

Next, take a compass and draw several circles about 2" in diameter on brown paper lunch sacks. These are made of a thinner grade of Kraft paper than the double strength bags. These circles are used to beef up the cherry bombs to create a louder report. Three such circles are needed for each casing.

Cut out the circles and punch a hole in the center of each with an ice pick so they can be slid down over the fuse. Take one circle, smear it lightly on one side with white glue, and slide it down over the fuse to the casing with the glued side down and carefully wrap it around the casing. You may have to moisten your fingers slightly with glue as you do this. The idea is to form the glued paper around the casing as evenly as possible, so that it becomes a part of the casing. After mating the paper to the casing as tightly as possible, cut away any excess paper. Allow this first application to dry overnight, then repeat the process with the other two, allowing each to dry overnight.

Once the final circle has dried, the cherry bomb can be painted with model airplane dope. The traditional color, as you may have guessed from the name, is red. After being waterproofed with wax, it's ready to use.

Don't underestimate the power of cherry bombs, for they can be very potent.

It's rumored that some salutes are as powerful as one eighth or one quarter stick of dynamite. The M-80 is said to equal one eighth stick. I don't know if this is true, as I haven't had any experience with dynamite (nor do I care to). There are several types of dynamite with different velocities. I would imagine that the people who made these comparisons had the lower velocity explosives in mind. At any rate, it would be a fun topic to bring up at a party. But know your audience first. There are some people out there who would be convinced that you were a real looney, or subversive, or both, if they found out you were interested in pyrotechnics of any kind. Others could care less or might show a genuine curiosity about the subject, even though they knew nothing about it.

Some people say to never hold a salute or any other firecracker in the hand when lighting it, but rather place it on the ground. I disagree. I would much rather hold it in my hand while lighting it so

I could throw it to a safe area to explode. And if the fuse were a bit faster than normal, I could get rid of it quickly before it went off (You develop fast hands in this business!).

By contrast, if I were standing over it when it went off, an injury could easily occur. Holding firecrackers in your hand to light them is perfectly safe if you use safety fuse. 2" *outside* the cracker is

sufficient as it burns slowly and evenly. If you use homemade black match, make it long.

Salutes are very powerful even in the smaller sizes and are not to be misused. They are for adult use and should be stored in a locked box. Don't let children play with them, and keep them out of the hands of adults who have been consuming alcoholic beverages.



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lines of the firecracker stapled to it in a staggered line, about 3" apart. For best results use black match for the long fuse as well as for the fuse in the individual firecracker. The string can be topped off by a salute by lighting the end of the long fuse. These firecrackers are so recommended that you assemble them where you wish to set them off.

## Triangle Firecrackers



Triangle firecrackers are a novelty item which are simple and fun to make. They are very loud when carefully made and are lots of fun when shot off in long strings. A nice feature of triangle firecrackers is that duds are virtually non-existent.

There are a few different ways to make them, but the following method is about the simplest and it produces good, loud firecrackers.

To make one, you will need four strips of paper from a glossy magazine page. Cut the strips 1 1/4" wide lengthwise from the page. This will make a strip approximately 11" long. If you want to give the triangle firecracker a finished appearance, cut a piece of colored tissue paper the same size as the other strips and wrap it around them last.

To begin, take one of the magazine strips and measure off 2-1/8" on the top and 1-3/8" on the bottom. Using your ruler as a straight edge, draw a diagonal line between the two.

Lay this marked strip over a second one, making sure the edges are even, and fold both strips down and to the right along the diagonal line. Crease the fold firmly.

Next, turn the strips over so that the tab created by the fold is projecting up. Fold this tab over the top of the strips toward you. If its edge doesn't line up with the edge created by the first crease, adjust it until it does. This is important. Once the fold is completed, attach it to the back of the paper strips with a piece of masking tape as shown. This is all much easier than it sounds and is illustrated in Steps 1-4.

Turn the strips over once more and pick them up so the point of the triangle is facing down. Spread the pocket formed by the last step out a little and add roughly a half teaspoon of the flash-powder of your choice. Insert a 3" piece of fuse into the pocket alongside the powder so it is resting along the left side of the pocket as shown in the illustration on page 26.

Be sure that the powder pocket bulges out a little bit, but not too much. After making a few of these, you will be able to judge the proper amount strictly by eye.

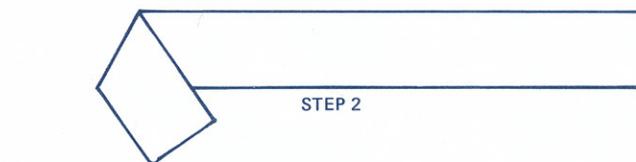
Next, fold the paper strips down and to the right. This will effectively close the powder pocket and secure the fuse. Fold the strips firmly and keep them in an even line with the edges of the triangle.

Next fold the strips up and to the left around the triangle. Now fold them to the right around the front of the triangle, and down and to the left around the triangle. Continue wrapping in this manner until you come to the end of the strips, then tape them down neatly. As you fold, be sure that the turns are pulled firmly and evenly, as this is important. Don't squeeze or pinch the firecracker too tightly as you wrap the strips.

Take another strip and line one end up evenly with the taped ends of the first two strips. Fold



STEP 1



STEP 2

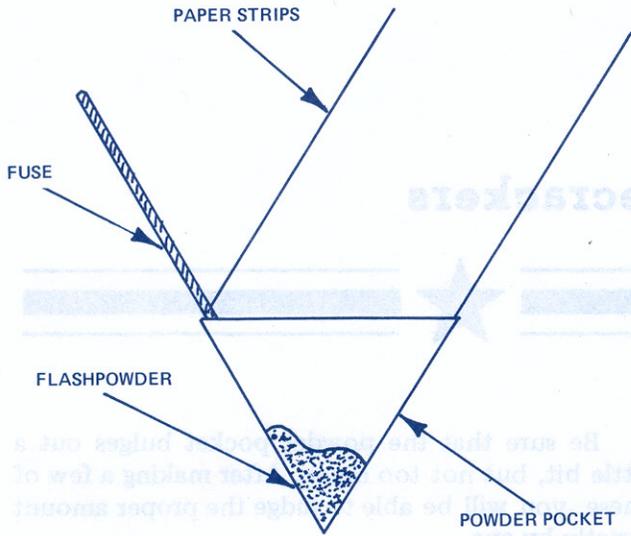


STEP 3



STEP 4

# THE FIRECRACKER COOKBOOK



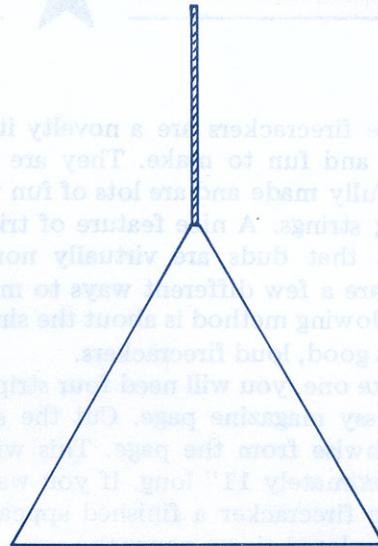
and wrap around the triangle as before. Again, wrap firmly and evenly. Take the fourth paper strip and repeat, finally adding the colored tissue in the same manner.

The triangle firecracker is now finished and ready to use. Don't be discouraged if your first few turn out looking a little tacky. Practice makes perfect. The results will speak loudly for themselves.

Long strings of these firecrackers can easily be made by simply using a length of fuse with the

fuses of the firecrackers stapled to it in a staggered line, about 2" to 3" apart. For best results, use black match for the the long fuse as well as for the fuses in the individual firecrackers.

The string can be topped off by a salute by stapling its fuse to the end of the long fuse. These strings are rather fragile, so it's recommended that you assemble them where you wish to set them off.



**COMPLETED TRIANGLE FIRECRACKER**



## Delayed Ignition Devices



I used to use delayed ignition devices for testing salutes and other fireworks so that I could observe them from a distance. I would rig one up, back off maybe 300 feet, and watch for the show. You may wish to repeat my tests on your own, so a brief description of these devices is included for that purpose.

Most of the time, I used a cigarette attached to the fuse as a delay. This is about the oldest and simplest technique, and is workable. Take a cigarette and remove the filter, then punch a hole near the end so the fuse to the goody of your choice can be inserted into the tobacco. Cigarettes can also be cut to different lengths for varied delay times.

During one such test, we found that a whole cigarette (a Marlboro) provided roughly ten minutes of delay time. With cigarettes coming in all different lengths, the size you pick should be tested by attaching a small piece of fuse to it and timing how long it takes to ignite with a watch with a second hand.

However, the cigarette method does have its drawbacks. Quite often cigarettes will just burn out if they weren't lit right. Also, if they get damp, they are sure to go out. I found this out when I was trying some aerial fireworks attached to kites and flying them at the beach. The damp sea air ruined my delay almost every time. The cigarettes simply wouldn't stay lit.

The following delays will give good results. However, the delay times may vary due to temperature, humidity and the like, so testing under various conditions would be in order if you plan to experiment with these.

One device uses match head powder and concentrated sulfuric acid. Match heads contain potassium chlorate, which will ignite on contact with

the acid. Match head powder is made by taking several books of matches, placing them on a concrete surface, then pulverizing them with a hammer. The resultant powder is then sifted through a fine tea strainer and is stored in a pill bottle until needed.

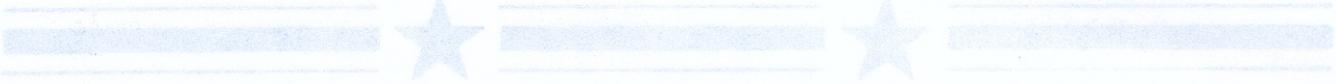
To make a match head powder delay, simply fill a small match box about three fourths full with match head powder. Then use a glass eye dropper to fill a gelatin capsule almost full with sulfuric acid. *Make certain there is no sulfuric acid on the outside of the capsule.* If there is, all the match head powder will ignite immediately upon contact with the botched capsule.

Place the capsule in the box of match powder, insert the end of the fuse of the goody into the box, slide the box shut and depart.

A similar device is made almost the same way. Instead of match head powder, a mixture of one part silver nitrate and one part magnesium powder is used. Keep the mixture dry, as water will ignite it and is, in fact, used in the capsule in this delay instead of acid, which will also ignite it. The silver nitrate/magnesium powder mixture goes into the match box and a water-filled capsule is inserted into it. Again, make certain there is no water on the outside of the capsule.

Yet another delayed ignition device consists of strips of newspaper that have been soaked for 12 hours in a concentrated water solution of potassium nitrate (saltpeter). These strips are then allowed to dry. Once dry, they should be tested for their burning time, just like black match fuse. One end of the newspaper is simply attached to the fuse of your pyrotechnic device and the other end is lit. This is a slow burning fuse, making it ideal for setting off fireworks carried high into the sky by balloons, which brings us to our next chapter.

# Delayed Ignition Devices



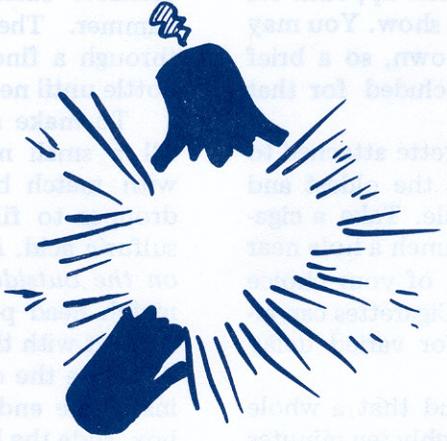
the acid. Match head powder is made by taking several books of matches, placing them on a concrete surface, then pulverizing them with a hammer. The resultant powder is then sifted through a fine tea strainer and is stored in a pill bottle until needed.

Make a match head powder delay; simply fill a match box about three fourths full with match head powder. Then use a glass eye dropper to fill a gelatin capsule almost full with water. Make certain there is no sulfuric acid on the inside of the capsule. If there is, all the powder will ignite immediately upon insertion into the pocketed capsule.

the capsule in the box of match powder, and the end of the fuse of the goody into the box, and the box shut and depart.

A smaller device is made almost the same way. Instead of match head powder, a mixture of one part silver nitrate and one part magnesium powder is used. Keep the mixture dry, as water will ignite it and is, in fact, used in the capsule in this delay instead of acid, which will also ignite it. The silver nitrate/magnesium powder mixture goes into the match box and a water-filled capsule is inserted into it. Again, make certain there is no water on the outside of the capsule.

Yet another delayed ignition device consists of strips of newspaper that have been soaked for 12 hours in a concentrated water solution of potassium nitrate (saltpeter). These strips are then allowed to dry. Once dry, they should be tested for their burning time, just like black match fuses. One end of the newspaper is simply attached to the fuse of your pyrotechnic device and the other end is lit. This is a slow burning fuse, making it ideal for setting off fireworks carried high into the sky by balloons, which brings us to our next chapter.



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Most of the time, I used a cigarette as the fuse as a delay. This is about the simplest technique, and it works. First, take the filter from a pack of cigarettes and remove the filter from the pack. Cut the end of the fuse to the body of the cigarette. Insert the fuse into the tobacco. The cigarette can be inserted into the tobacco. Different lengths for different delays for different times.

During one such test, we found that a whole cigarette (a Marlboro) provided roughly ten minutes of delay time. With cigarettes coming in all different lengths, the size you pick should be tested by attaching a small piece of fuse to it and timing how long it takes to ignite with a watch with a second hand.

However, the cigarette method does have its drawbacks. Quite often cigarettes will just burn out if they weren't lit right. Also, if they get damp, they are sure to go out. I found this out when I was trying some aerial fireworks attached to fuses and flying them at the beach. The damp air ruined my delay almost every time. The cigarettes simply wouldn't stay lit.

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## U.F.O.'s & Rocket Aerial Bombs

### U.F.O.'s

**WARNING:** These devices carry flammable and burning material thousands of feet into the air. They are probably illegal everywhere. Don't launch these near any fire risk areas, and especially near any airport or known flight patterns. This same warning also applies to any other aerial pyrotechnic devices.

These U.F.O.'s are simple and quick to make, being based on medium and large helium filled weather balloons. The balloons are available from some science supply companies like Edmund Scientific, as well as novelty and surplus stores. Check the classified ads in science magazines, *Popular Mechanics*, etc., for additional sources.

Helium can be bought or ordered through dealers listed in the Yellow Pages under "gasses", by mail order, or from local welding and toy shops. You will need a large refillable tank with the valve and hose connections for balloons. The gas dealer should be able to get you refills at a reasonable cost.

Be sure to weigh your payload and choose a balloon or group of balloons that will lift it quickly and reliably. Do a trial run with a tether string attached to the balloon to check the rate of ascent before doing a "live performance" with pyrotechnics.

Balloons can carry long strings of firecrackers, smoke devices, horizontal pinwheels, road flares and anything else you can imagine along those lines thousands of feet into the sky. They can even be used to launch radio controlled model gliders from an altitude of thousands of feet when used with a tether line. An extra channel should be installed in the glider for a simple release mechanism.

Any type of delayed ignition device or radio control signal can be used to set off your pyrotech-

nic masterpiece. Experiment and have fun. For those few unfamiliar with the term, a tether line is nothing more than a roll of kite string or monofilament fishing line tied to the balloon(s) like a kite. That way you can send up a display and watch it explode, burn, sparkle, smoke, etc., then reel in the balloon for another payload. However, be sure to suspend all pyrotechnic devices well below the balloon to avoid burning or destroying it.

These balloons can be disguised as flying saucers, alien warships or any other forms and shapes you want by using balsa or plastic struts, tissue, mylar and similar lightweight materials. Use your imagination, as the sky is the limit here so long as weight and size are kept within manageable proportions.

Daytime U.F.O.'s can carry firecrackers, smoke, banners, streamers and flags. Night U.F.O.'s can carry large spherical or cannister shells, flares and various display fireworks.

Large plastic trash bags and dry cleaning bags can also be used for lightweight payloads. Be sure that any small holes in the bag are covered with a dab of Scotch tape before filling with helium. Also, be sure to use a bag large enough to lift your payload. These bags make good one shot "disposable" U.F.O.'s.

### Rocket Aerial Bombs

These zip up hundreds of feet into the sky and explode with a loud report. They are easier to make than common skyrockets, are safer, and perform as well as or better than the commercial pyrotechnic offerings.

### MATERIALS

1. Estes Mini-Rocket engines, A34-T size or similar.

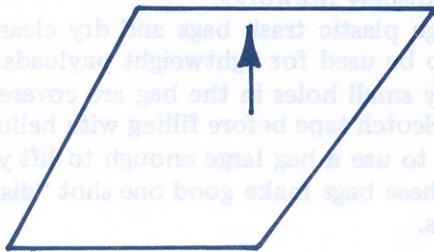
## THE FIRECRACKER COOKBOOK

2. Finger Long salute with black powder fuse (homemade).
3. Balsa wood fin stock, 1/8" thick.
4. Estes rocket body tube No. BT-5.
5. Safety fuse and match powder, or battery powered model rocket ignition system.
6. Launch pad, either homemade or commercially made.
7. Fin pattern (below).
8. Nose cone, either homemade or commercially made.

All the above components except the salute are available at most hobby shops or by mail order. Hobby shops also carry many catalogs and books on model rocketry, which is a fascinating hobby in itself.

Californians no longer need a State Fire Marshal's permit to buy rocket engines. This is a big step forward, as a lot of people have been severely injured trying to make their own rockets. Unless you have had a great deal of experience, it can be very dangerous. By using commercially available components and fuel, most of the work — and risk — is taken out of rocket making.

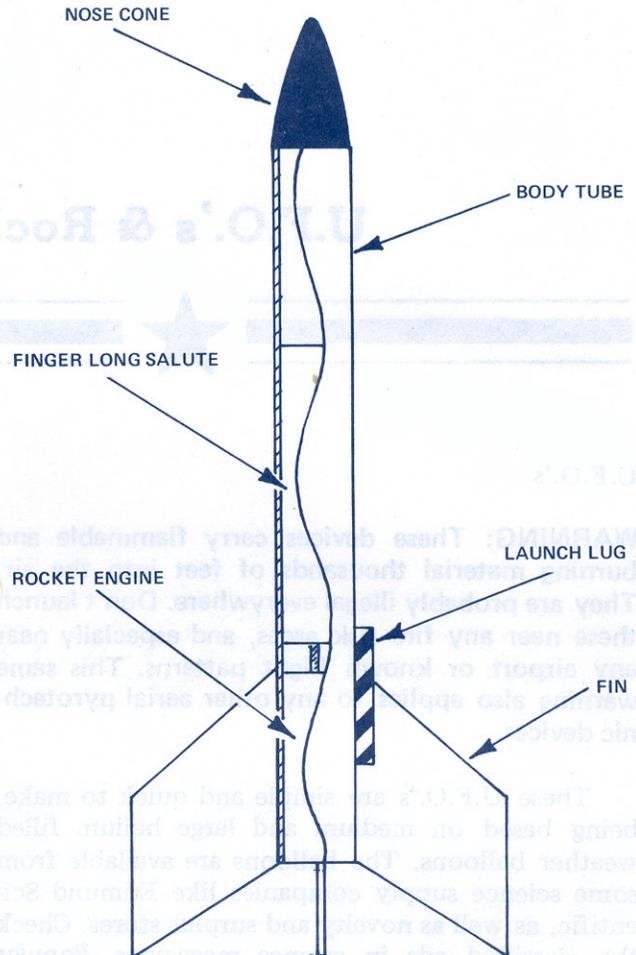
First, take a piece of tracing paper and trace the fin pattern shown below. Trace several patterns, as you will be using them as tracing templates and will need three fins for each rocket. The pattern is full sized. The arrow indicates the edge that is to be glued to the rocket body. After tracing the patterns onto the balsa fin stock, cut the fins out with an X-acto knife or razor blade.



ROCKET FIN TEMPLATE

Cut the rocket body tubes into 6" lengths and glue the fins on straight, 120° apart. Be sure that they are glued on securely and that you attach the correct edge to the rocket body. Stand the body tube upright on the nose end and allow the fins to dry in place overnight.

Next, the rocket engine has to be modified so it will ignite the salute once it reaches its zenith. To do this, take a pencil and scrape out the clay



cap and ejection charge opposite the exhaust nozzle in the engine. The ejection charge is what blows the parachute or streamer out of a normal rocket. It must be removed for our purpose. When all the ejection charge has been removed, a black shiny surface will appear. This is the smoke tracking charge which should be left alone.

Spread a thin coat of glue on the modified engine and insert it into the rocket tube until it is flush with the end of the tube. Next, take an unpainted Finger Long salute (page 21) which has been fused on the end with about 1" of black match, smear it lightly with glue and insert it into the tube with the fuse down. Make sure that the fuse touches the smoke tracking charge in the engine, as that is what ignites it.

Finally, a nose cone and launch lug are added. The nose cone can be homemade or of commercial manufacture while the launch lug is nothing more than a piece of soda straw. It is glued to the rocket tube next to a fin as shown in the accompanying illustration. The launch lug fits over the rod on the launching pad and is used for guidance. Allow the

finished rocket aerial bomb to dry overnight, then paint with model spray paint if desired.

Although just this one size rocket is described, any other size model rocket can be so modified as well as Class B, C and D rocket engines. Look through the various model rocketry catalogs for ideas. There is no reason why multiple stage rockets, clustered engines and group launchings can't be used. Just be sure to test each design in a remote area away from people and buildings.

Commercially manufactured launching pads are inexpensive, but a homemade one works just as well. A 10"x10"x1" square of wood with a 1/8" hole drilled in the center for a three foot long launch rod works just fine. At the time of writing, launch rods cost about 50 cents at most hobby shops. The pad itself should be covered with aluminum foil to prevent scorching from the rocket's exhaust.

For ignition, you have two choices: a commercially made electric launcher or match powder

and safety fuse. Any model rocketry catalog should have a description of the commercial systems, so we will concern ourselves solely with the homemade style ignition.

Put a bit of ground match head powder (see Delayed Ignition Devices) into the exhaust nozzle of the rocket engine and place a 3" length of safety fuse across it. Cover with a bit of masking tape to keep the match head powder from falling out. For safety's sake, do this just prior to launch.

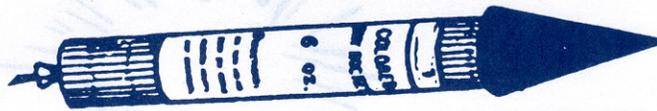
To launch, place the rocket on the pad with the rod fitting through the launch lug on the rocket. Attach the ignition system of your choice and blast off. The rocket will streak skyward and the smoke tracking charge will allow you to follow its arc across the sky, then your payload will explode. Have a good time!

An advertisement for commercially made pyrotechnic rockets appears below to give you an idea of the wide variety available where they are legal.

**Reports and Stars  
Skyrockets**

When shot from a trough or a piece of eaves spouting, this item will shoot high into the air with a trail of sparks and then will burst into a canopy of colored stars.

- 2 ounce Skyrocket .... 3.49 Doz.
- 4 ounce Skyrocket .... 5.50 Doz.
- 6 ounce Skyrocket .... 7.99 Doz.
- 8 ounce NEW Skyrocket ..... 10.99 Doz.
- Butterfly ..... 6.99 Doz.
- Clustering Bees ..... 6.99 Doz.
- Wild Bees ..... 6.99 Doz.
- Snow and Red Plum - Color ..... 6.99 Doz.
- Extra Rocket - Double Grade ..... 6.99 Doz.
- Rocket Parachute .... 6.99 Doz.
- Brightening Rocket ... 6.99 Doz.
- Flower Scattering Child ..... 6.99 Doz.
- Moon with Silver Brightness ..... 6.99 Doz.
- Glitterous Lights .... 6.99 Doz.
- Emerald Meteors .... 6.99 Doz.
- 6 Dozen Assorted ..... 37.99



**SUPER Bottle Rockets**

- Super Large ..... \$5.99 1/2 Gross
- Bottle Rocket Barrage**
- One dozen rockets fused together in a firing rack - all 12 fired in order ..... \$5.50 Doz.

**Imported Pop  
Bottle Rockets**

- Zip and away they go to a height of about 100 feet, leaving a trail of beautiful sparks. They're showy and inexpensive ... a lot of fireworks for a little money.
- With Report
- 1 Gross Carton ..... \$5.75

**Tri-Color Rocket**

- Box of 12 ..... \$6.99
- STARRY SKIES**
- The only exploding floral shells - 5 reports ..... \$4.99 Doz.
- THOR MISSILE**
- Stands about 9 inches high and reaches altitudes in excess of 2,000 feet and finishes with a loud report or colors.
- \$7.99 Doz., 2 Doz. .... \$12.99
- BLACK DIAMOND**
- Stands about 14 inches high and reaches altitudes in excess of 5,000 feet and finishes with a loud report or colors ..... \$16.99 Doz.
- FLAMING ARROWS**
- Stands about 12 inches high and reaches altitudes in excess of 2,500 feet and finishes with a loud report or colors ..... \$10.99 Doz.
- Mars Rocket**
- Box of 12 ..... \$6.99

**ROCKETS**



## Exotic Pyrotechnics

### Flashlight Torpedoes

These explode with a brilliant flash and sharp report when thrown against a hard surface.

#### MATERIALS

1. Squares of bright wrapping tissue about 2" square.
2. Flashpowder (any type).
3. Toy caps.
4. 1/4" lead ball (buckshot or pistol ball) or steel ball bearing.

Take a square of tissue paper and center a toy cap on it with the colored side up. Place the ball so it is centered directly on top of the cap.

Gather the edges of the tissue about halfway up, making sure the ball stays centered on the cap. Pour in a small pinch of flashpowder. Gather the edges of the paper up the rest of the way and twist them firmly together after moistening your fingers lightly with glue. The torpedo is finished and ready to use.

These torpedoes are perfectly safe to make and carry. Even children can enjoy them safely, provided they do so under an adult's supervision. Also, they are not so loud as to get the neighbors all hysterical.

### Contact Explosive

#### MATERIALS

1. Iodine crystals.
2. Pure non-detergent ammonia or ammonium hydroxide.
3. Glass jar with screw-on top.
4. Paper towels.

Grind about half a teaspoonful of the iodine crystals into a coarse powder, then set it aside. Next, pour about 8 ounces of ammonia into a

jar. Add the iodine crystals to the ammonia and cap the jar. Swirl the mixture gently for approximately 10 minutes, then pour the ammonia off slowly so as not to disturb the crystals. Collect the treated crystals (which are the explosive) with a teaspoon and transfer them to a few layers of paper towels. This is done just to remove the excess moisture, for the crystals must remain quite moist to be safe.

For storage, transfer the moist crystals into a clean pill vial. They should be used soon after treating, as once they are dry the slightest touch will set them off. The explosive goes off with a loud snapping sound. Some chemists make it a lot more potent by washing the finished product with alcohol, then ether. However, it is much more dangerous to handle this way.

Time each batch to see how long it takes to dry. Ten to twenty minutes is about usual. This stuff can be used as a practical joke by putting a small amount on stairways, sidewalks, and similar places.

### Carbide Cannons

Carbide cannons are sold in toy stores and hobby shops, as well as at some fireworks stands. The only problem with them is that they are too expensive, and aren't all that loud. I first saw a homemade version of the carbide cannon some years ago. It consisted of a length of pipe about three feet long and about 2" to 3" in diameter.

This pipe was capped or plugged on one end and propped up on some type of stand or support. About two cups of water were poured down the pipe. There was a 1/8" hole drilled into the side of the pipe about 1" above water level.

The cannon was fired by dropping a bit of calcium carbide down the barrel, inserting the fuse into the hole and then lighting it (or holding the match right up to the hole to look macho).

# THE FIRECRACKER COOKBOOK

Just a bit of carbide is needed for a good, loud boom. In fact, if you put in too much, too much gas will be generated and the thing will just dud out. So much for overloads.

Following the above guidelines, you can experiment with your own carbide cannon. Try different amounts of carbide and pipe lengths and diameters until you get the results you want. Keep track of the results in your log book.

Calcium carbide can be ordered from chemical supply outlets and can be found in some toy stores under the name BANGSITE. It is also often sold at fireworks stands.

Be sure to keep the carbide in an airtight jar or tube, as it is very hygroscopic. Moisture in the air will cause it to gradually deteriorate and become useless. When it turns white and crumbly, it is no longer good.

jar. Add the iodine crystals to the ammonia and cap the jar. Swirl the mixture gently for approximately 10 minutes, then pour the ammonia off slowly so as not to disturb the crystals. Collect the treated crystals (which are the explosive) with a teaspoon and transfer them to a few layers of paper towels. This is done just to remove the excess moisture, for the crystals must remain quite moist to be safe.

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The cannon was fired by dropping a bit of calcium carbide down the barrel, inserting the fuse into the hole and then lighting it (or holding the match right up to the hole to look macho).

Flashlight Torpedoes  
These explode with a brilliant flash and sharp report when thrown against a hard surface.

## MATERIALS

1. Square of bright wrapping tissue about 5" square.
2. Flashpowder (any type).
3. Toy caps.
4. 1/4" lead ball (bullet or pistol ball) or steel ball bearing.

Take a square of tissue paper and center a toy cap on it with the colored side up. Place the ball so it is centered directly on top of the cap.

Gather the edges of the tissue about halfway up, making sure the ball stays centered on the cap. Fold in a small pinch of flashpowder. Gather the edges of the paper up the rest of the way and twist them tightly together after moistening your fingers lightly with glue. The torpedo is finished and ready to use.

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## Contact Explosive

## MATERIALS

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Grind about half a teaspoonful of the iodine crystals into a coarse powder, then set it aside. Next, pour about 8 ounces of ammonia into a

## Sources



At the end of this chapter is a list of sources for fireworks related books, plans, chemicals and components, as well as a listing of manufacturers of commercially made fireworks of all types. All of these companies have interesting catalogs which are updated from time to time. I would suggest that you order as many of them as you can for the best overall selection of items.

If you plan to order fireworks from out of state (legally, I assume), be sure to read the ordering instructions very carefully as well as all the fine print.

Some companies will ship anything anywhere while others are so paranoid that I'm surprised they're still in business at all. One such company wouldn't even send me a catalog just because I live in the Los Angeles area. The fact that I have been a collector of these catalogs for some time didn't make any difference at all. If you live in California, no catalog. Oh, well.

These companies usually ship their merchandise via motor freight or United Parcel Service. At this writing, I understand that UPS is starting to get a bit leary of hauling fireworks, and all shipments may have to be by freight in the near future.

No fireworks can be sent through the mail for obvious reasons. The package will be clearly marked and labeled, often dramatically, as to the contents. This is required by law by the Department Of Transportation.

Most, if not all, fireworks companies will require you to sign a waiver releasing them from liability in case you wipe out your neighborhood, hurt yourself or someone else, or otherwise botch it up. With the way some morons handle fireworks (see newspaper clippings on pages 4-10), who can blame them?

I don't know how much longer you will be able to order this stuff, so if you want it, get it while you can. The same applies to books (it's already

a no-no to ship certain titles to Australia or Canada), chemicals and components.

Various local fire departments are getting increasingly aggressive in trying to reduce the flow of illegal fireworks. As I said before, they despise fireworks, and are doing their best to combat them. However, like booze, guns, and pot, it has been proven that enforcement of prohibition was, is and always will be an uphill battle and generally a waste of time and effort. A *reasonable* change of the present laws is the only realistic solution.

A law was recently passed in California that all delivery companies must report any shipments of fireworks to the local fire department. The same may be true in other states as well. The fire department gets word that fireworks are to be delivered to your address, and they send out a unit to confiscate the booty (see page 10). At this writing, such Orwellian tactics don't yet apply to chemicals and components.

Being an amateur chemist and model rocketry buff for several years, I have ordered chemicals and other goodies that would have the staff of our local fire station biting their nails and throwing fits, but I've never been hassled since my present activities are legal and are for scientific and academic purposes. I could care less if they know that I possess and use such materials.

At any rate, if one desired to obtain illicit fireworks, he could simply drive to a neighboring state that allowed their sale and load up and bring them back. It's up to you to be cognizant of state and local laws and act accordingly.

Our sources are broken down into three lists. The first covers books and literature. The second is devoted to chemicals and components. The third covers commercially made fireworks. Current prices for catalogs are also listed. These lists are by no means complete. Additional companies can be found in the classified ads of various science and

## THE FIRECRACKER COOKBOOK

gun magazines as well as in *The Shotgun News*. Other sources can also be found. Some libraries have reference materials pertaining to fireworks and their history and such material is recommended reading. Seek and you shall find.

The author has no financial or other interests in the companies listed below and lists them merely for your convenience and reference.

It is hoped that *The Firecracker Cookbook* will at least partially clarify the science of pyrotechnics and encourage further study into one of the most fascinating and yet least understood forms of art.

I hope that in the near future some of the current restrictive fireworks laws are changed so that people can legally enjoy a traditional Fourth of July, and that those who would make and use potent fireworks obtain the information to make their practice at least somewhat safer to themselves and others.

With caution, care and common sense, fireworks can be a tradition to be enjoyed for years to come and not outlawed and forced underground. I hope this is sooner rather than later.

### BOOKS AND LITERATURE

#### BILL MOORE PUBLICATIONS

P.O. Box 1600  
Cottonwood, Arizona 86326  
Catalog \$1.00

#### BUTOKUKAI

P.O. Box 386  
Cornville, Arizona 86325  
Catalog \$1.00

#### CHEMICAL PUBLISHING COMPANY

155 W. 19th St., Dept. 631  
New York, New York 10011  
Catalog \$1.00

#### PYROTEXT PUBLICATIONS

1064 Lamplighter Drive  
Logan, Utah 84321  
Catalog \$1.00 plus S.A.S.E.

#### SCIENTIFIC SYSTEMS

Box 716  
Amherst, New Hampshire 03031  
Catalog \$1.00

### CHEMICALS AND COMPONENTS

#### THE CHEMICAL SHED

944 E. Baseline  
San Bernardino, California 92410  
Catalog \$2.00

#### HAGENOW LABORATORIES

1302 Washington St.  
Manitowic, Wisconsin 54220  
Catalog \$1.00

#### MERRILL SCIENTIFIC

1665 Buffalo Road  
Rochester, New York 14624  
Catalog \$2.00

#### RICHARD O. WOLTER

326 Summit Court  
Schaumburg, Illinois 60193  
Catalog \$1.00

#### WESTECH CORPORATION

P.O. Box 593  
Logan, Utah 84321  
Catalog \$2.00

### COMMERCIALLY MADE FIREWORKS

#### ACE FIREWORKS

P.O. Box 221  
Conneaut, Ohio 44030  
Catalog \$1.00

#### APOGEE

Box 5618-A  
Chicago, Illinois 60680  
Catalog \$1.00

#### BETHANY SALES CO. INC.

P.O. Box 248  
Bethany, Illinois 61914  
Catalog \$2.00

#### B. J. ALAN CO. FIREWORKS

3800-B Southern Blvd.  
Youngstown, Ohio 44507  
Catalog \$2.00

#### FALCON FIREWORKS

P.O. Box 634  
Canal Fulton, Ohio 44614  
Catalog \$1.00

## THE FIRECRACKER COOKBOOK

FIREWORKS UNLIMITED  
8550 Route 224  
Deerfield, Ohio 44411  
Catalog \$2.00

KEVSAR INC.  
P.O. Box 215  
Logan, Utah 84321  
Catalog \$2.00

L & M AMUSEMENTS  
P.O. Box 32395  
Louisville, Kentucky 40232  
Catalog \$1.00

MERCURY ENTERPRISES  
P.O. Box 207  
Carrollton, Virginia 23314  
Catalog \$1.00

R & R FIREWORKS  
R.D. 3 Efts Lane  
Winterville, Ohio 43952  
Catalog \$1.00

SAFETY FOURTH NOVELTY CO.  
Box 47  
Hammondsville, Ohio 43930  
Catalog \$2.00

WESTSHORE FIREWORKS  
6641 Dewey  
Fountain, Michigan 49410  
Catalog \$1.00



THE FIRECRACKER COOKBOOK

R & R FIREWORKS  
R.D. 3 Ellis Lane  
Winterville, Ohio 43952  
Catalog \$1.00

SAFETY FOURTH NOVELTY CO.  
Box 47  
Hammondsville, Ohio 43980  
Catalog \$2.00

WESTSHORE FIREWORKS  
6841 Dewey  
Fountain, Michigan 49416  
Catalog \$1.00

FIREWORKS UNLIMITED  
8550 Route 234  
Dorset, Ohio 44411  
Catalog \$2.00

KEVBAR INC.  
P.O. Box 215  
Logan, Utah 84321  
Catalog \$2.00

L & M AMUSEMENTS  
P.O. Box 32355  
Louisville, Kentucky 40232  
Catalog \$1.00

MERCURY ENTERPRISES  
P.O. Box 207  
Carrollton, Virginia 22814  
Catalog \$1.00





## **PUBLICATIONS**

*Look to FIREPOWER PUBLICATIONS for the finest titles on automatic & exotic weapons, silencers, improvised weapons, munitions & pyrotechnics, and other subjects of interest to bold adventurers.*

Professional Homemade

**Cherry  
Bombs**

**& Other Fireworks**

Formerly Released as  
*Professional Homemade Salutes*

Professional Homemade

**Cherry  
Bombs**

**& Other Fireworks**

Formerly Released as  
*Professional Homemade Salutes*

# Professional Homemade Cherry Bombs

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— WARNING —

THE MAKING AND USING OF FIREWORKS, AS WITH ANY EXPLOSIVE, IS POTENTIALLY HAZARDOUS AND THE READER IS ADVISED TO EXERCISE EXTREME CAUTION WHEN MAKING AND USING ANY OF THE DEVICES DESCRIBED IN THIS BOOK. THE READER IS, ALSO, ADVISED TO REMAIN COGNIZANT OF ALL APPLICABLE LAWS PERTAINING TO FIREWORKS AND EXPLOSIVES.

## GENERAL INFORMATION

Exploding fireworks are very easy to make and, if reasonable care is exercised during the making and using, they are relatively safe.

Our efforts will be concentrated on six types of exploding fireworks:

Miniature Salutes

Kraft Salutes

Super Kraft Salutes

Stick Salutes

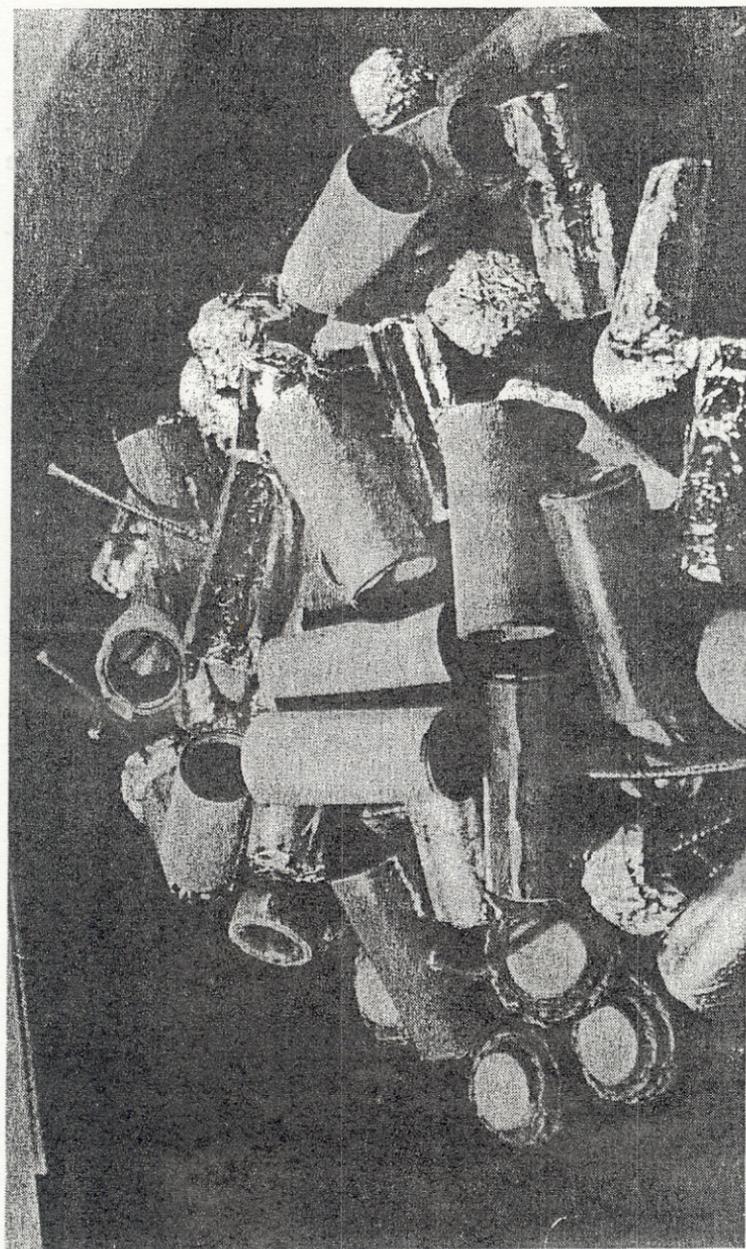
Thunderbolt Salutes

Super Thunderbolt Salutes

The above fireworks are comprised of the following components: Cases made from scrap cardboard or paper; End plugs made from grocery bags; Powder mixed from purchased ingredients; and Fuse which is purchased.

Fuses are very important! Most fireworks accidents are caused by faulty fuses; fuses that are too short or fuses that have been carelessly inserted or attached to the fireworks.

Only controlled 3/32 in. dia. waterproof fuse is recommended. The length of the fuse should be from 2 to 4 inches with 2 inches an absolute minimum!



THE ABOVE PHOTOGRAPH SHOWS SOME OF THE FINISHED SALUTES THAT CAN BE EASILY MADE BY FOLLOWING THE DIRECTIONS IN THIS BOOK.

## POWDER FORMULA

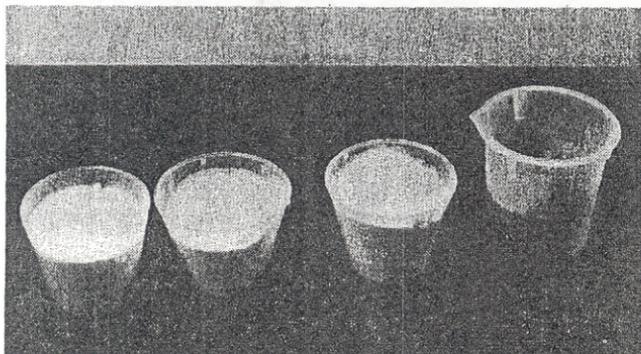
The following formula is very hazardous and extreme care should be used when mixing, storing or using it. Be sure to use the powder mixing instructions as given in this book. When filling cases never fill over 1/3 full. Also, never ram or compress the powder in the case.

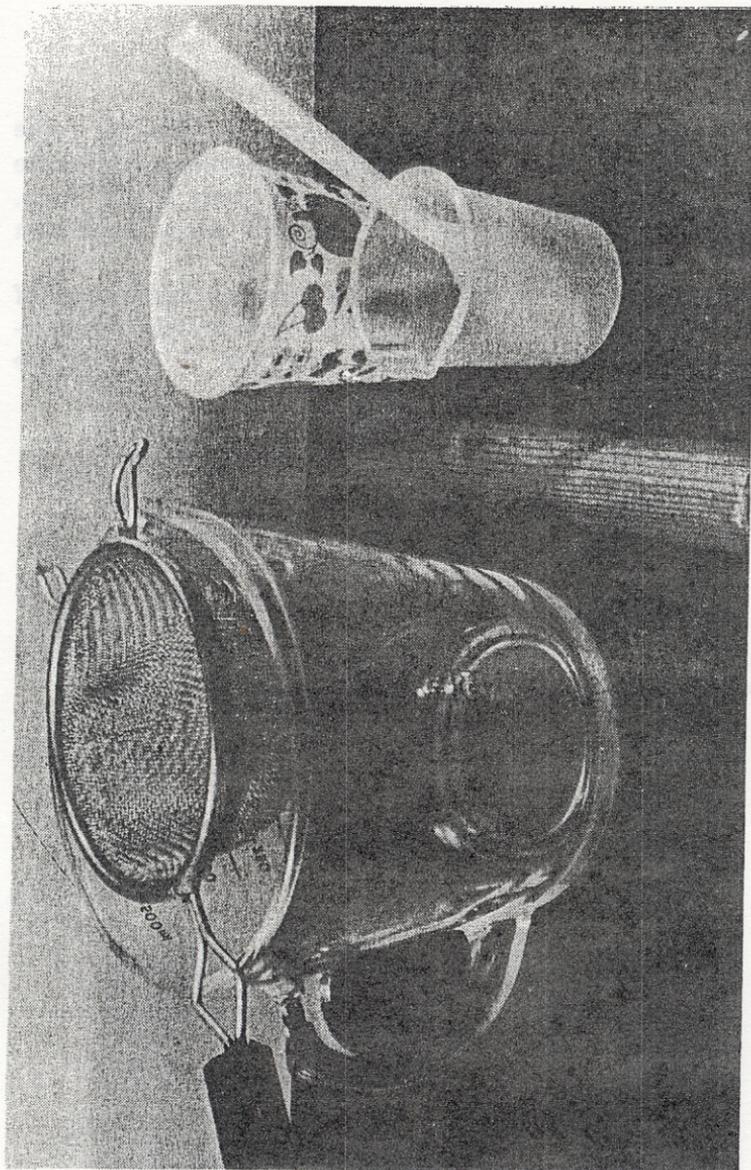
Quantities given in the following formulas are in units of weight. Do not mix by volume! Any type weight measurement can be used (grams, ounces, etc.) just as long as the same type is used for all the ingredients.

Ingredient	Parts By Weight
Potassium Chlorate . . . . .	2
Pyro Aluminum (400 mesh) . . . . .	1
Sulfur . . . . .	1

If Potassium Chlorate is unavailable or if you desire a less volatile mixture the following formula can be used.

Ingredients	Parts By Weight
Potassium Nitrate . . . . .	5
Pyro Aluminum (400 mesh) . . . . .	2
Sulfur . . . . .	3





THE PHOTOGRAPH ABOVE SHOWS SOME OF THE UTENSILS THAT YOU WILL BE USING TO CORRECTLY MIX YOUR POWDER.

## MIXING OF POWDER

Powder mixing is a step by step operation with the most dangerous step (the adding of the oxidizing agent potassium chlorate) reserved for last for obvious safety reasons. Powder should be mixed in small quantities using only paper or cardboard to contain and mix. Any procedure that might produce a spark or friction is to be avoided.

All ingredients are measured by weight.

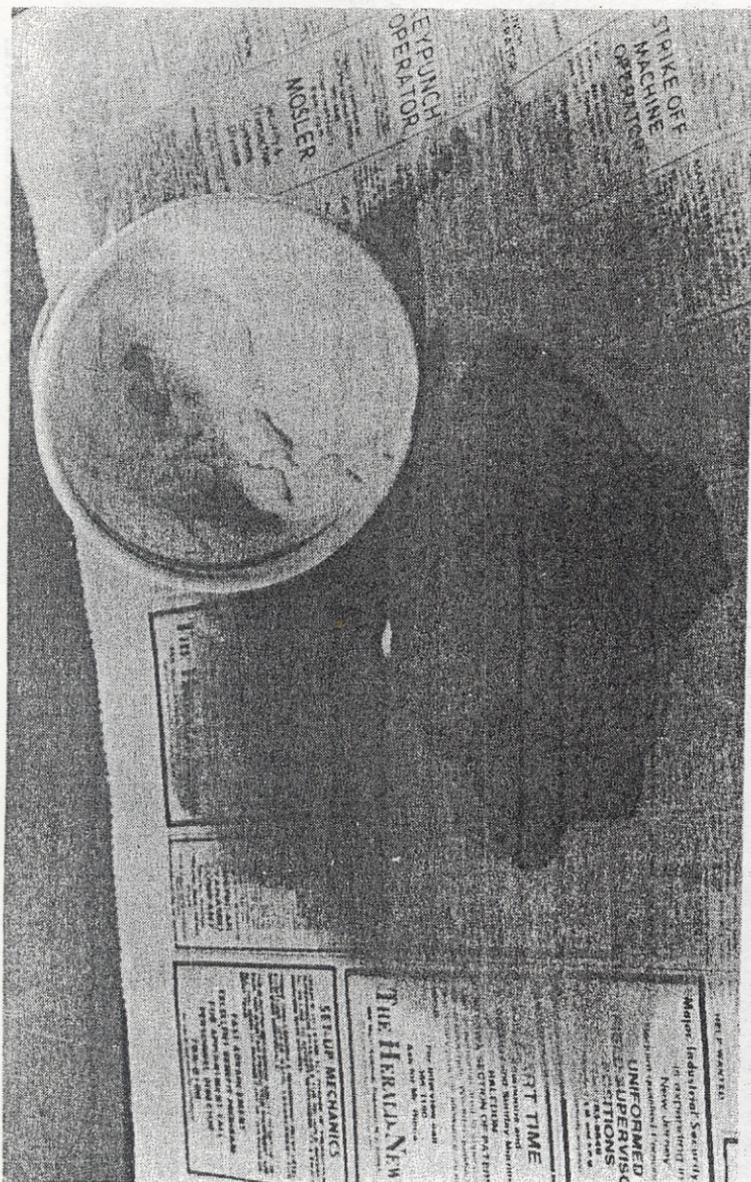
Begin mixing by weighing the proper amount of sulfur and screening it through a fine mesh kitchen strainer onto a sheet of newspaper. Now add the correct amount of pyro aluminum to the sulfur and mix throughly until a fine blend is obtained.

Now, CAREFULLY, add the correct amount of potassium chlorate only after screening it through the fine mesh kitchen strainer to insure its being fine grain enough to mix well with the sulfur and pyro aluminum.

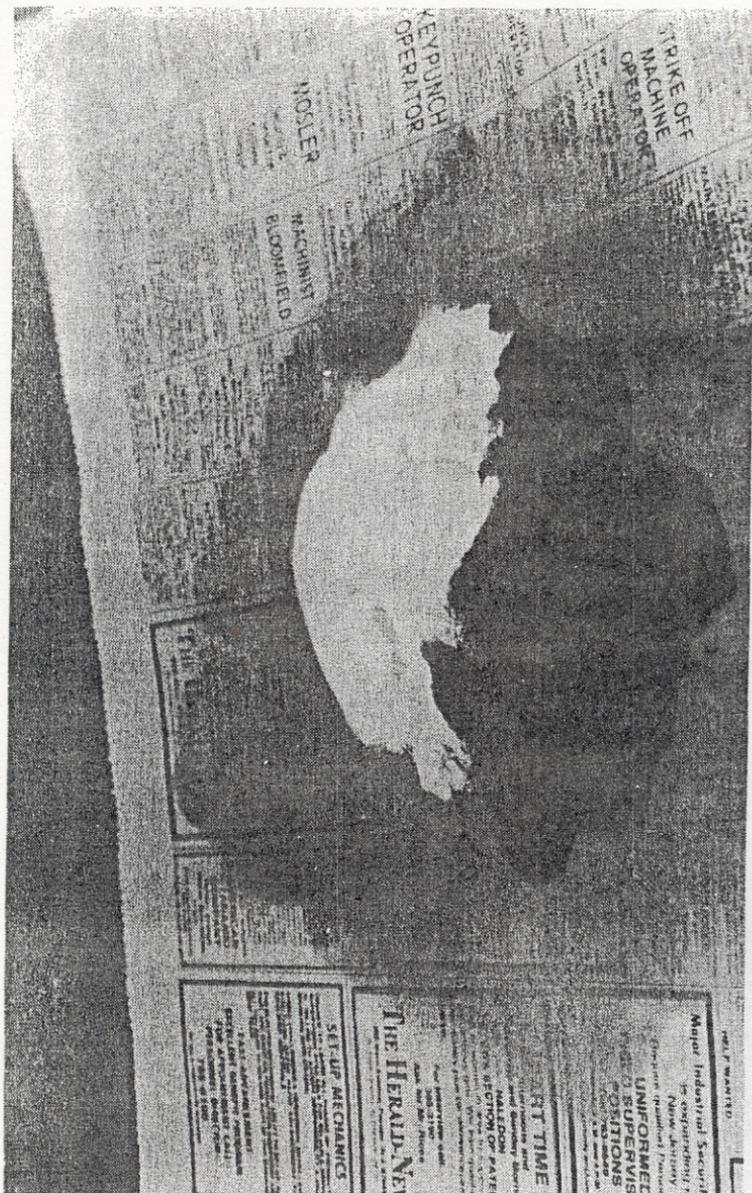
Mixing the three ingredients is SAFELY accomplished by picking up the sheet of newspaper containing them and rolling the mixture by first elevating one side of the paper then the other. Continue this for about ten minutes until you have a fine, well mixed mixture. Remember, at all times during the mixing process there should be no friction or spark producing materials used!



BEFORE MIXING ANY OF THE POWDER COMPONENTS TOGETHER EACH SHOULD BE SIEVED TO BREAK UP ANY LUMPS THAT MIGHT EXIST.

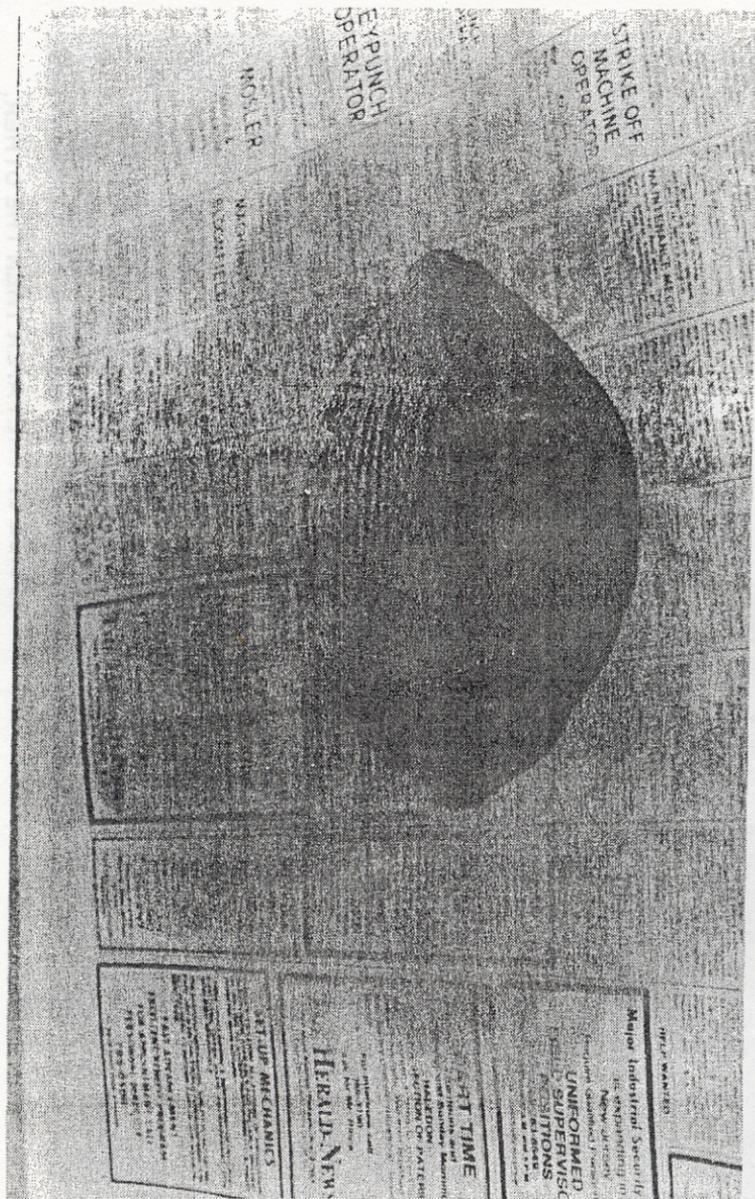


THE SULFUR AND PYRO ALUMINUM HAVE BEEN THOROUGHLY MIXED AND NOW WE ARE READY TO ADD THE POTASSIUM CHLORATE.



CAREFULLY POUR THE POTASSIUM CHLORATE ONTO THE SULFUR/ALUMINUM MIXTURE.





CONTINUE THE MIXING PROCESS FOR APPROXIMATELY 10 MINUTES OR UNTIL THE INGREDIENTS ARE THOROUGHLY MIXED.

## MAKING CASES FROM SCRAP CARDBOARD

The cardboard used for fireworks casings is the type of cardboard found in cereal boxes, pizza boxes, cracker boxes and other similar type containers. If you examine this cardboard carefully you will notice that it has a "grain." Like wood it will bend or form easier by rolling with the grain.

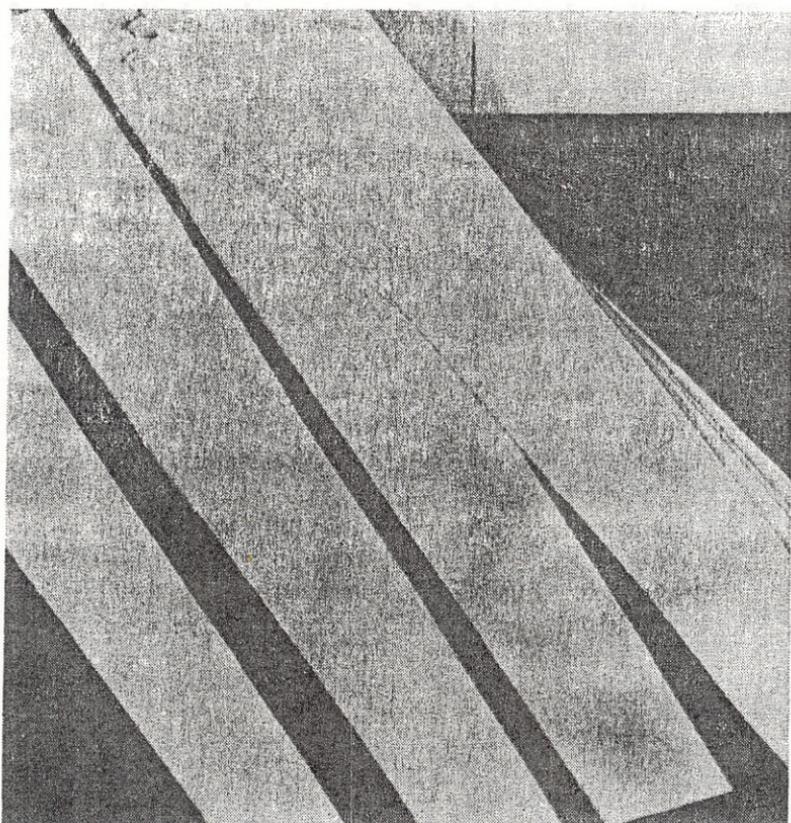
In making the various fireworks described in this book you will be cutting various width strips of cardboard to form the casings. The width of these strips will correspond to the length of the casing desired. The length of these strips will vary according to the thickness of cardboard used and will have to be determined by trial and error. Each type of salute described will refer to a casing size by the I.D., O.D., and length. The I.D. (inside diameter) is determined by the former or dowel used. The O.D. (outside diameter) is determined by how much cardboard is rolled up to form the casing.

With the former or dowel desired, roll up a strip of the cardboard you have selected to use until the O.D. of the casing equals that called out in the instructions. Unroll this strip and measure the length. If you continue to use the same thickness cardboard then you can pre-cut your strips to the same length.

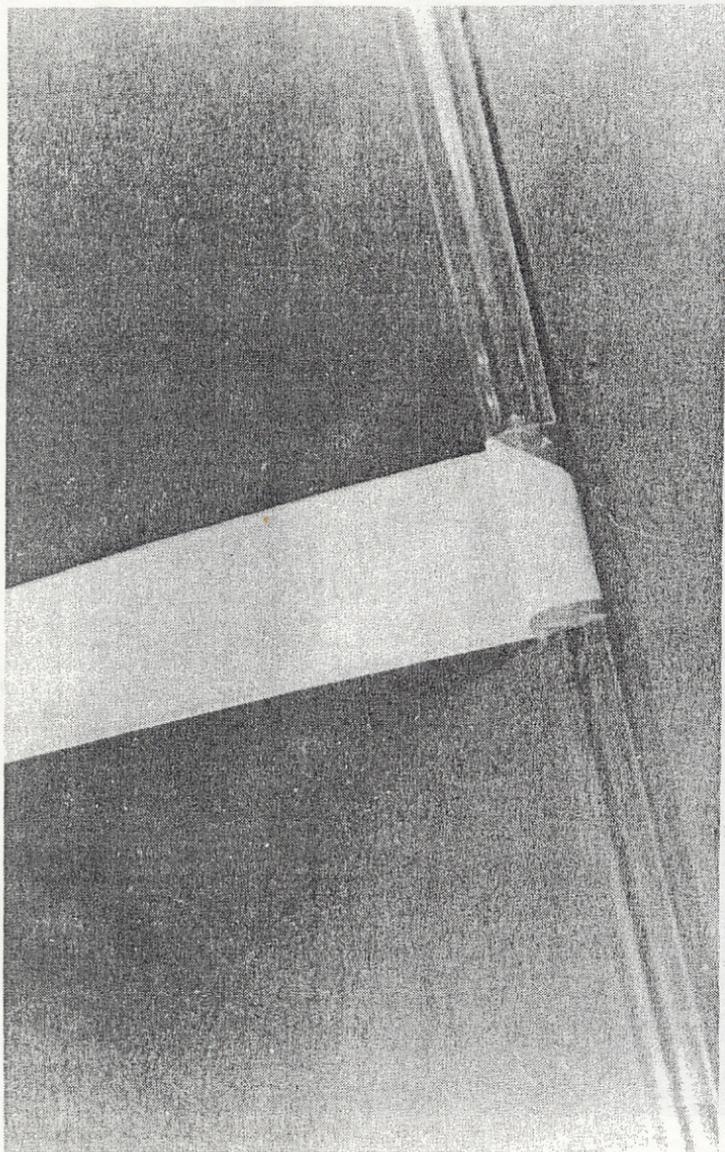
Begin forming a casing by tightly rolling the first roll with adhesive applied to edge. Continue to tightly roll and secure the last edge with adhesive. Remove casing from former and set aside to thoroughly dry. If your cardboard has a slick surface with printing on it then you might wish to peel off approximately 2 inches from each end for better adhering of the adhesive.

**NOTE:** The stronger the casings the louder the "report" of salutes. Therefore, your casings should be well made with the fuse and end plugs well secured.

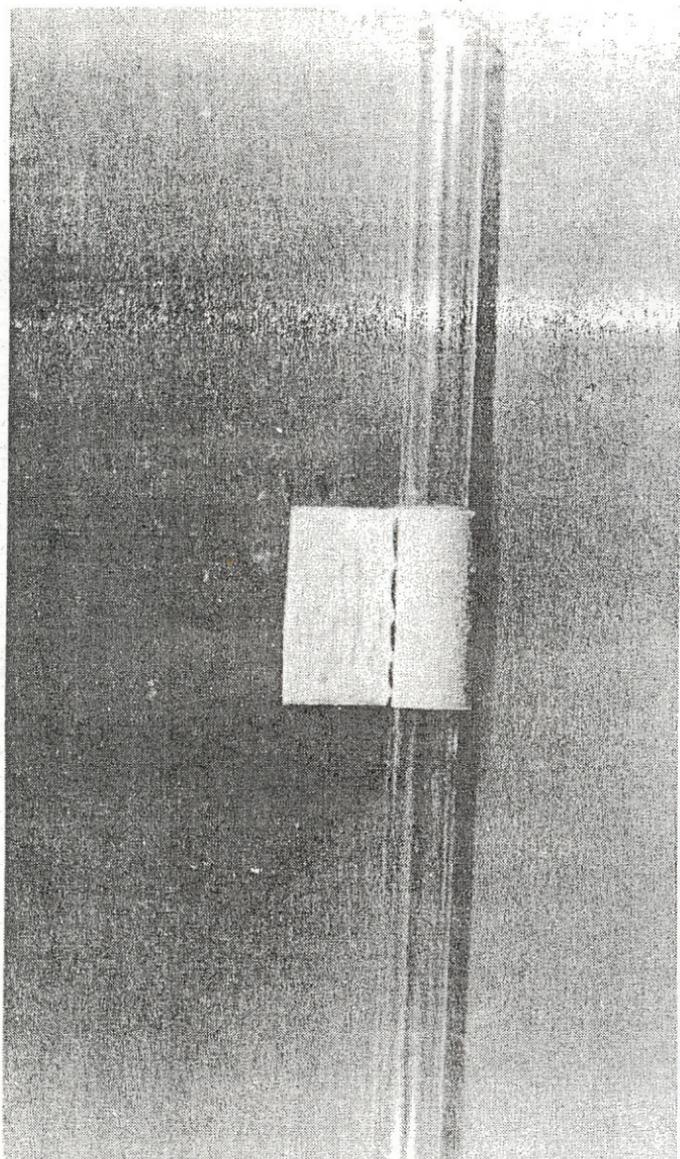
**CAUTION:** Use only cardboard and paper for making casings and end plugs. DO NOT use metal, wood, glass, or any substance that might become a "missile" and inflict injury.



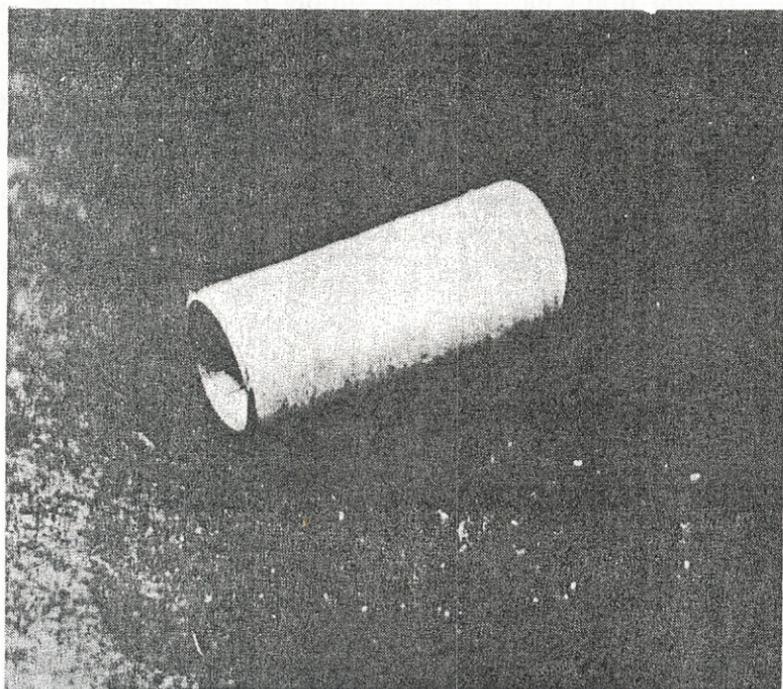
CARDBOARD STRIPS READY TO BE ROLLED INTO CASES. A LARGE PAPER CUTTER MAKES EASY WORK OF THIS. IF YOU DON'T HAVE ONE THEN CUT WITH SCISSORS BY FOLLOWING DRAWN LINES. FOR THE ECOLOGY MINDED THIS IS A GREAT WAY TO RECYCLE WASTE PAPER AND CARDBOARD. IF YOU ARE NOT ECONOMY MINDED YOU CAN BUY CASES READY MADE. SEE LIST OF SUPPLIERS ON PAGE 44.



A STRIP OF CARDBOARD IS TIGHTLY ROLLED AROUND A FORMER.



ELMER'S GLUE IS APPLIED TO THE LAST 1 INCH AND ROLLING IS COMPLETED.



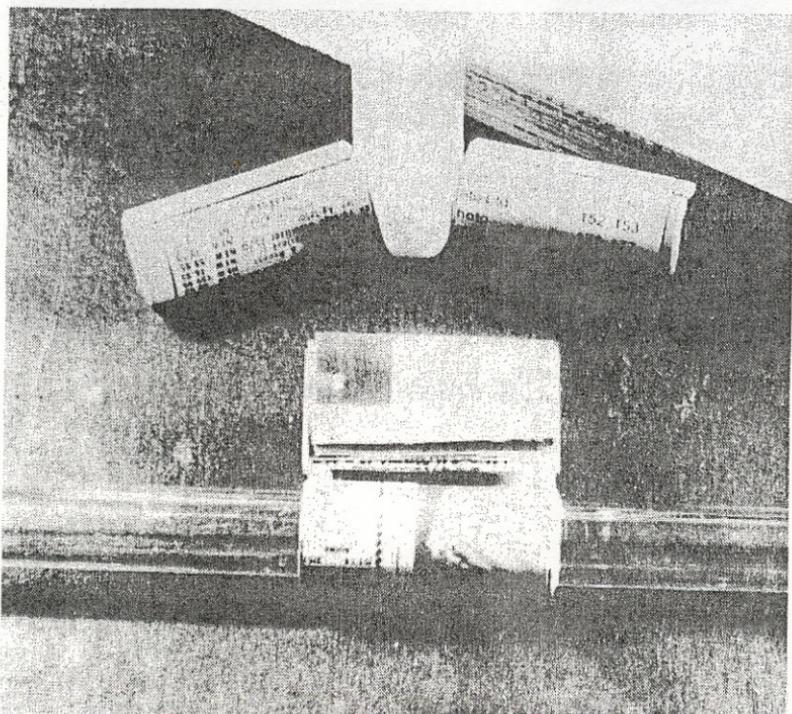
A FINISHED CASE

## MAKING CASES FROM SCRAP PAPER

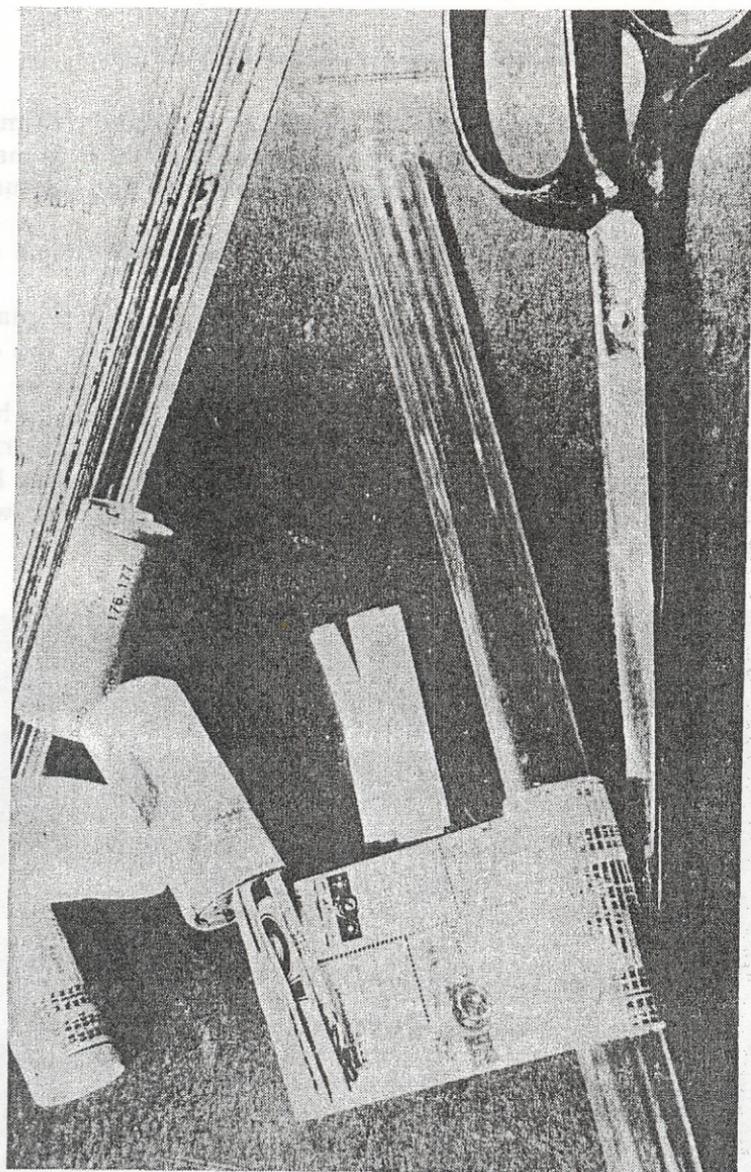
If you don't have a ready supply of scrap cardboard as previously mentioned you might wish to use scrap paper such as found in old magazines.

Cases are rolled the same as before only we use 5 or 6 sheets for more thickness. These strips are rolled until the proper O.D. is obtained.

The major difference now is, unlike when using cardboard, the 5 or 6 strips of magazine are folded under the last inch or so before gluing. This allows one glue joint to secure all 5 or 6 strips.



PROCEDURE IS SIMILAR TO CARDBOARD EXCEPT SEVERAL THICKNESSES ARE ROLLED AT ONE TIME AND END IS FOLDED UNDER BEFORE GLUE IS APPLIED AND FINAL ROLLING COMPLETED.



EXCEPT FOR THE ENDS THE INDIVIDUAL SHEETS NEED NOT BE GLUED TOGETHER.

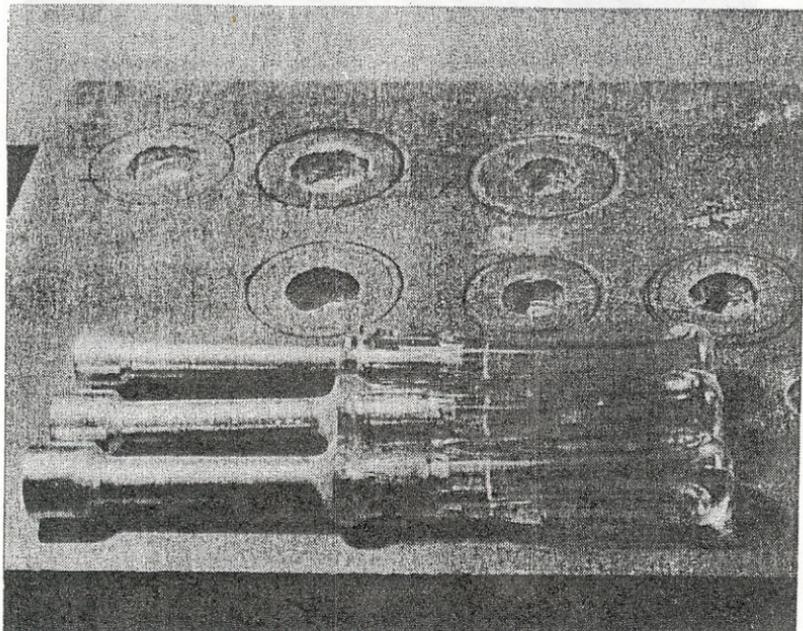
## MAKING A DIE TO FORM END PLUGS

The die or tool that we are about to describe is made from wood. If available, a piece of hardwood such as maple could be used. However, for economy's sake you can use a small piece of 3/4 inch particle board.

If you or a friend have the facilities a set of punch and dies could be machined from metal.

Since our end plugs will have to have an O.D. to match the I.D. of our casings that means the die to form the end plugs must have holes in it to correspond to these O.D.'s.

The punch diameter should be less than that of the hole by approximately 1/16 of an inch. You may use a nut driver of the right size or select a piece of wooden dowel. If a dowel is used both it and the hole can be "adjusted" with sandpaper if necessary.



NOTE: CIRCLES ARE DRAWN AROUND HOLES FOR EASE OF CENTERING PAPER DISCS.



ORDINARY GROCERY SACKS ARE CUT INTO DISCS OF APPROPRIATE SIZE.

## HOW TO MAKE END PLUGS

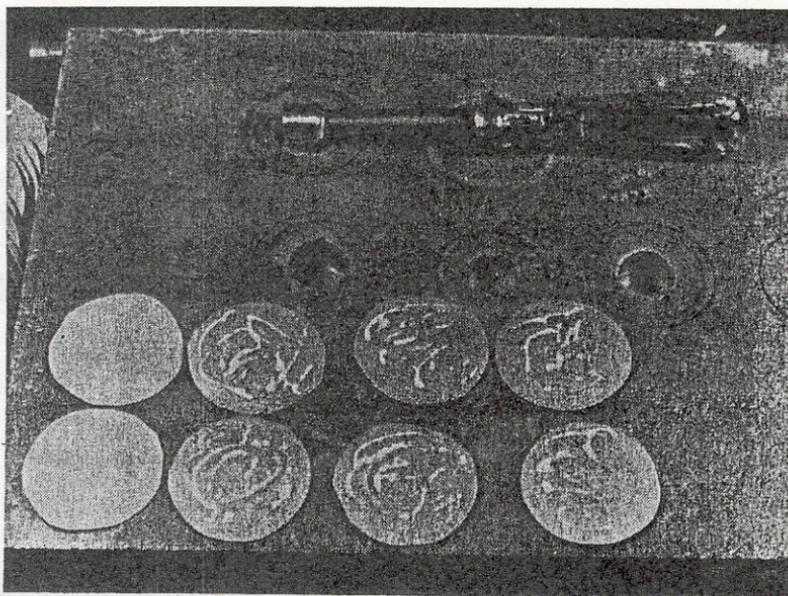
The end plugs shown in this book are made from kraft paper as found in grocery sacks. Cut and flatten the sacks out and by using a compass or a round templete draw circles of the size desired on the paper. With scissors, cut out the circles one at a time or by stacking more than one sheet you can save time in cutting. Again, as with the forming die, if you or a friend have the facilities, hard tooling could be made to blank out the disks.

The fireworks described in this book use two sizes of Kraft paper discs —  $1\frac{1}{4}$  in. diameter and  $1\frac{1}{2}$  in. diameter

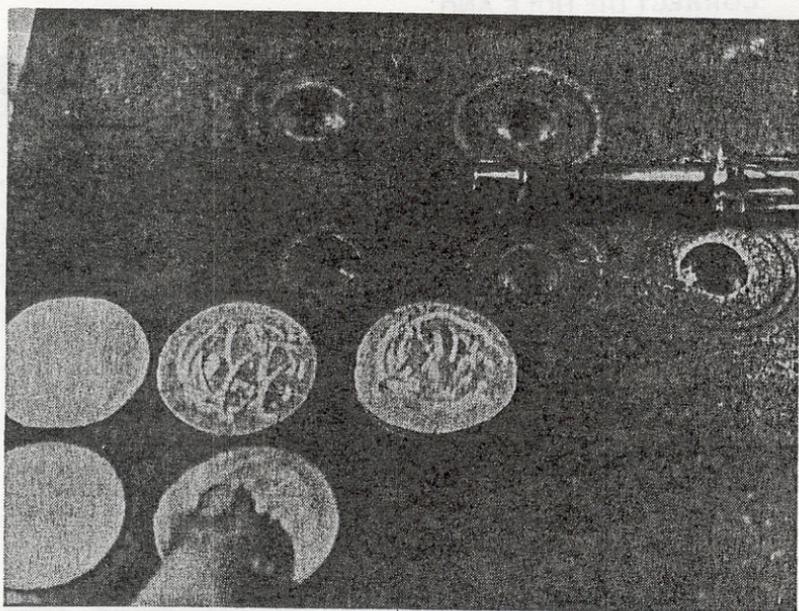
After a sufficient quantity of discs are cut out you are ready to form your end plugs. Glue 4 discs together with Elmer's glue, press flat and roll with a piece of large wooden dowel. Immediately press this on the die block, center over the correct hole and press in with a nut driver or correct size dowel. Remove and set aside to dry. This is a completed end plug.

Kraft paper discs  $1\frac{1}{4}$  in. diameter are used for the Thunderbolt salutes and  $1\frac{1}{2}$  in. diameter discs are used for the Super Thunderbolt Salutes and both sizes of Kraft Salutes (Cherry Bombs).

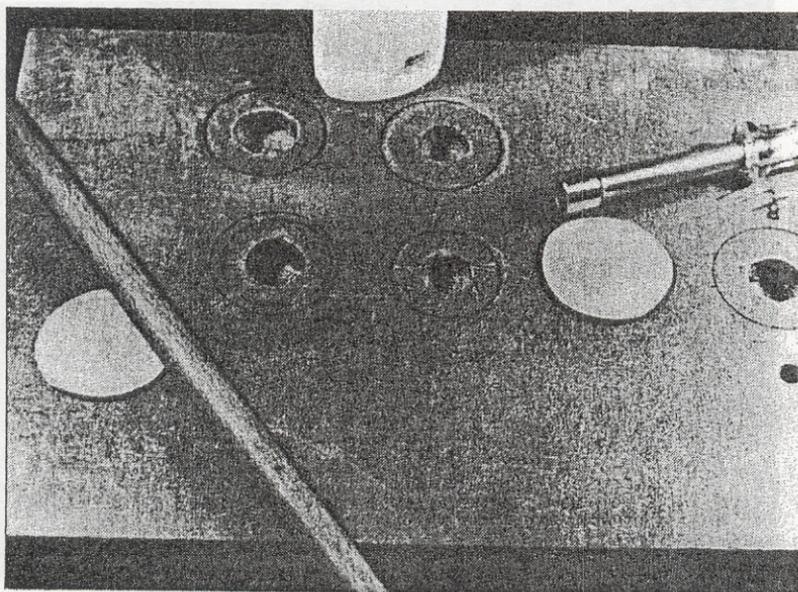
The O.D. (outside diameter) of end plugs used in this book are  $\frac{3}{8}$ ,  $\frac{1}{2}$ ,  $\frac{5}{8}$ ,  $\frac{11}{16}$  &  $\frac{3}{4}$ .



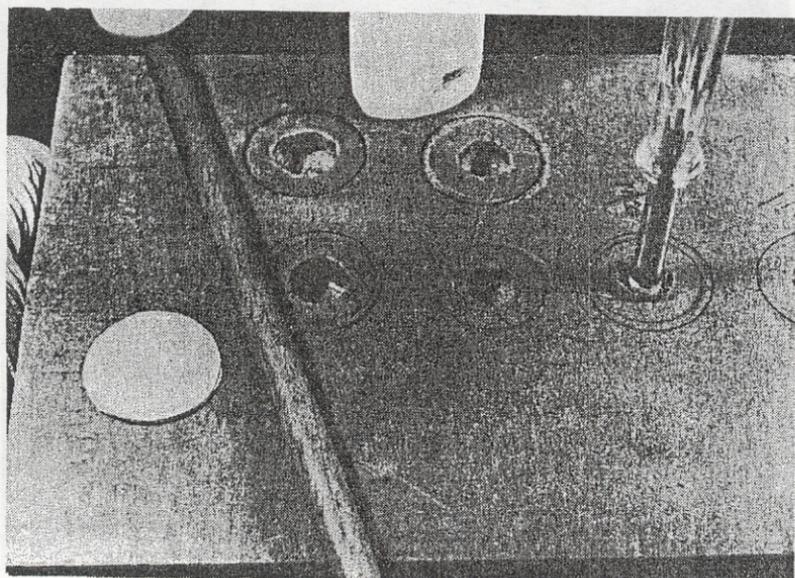
APPLY ELMER'S GLUE THUSLY. ....



..... AND BUILD UP A SET OF FOUR DISCS.



BEFORE THE GLUE SETS UP CENTER DISC AROUND THE  
CORRECT DIE HOLE AND .....



..... PUSH INTO HOLE AS ABOVE.



A PILE OF COMPLETED END PLUGS. AS WITH CASES  
END PLUGS CAN, ALSO, BE PURCHASED READY MADE.

## HOW TO MAKE SUPER THUNDERBOLT SALUTES

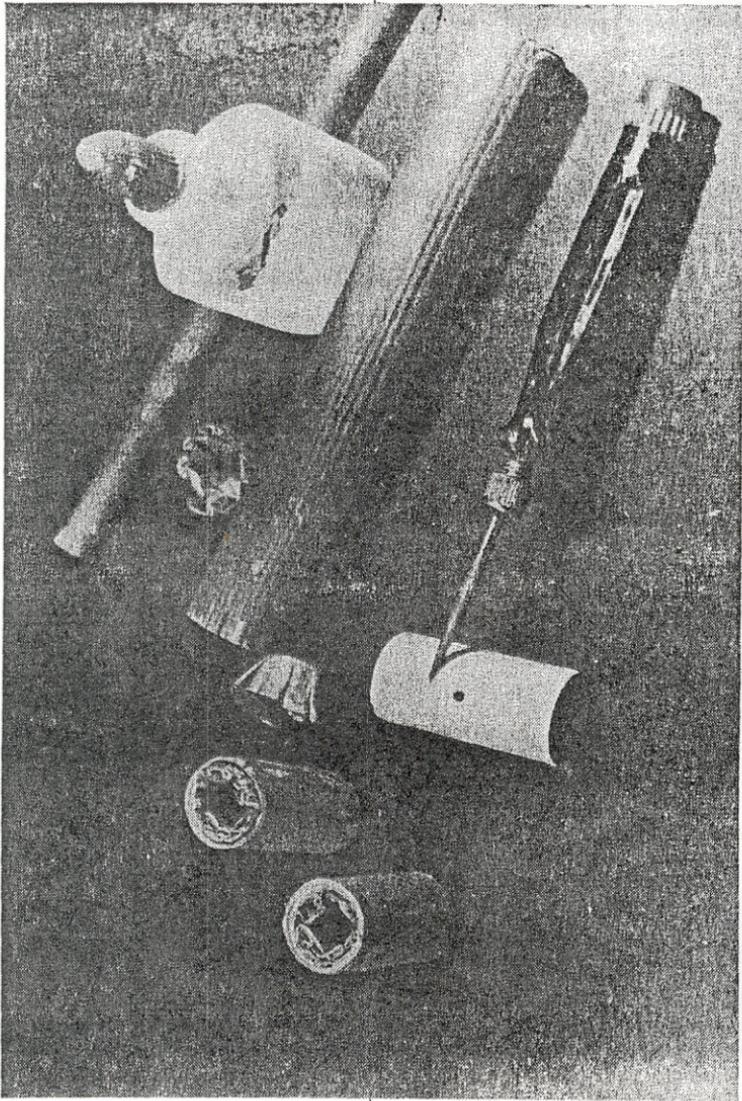
The case measurements for this one are  $\frac{5}{8}$  in. I.D. X  $\frac{3}{4}$  in. O.D. X  $1\frac{3}{4}$  in. long.

Select a previously prepared case this size. Apply adhesive to the O.D. of a  $\frac{5}{8}$  in. end plug and insert into one end of the casing. With an awl or a sharpened nail pierce a hole in the side of the casing to accept the fuse. Insert the fuse into the casing and secure with a dab of adhesive.

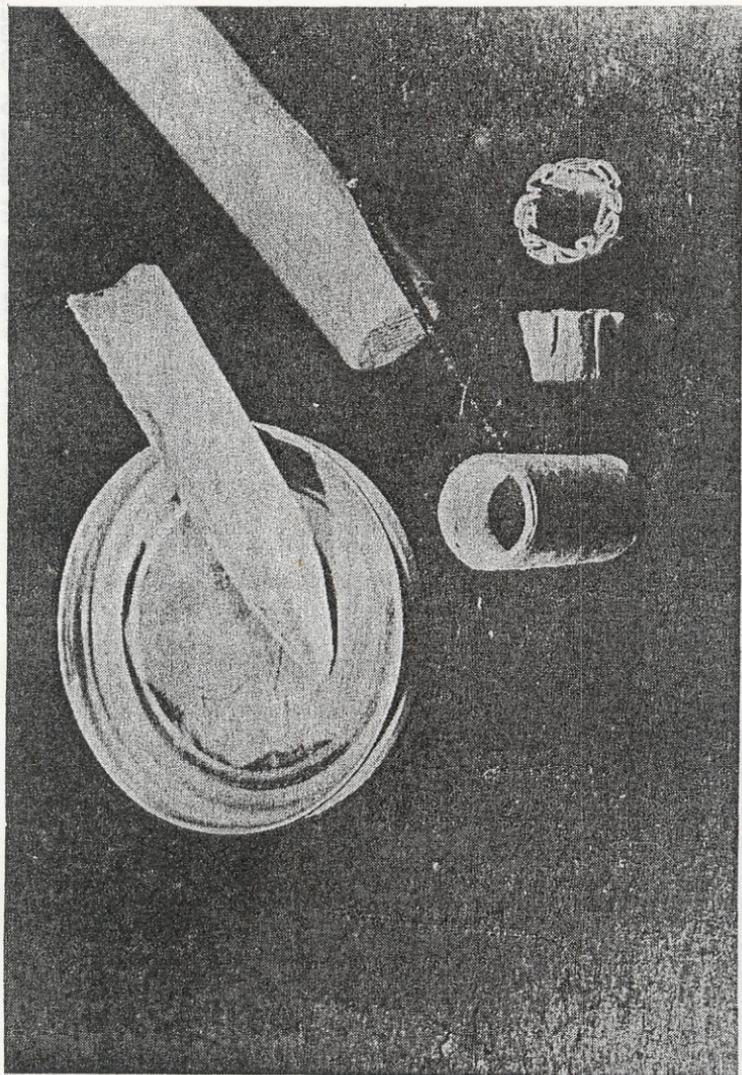
We now have a casing ready to be charged with powder. With a cardboard spoon carefully load the casing until it is about  $\frac{1}{3}$  full of powder. NOTE: Never fill the casing to the point where the remaining end plug will compress the powder when inserted fully.

Apply adhesive to the O.D. of the remaining end plug and insert into the open end of the casing thus captivating the powder. Set the salute aside to dry.

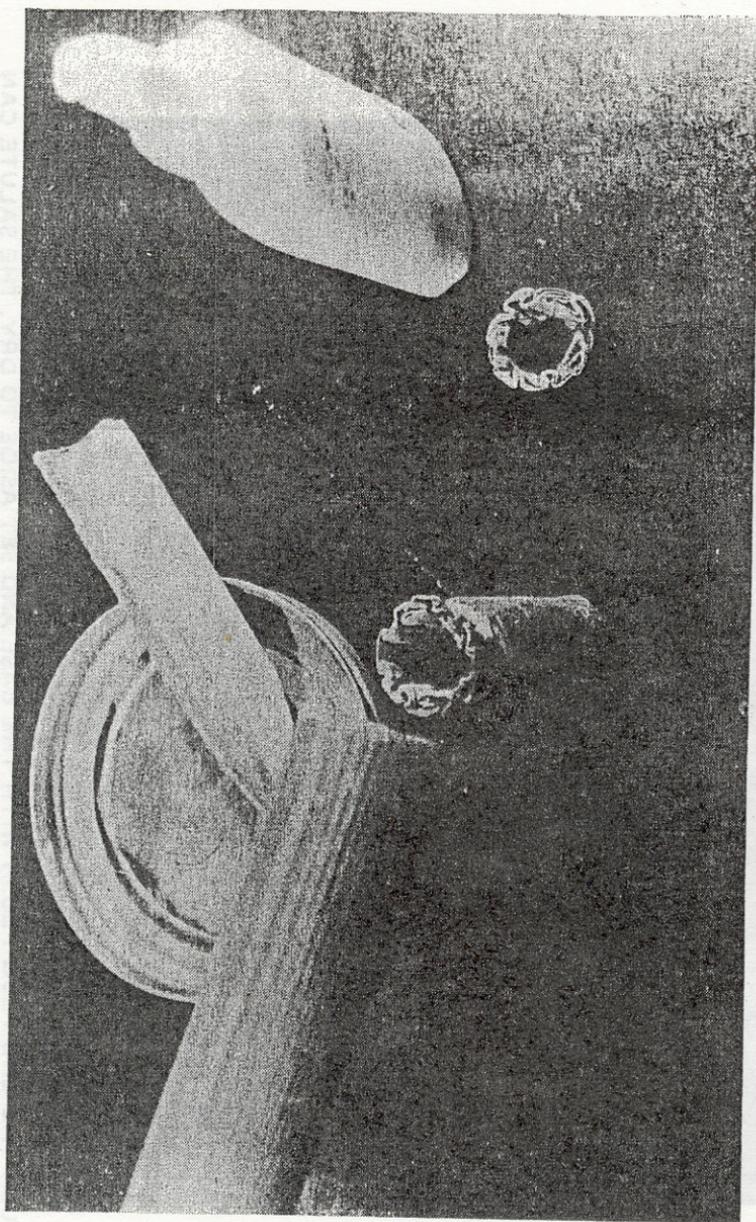
The finished salute can have a decorative covering of aluminum foil or colored paper (such as gift wrapping paper) applied by cutting a 3 in. square piece, piercing a hole in the center to clear the fuse and applying adhesive to it. Pass this paper or foil over the fuse and form around the casing with your fingers. NOTE: This last step is for decoration only and can be bypassed if desired.



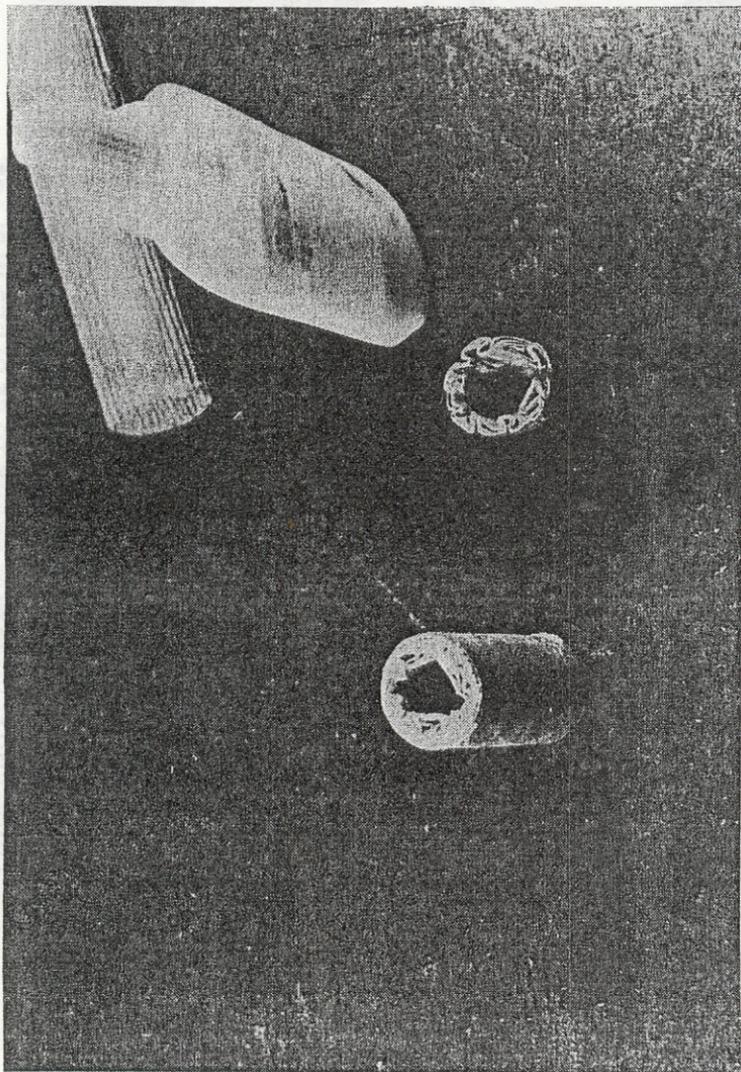
ONE END PLUG HAS BEEN GLUED IN PLACE AND FUSE HOLE PUNCHED IN SIDE OF CASE.



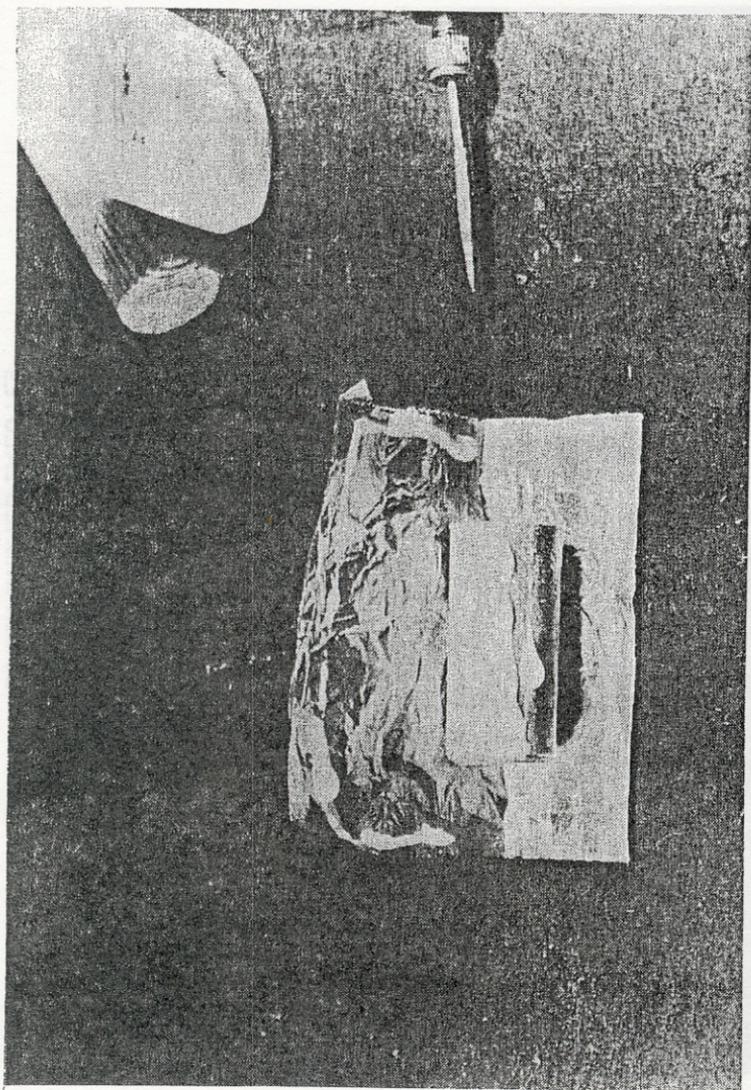
AFTER FUSE HAS BEEN SECURELY GLUED IN PLACE THE CASE IS READY TO BE FILLED WITH POWDER. READ PAGE 3 AGAIN!!!



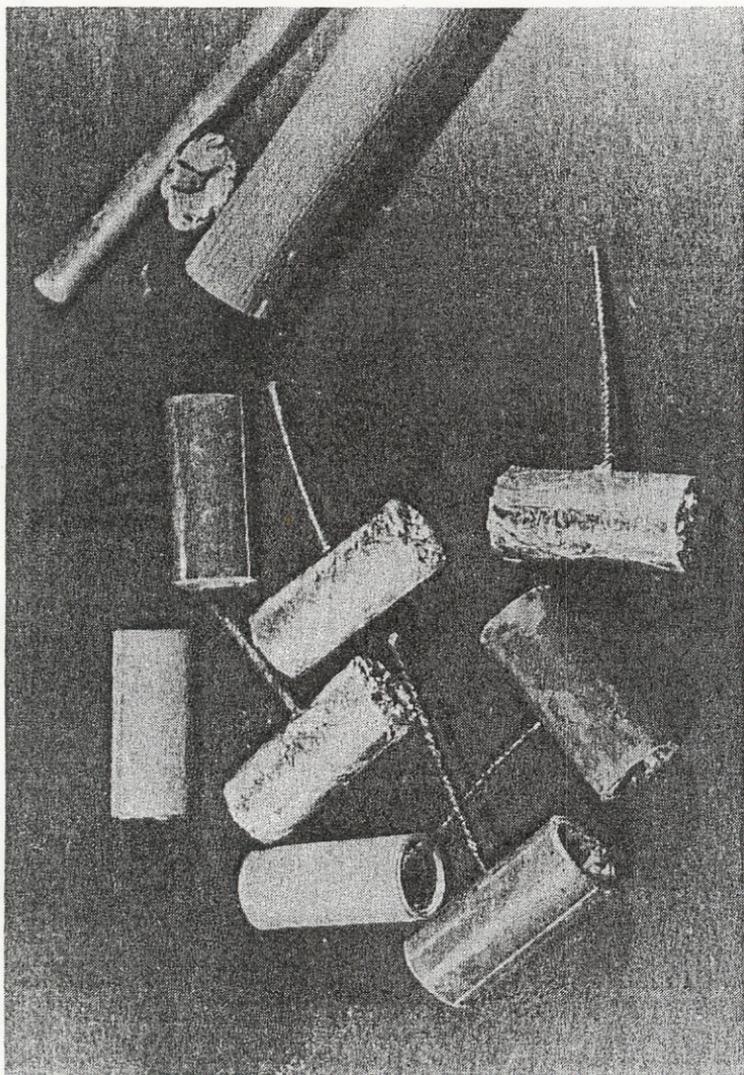
FINAL END PLUG IS NOW READY TO BE GLUED IN PLACE.



PUSH THE END PLUG FLUSH WITH THE CASE AND SET ASIDE TO DRY. THE SALUTE CAN BE USED "AS IS" OR COVERED WITH ALUMINUM FOIL OR OTHER DECRATIVE COVERING.



ALUMINUM FOIL IS GLUED ON THIS SALUTE. BRIGHT COLORED WRAPPING PAPER COULD BE USED, ALSO.



SOME FINISHED SALUTES

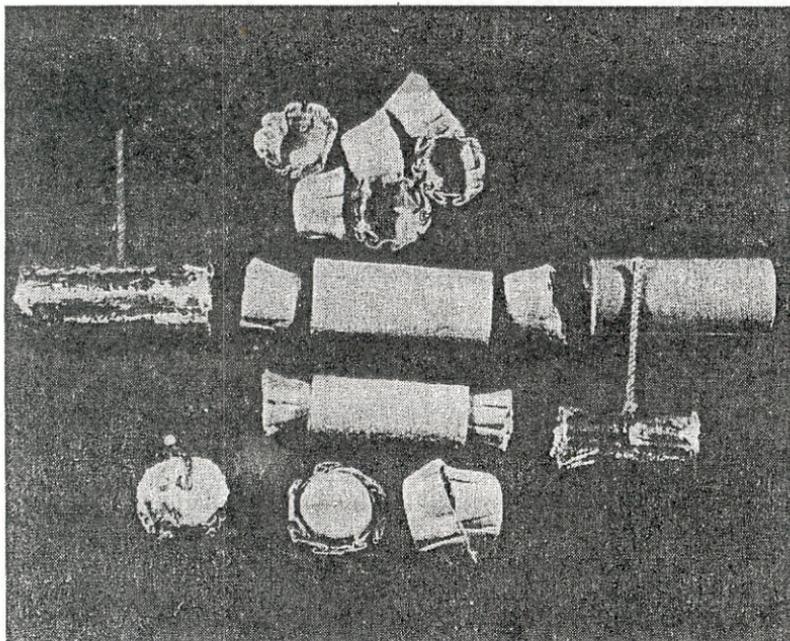
## HOW TO MAKE THUNDERBOLT SALUTES

The case measurements for this one are  $1/2$  in. I.D. X  $5/8$  in. O.D. X  $1\ 1/2$  in. long. The end plugs used are  $1/2$  in. O. D.

Other than being physically smaller this salute is identical to its big brother the Super Thunderbolt Salute.

## HOW TO MAKE MINIATURE SALUTES

The baby of the Thunderbolt family is this miniature whose casing measures  $3/8$  I.D. X  $9/16$  O.D. X  $1\ 1/2$  long and uses a  $3/8$  O.D. end plug. Other than its small size it is identical in construction to Thunderbolts.



SOME VARIOUS SIZE SALUTES

## HOW TO MAKE KRAFT SALUTES

Better known through the years as "Cherry Bombs," these salutes didn't find the popularity among the homemade fireworks buffs as other types of fireworks. This may have been largely due to the case being difficult to make.

On the following pages we are going to show you how to make such casings by simply using two large end plugs. The O.D.'s of these two plugs should differ by 1/16 in. to allow one to telescope over the other.

For a regular size Kraft Salute use on 5/8 in O.D. and one 11/16 in. O.D. end plug. Filler the smaller one 1/3 full of powder. Apply adhesive to the inner lip of the larger end plug and place it down over the smaller one capturing the powder. With your fingers form the outer plug onto the inner one to better adhere them together. When dry punch a fuse hole in the smaller end plug. Punch it a little on the small side so that the fuse is held in rather snugly.

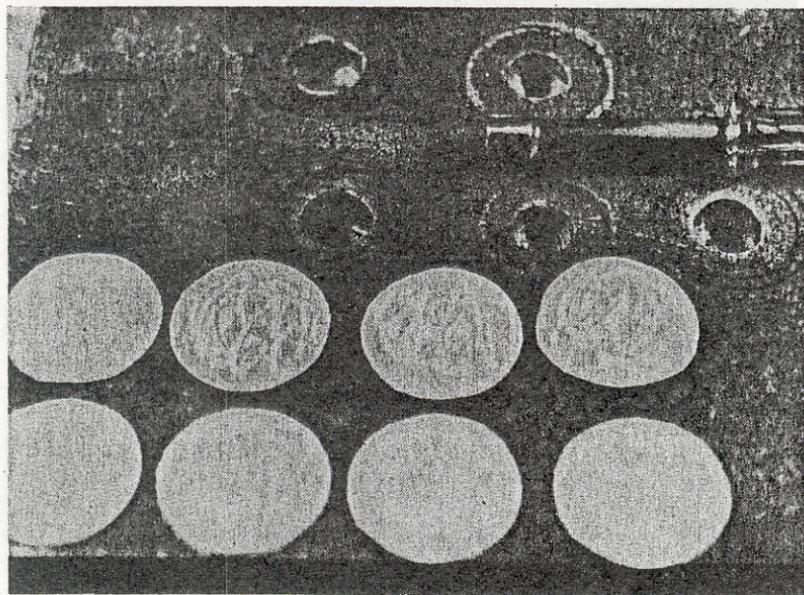
Push the fuse in until it touches bottom and secure it with a dab of glue where it enters. While this is drying prepare a 3 inch square piece of aluminum foil with a fuse clearing hole in the center.

Holding the salute by the fuse dip the entire body into a container of Elmer's glue. Allow the excess to drip off then insert the fuse through the hole in the foil and form it around the casing with your fingers and set aside to dry.

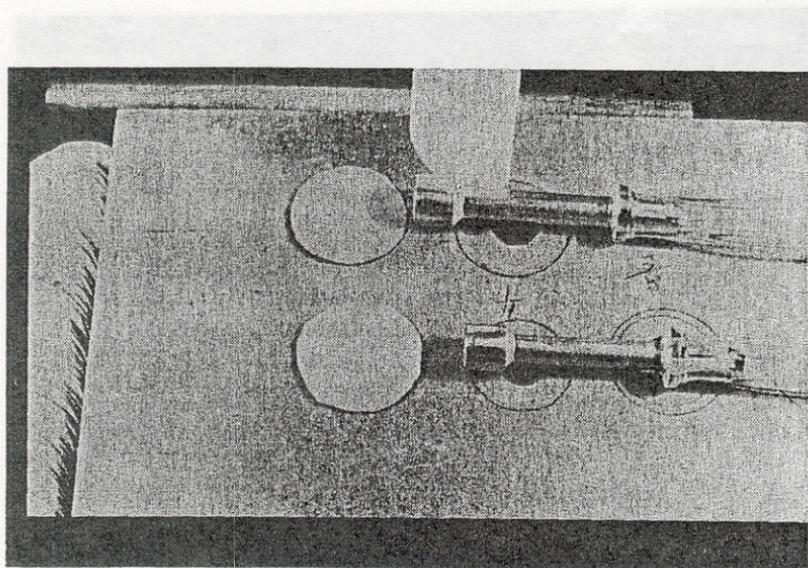
## HOW TO MAKE SUPER KRAFT SALUTES

These larger size "Cherry Bombs" are identical to the regular size ones except an 11/16 in. O.D. is used as the smaller with a 3/4 in. O.D. end plug fitted over it. This larger case naturally holds more powder and produces a louder report.

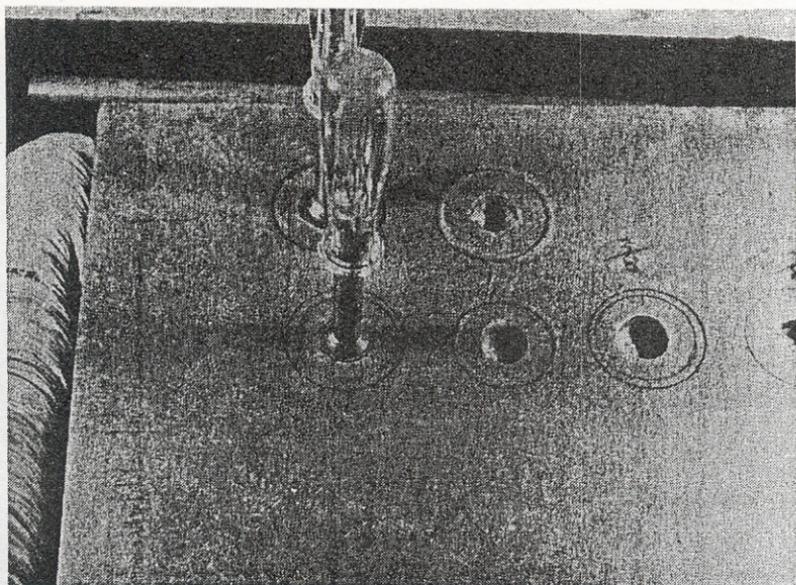
The remaining construction procedure is the same as for the regular size one.



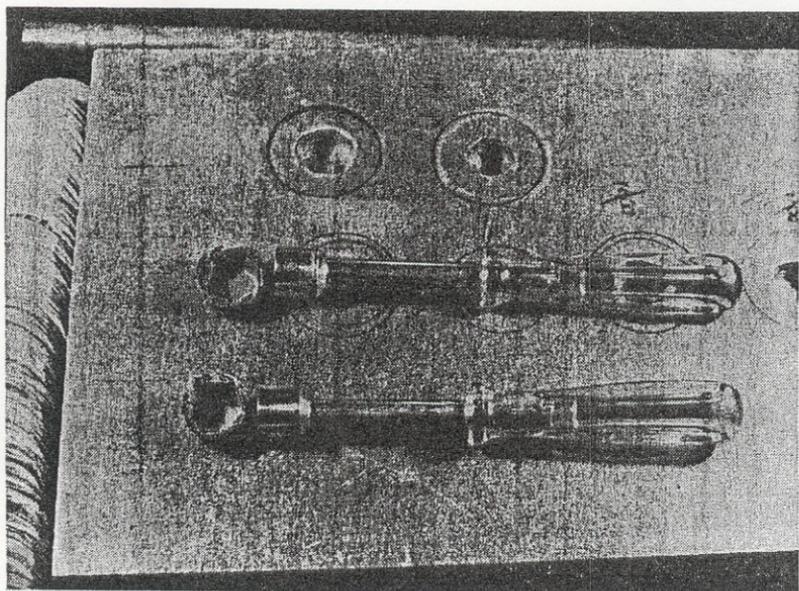
LAY OUT 2 DIFFERENT SIZE END PLUGS. . . . .



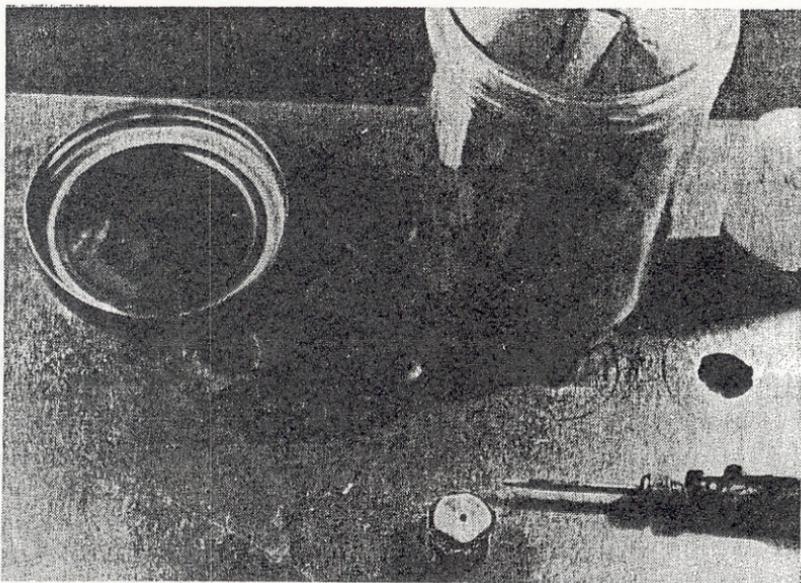
. . . . CONTINUE FORMING BEFORE GLUE SETS UP. . . . .



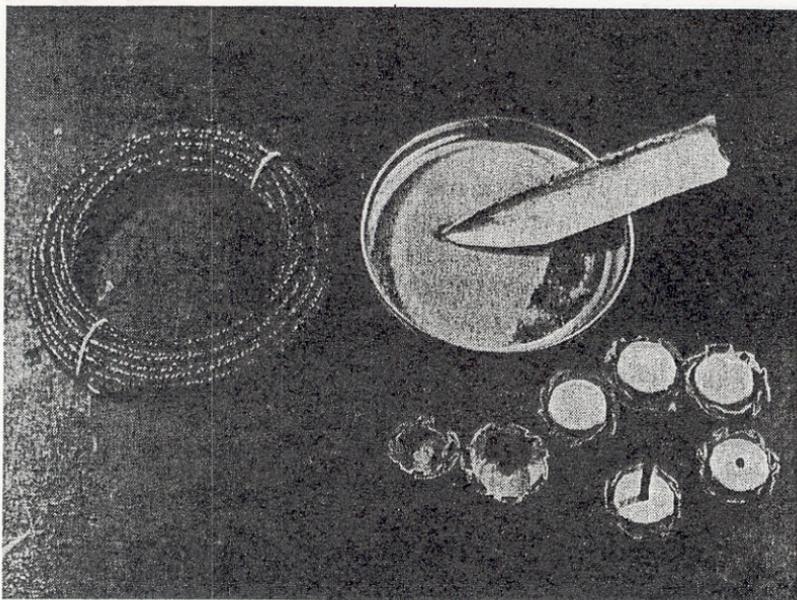
..... PUSH INTO 2 DIFFERENT SIZE DIE HOLES .....



..... THUS FORMING 2 HALVES OF A "CHERRY BOMB."



FUSE HOLE IS PUNCHED IN ONE HALF .....



..... THE OTHER IS CHARGED WITH POWDER AND THE TWO HALVES ARE GLUED TOGETHER.

## HOW TO MAKE STICK SALUTES

These are large, conventional looking fireworks with the fuse sticking out the end rather than the side as with the Thunderbolt Salutes.

The casings for these Stick Salutes can be either 1/4 or 3/8 in. I.D. Both are 1 inch O.D. The length can vary from 2 to 6 inches. DO NOT make them any longer than 6 inches as this large size can be very DANGEROUS!

The ends of the 3/8 I.D. case can be closed by two methods: Crimping or by using 3/8 O.D. end plugs.

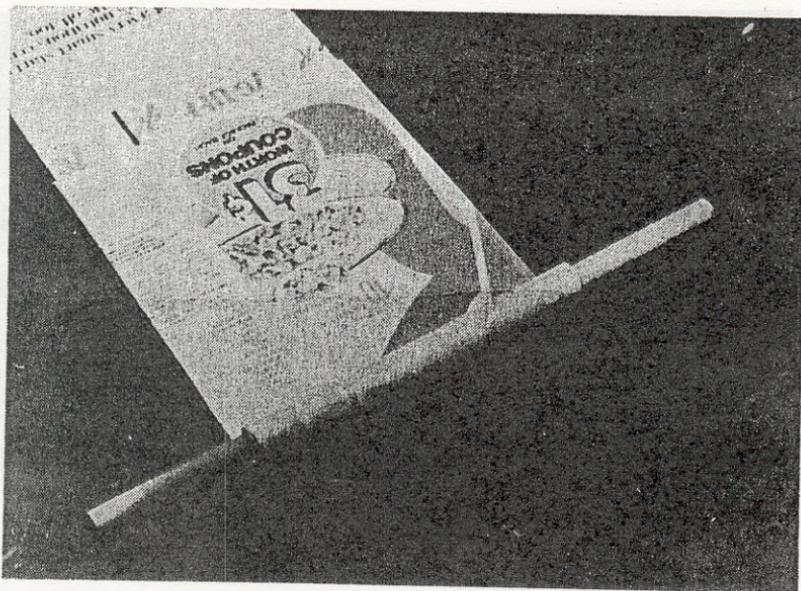
Crimping is accomplished by pushing the inside of the end in with a screwdriver and then applying a generous amount of glue.

Using a paper funnel the case is now filled with powder to within 1/2 inch of the other end. A fuse is installed and this end is also crimped in around the fuse and finally secured with a generous application of glue.

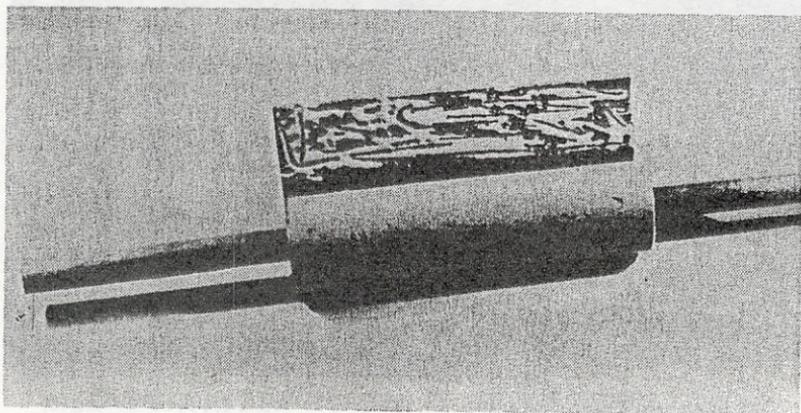
Crimping and filling for the 1/4 in. I.D. cases uses the same procedure as just mentioned.

Closing by using end plugs is very similar to the procedure used on the Thunderbolt Salutes. A 3/8 O.D. end plug is inserted with glue applied to its exterior, pressed flush and allowed to dry. The powder is now loaded as before. The remaining end plug has a fuse hole pierced in it with the awl and a length of fuse is inserted through this hole so that it will protrude internally about 1 inch. This end plug is now inserted with its exterior coated with glue into the casing and pressed flush. Now apply a dab of glue to where the fuse passes through the end plug to secure it. A poorly fitted fuse here can cause a weak report or misfire.

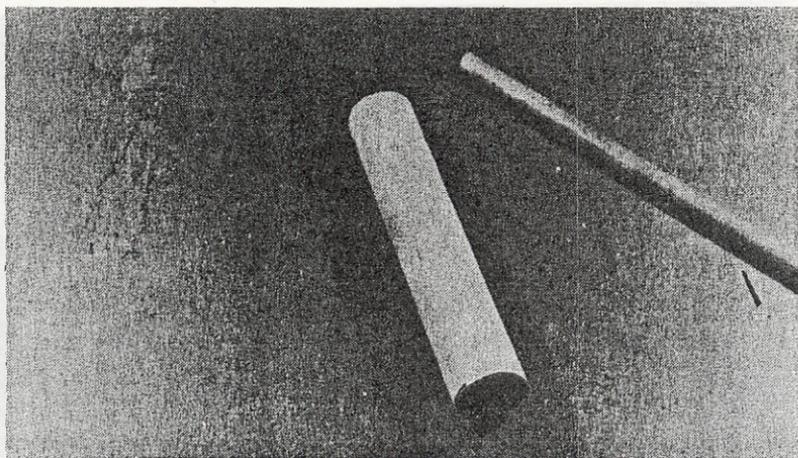
The appearance of these stick salutes can be enhanced by gluing a piece of aluminum foil or colored paper to the outside diameter if you desire.



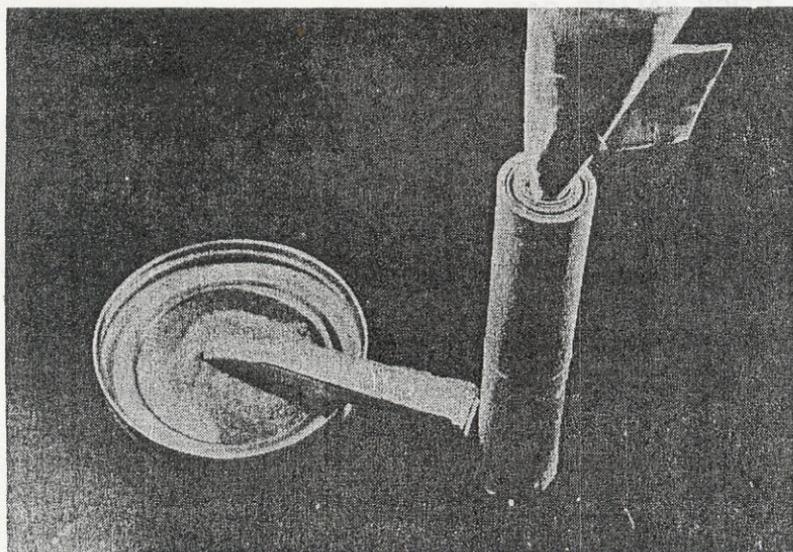
STICK SALUTE CASES ARE MADE THE SAME WAY AS BEFORE ONLY THEY USUALLY HAVE A SMALLER INSIDE DIAMETER AND ARE LONGER.



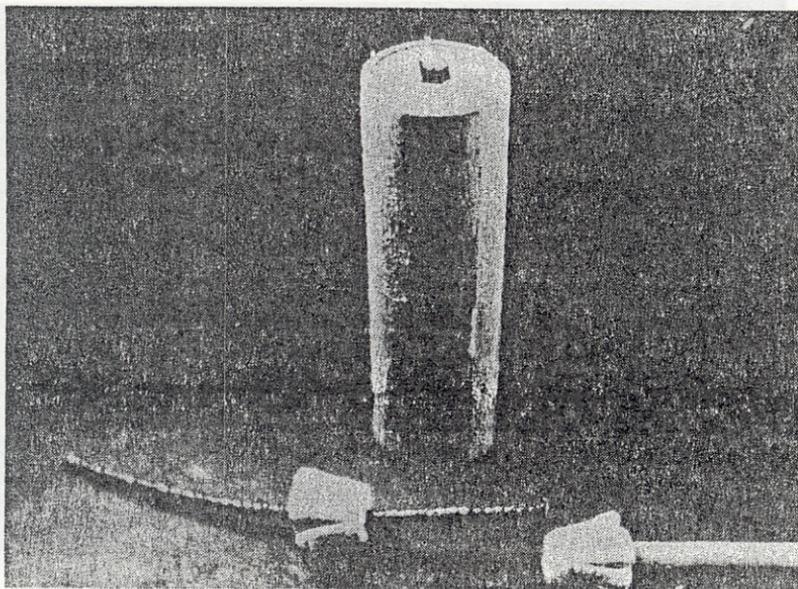
GLUE IS APPLIED TO THE FINAL 1 INCH



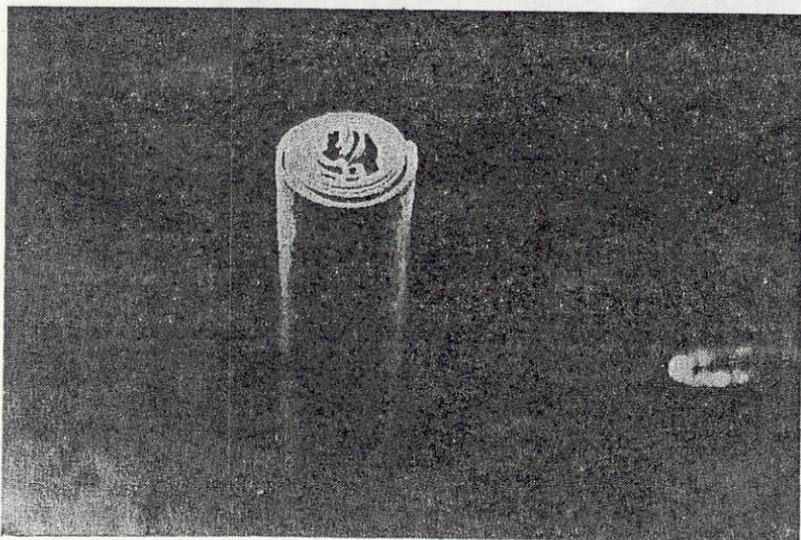
A FINISHED STICK SALUTE CASE



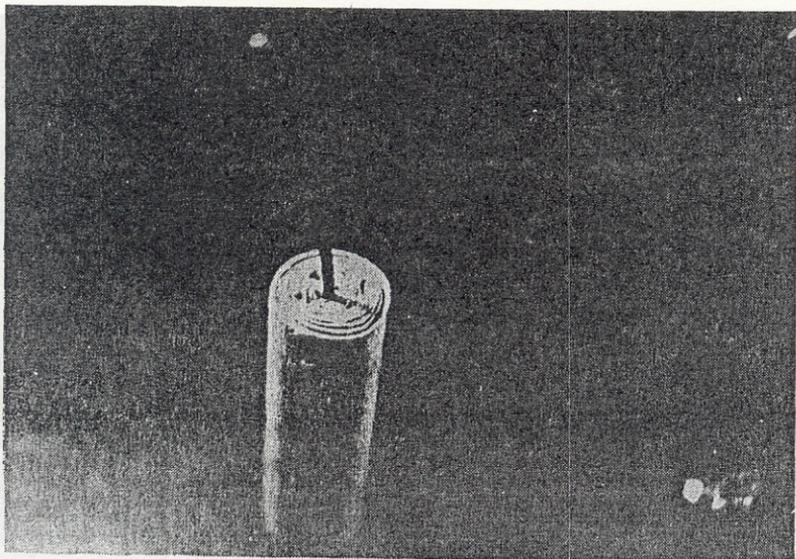
A SMALL PAPER FUNNEL IS USED TO FILL WITH POWDER.  
READ PAGE 3 AGAIN!!!



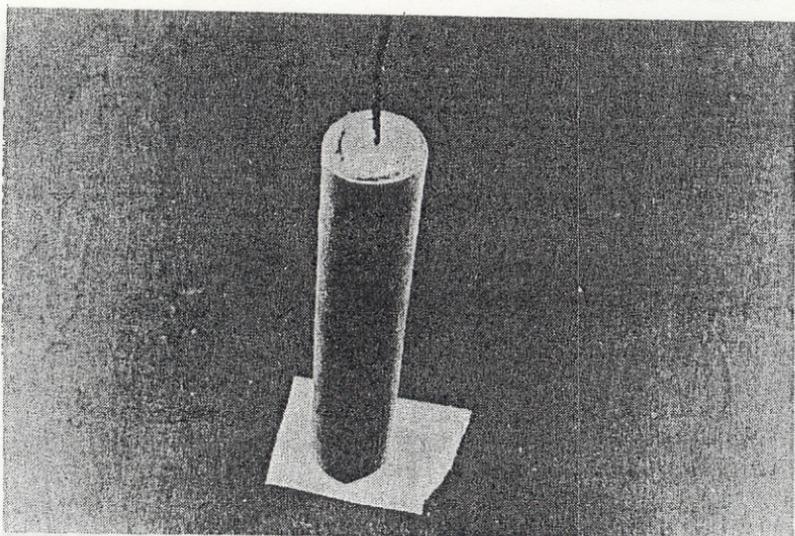
CASES CAN BE CLOSED TWO WAYS. ABOVE: REGULAR END PLUGS ARE USED WITH THE FUSE INSERTED THRU ONE OF THEM.



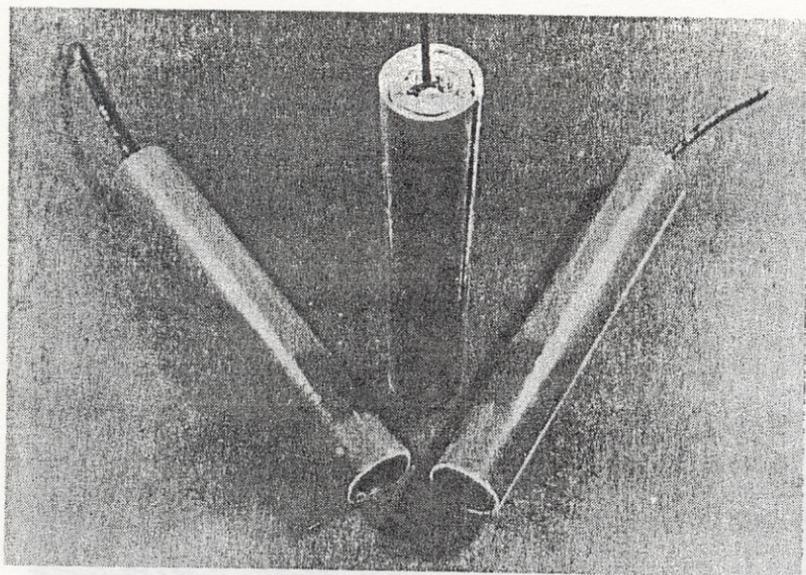
ABOVE: THE CASE IS CLOSED BY INTERNAL CRIMPING AND GLUING.



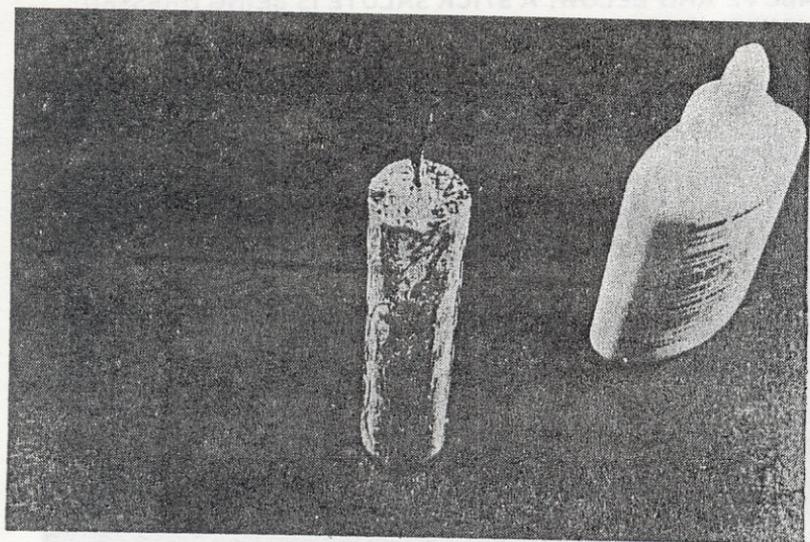
ABOVE: THE FUSE IS INSERTED INTO THE CASE THEN THE CASE IS CRIMPED IN AROUND IT.....



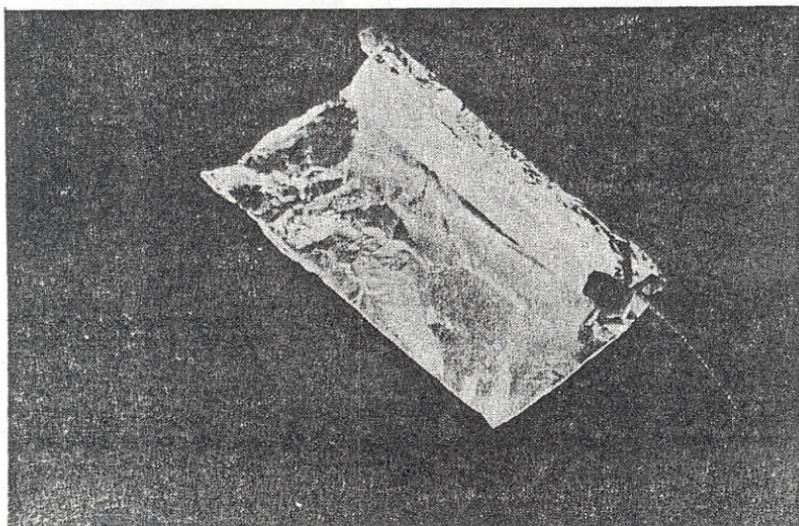
..... AND A GENEROUS AMOUNT OF GLUE APPLIED.



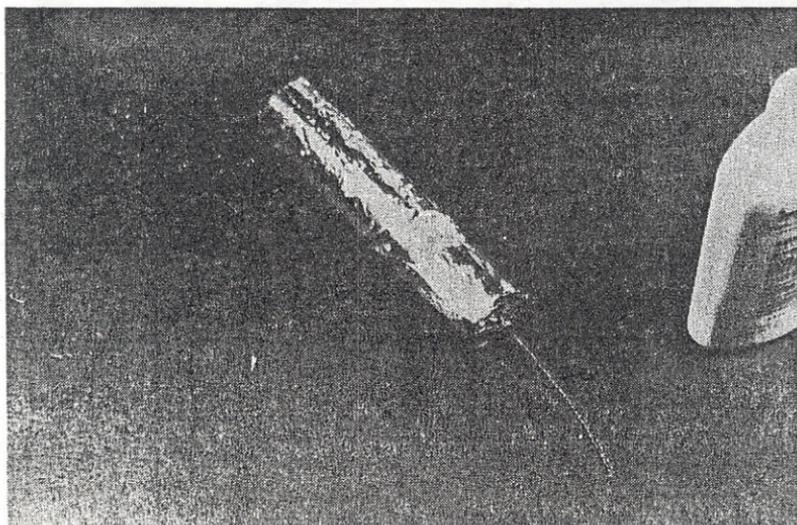
AS WITH REGULAR SALUTES STICK SALUTES CAN BE  
DECORATED WITH PAINT OR .....



..... ALUMINUM FOIL .....



ABOVE AND BELOW: A STICK SALUTE IS BEING DRESSED UP WITH A COVERING OF ALUMINUM FOIL.



## LIST OF SUPPLIES NEEDED

1. Compass or templates to draw circles for end plugs ( $1\frac{1}{4}$  &  $1\frac{1}{2}$  inch diameter).
2. One foot lengths of wooden dowels in the following diameters:  $1/4$ ,  $3/8$ ,  $1/2$ ,  $9/16$  and  $5/8$ .
3. Elmer's Glue.
4. One foot square piece of  $3/4$  in. particle board (to make die for end plugs).
5. Six inch length of broom handle or large wooden dowel (used to press in end plugs).
6. Paper spoons and funnel for loading powder (make from scrap materials).
7. Aluminum foil and colored paper (for decorative outer cover).
8. Ruler, pencil and scissors.
9. Screwdriver (small to medium size).
10. Seven piece set of nut drivers ( $3/16$  to  $1/2$ ).
11. Fine strainer (kitchen variety as shown in photographs on pages 4 and 6).
12. Measuring cup.
13. Scales to weigh powder ingredients (small postage scales).
14. Awl for piercing fuse holes in casings.
15. Wirecutter for cutting fuse.
16. Scrap cardboard (cereal boxes, etc.) and grocery sacks for end plugs.
17. Ingredients for powder (potassium chlorate, pyro aluminum [400 mesh] and sulfur flour).
18. Fuse ( $3/32$  dia. controlled, waterproof).

## LIST OF SUPPLIERS

### THE CHEMICAL SHED

944 E. Baseline  
San Bernardino, California 92410  
Catalog \$2.00

### HAGENOW LABORATORIES

1302 Washington Street  
Manitowic, Wisconsin 54220  
Catalog \$1.00

### MERRILL SCIENTIFIC

1665 Buffalo Road  
Rochester, New York 14624  
Catalog \$2.00

### RICHARD O. WOLTER

326 Summit Court  
Schaumburg, Illinois 60193  
Catalog \$1.00

### WESTECH CORPORATION

P.O. Box 593  
Logan, Utah 84321  
Catalog \$2.00



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A large, stylized black graphic of an explosion or burst, with numerous sharp, radiating lines and smaller triangular shapes, centered behind the title text.

**FLASH  
POWDER  
COOKBOOK**

**THIRD EDITION**

**PYROTECHNIC FORMULATION,  
MANUFACTURE,  
AND  
APPLICATIONS**



**THE FLASH POWDER COOKBOOK**

A Guide to the Chemistry,  
Manufacture, and Use of  
Flash Powder



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## NOTICE OF DISCLAIMER

The techniques described herein are DANGEROUS. The manufacture of flashing and explosive powders requires the utmost of care and attention. The use of flash powder in pyrotechnic construction for the purpose of creating noise or explosive effect is prohibited by law in many localities, with severe civil and criminal penalties.

The information contained in this manual is intended solely for educational purposes. The publisher accepts no responsibility for any harmful or illegal use, or for any damage caused directly or indirectly by that information.



## SAFETY CONSIDERATIONS

- 1) Read the directions carefully before beginning. Know how much time each step will take, and what equipment will be required.
- 2) Avoid glass containers. Chemicals and mixtures should be stored in strong plastic or metal containers. Each container should be labeled according to its contents.
- 3) Never store chemicals in your work area! The work area is a place where mixtures can accidentally explode. Storing chemicals in close proximity to electrical equipment can lead to an explosion and fire!
- 4) SMOKING in a work or storage area can be FATAL!
- 5) If your skin becomes contaminated with flash mixture, immediately wash off with large amounts of fresh, flowing water.
- 6) Do not attempt to extinguish metallic fires with water-based extinguishers. Water makes powdered metals release large amounts of hydrogen.
- 7) Never wear contact lenses while preparing flash mixtures.

- 8) Never store metallic powders together with oxidizers.
- 9) Always use eye and respiratory protection when mixing finely powdered metals. Wear latex gloves and cotton clothing, and keep them clean. Never wear synthetic materials when mixing these ingredients, as they tend to generate static electricity.
- 10) Clean up spills in the work area as soon as they happen.
- 11) Only make up small batches of flash powder, and use them right away. Over time, stored powder can become very unstable.
- 12) Do not attempt to manufacture flash powders on dry, cold days. The low humidity tends to create static electricity, a potentially fatal problem.

Flash powder is one of the most dangerous compounds to produce in the amateur lab. It is very sensitive to shock, heat, friction, and static electricity, and has been the source of many fatal accidents. There is no way to anticipate every safety problem which can arise from mixing flash powder. There is NO SAFE WAY to produce these mixtures. The home chemist therefore proceeds at his own risk.

## CHEMISTRY OF FLASH POWDER

Flashing powders are mixtures of oxidizers and finely powdered metals which, when set in close proximity to flame, burn with extreme vigor and velocity. If the powders are confined when ignited, they tend to burn even more rapidly, and ultimately burst their own container.

### WARNING

NEVER STORE FLASH POWDER IN METAL OR GLASS CONTAINERS, OR IN HARD PLASTIC PIPE. Accidental ignition of the powder would result in a BOMB BLAST!

### INGREDIENTS

Any finely powdered metal will ignite. Some metals are more flammable than others, and thus lend themselves quite nicely to flash mixtures.

Early pyrotechnicists discovered that a mixture of magnesium and chlorate of potash would explode with many times the vigor of black powder. Despite the high cost of the metal, it soon was in great demand by fireworks companies.

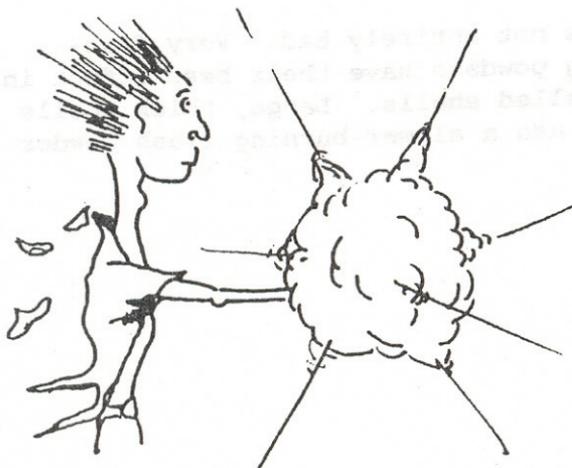
Later, it was discovered that powdered aluminum could provide much the same effect, at a lower cost. The aluminum could be manufactured in many different grades and purities, according to the intended use.

For use in flash powder, only fine "pyro" aluminum should be used. Coarser forms burn more slowly or erratically, and cannot give reliable results in flashing formulas. All formulas in this book work effectively with fine German black pyro aluminum (-400 mesh or finer) or Alcoa #422.

Today, the use of powdered magnesium as the only flammable metal is prohibited by law. A 50/50 mix of magnesium and aluminum is available for experimentation. Known as magnalium, some distributors sell it in one pound cans (see list of distributors).

In addition to powdered metal, flash powder must also contain an oxidizer. Originally, all fireworks were made with a mixture of potassium or sodium chlorate. Chlorates were extremely sensitive, and were deadly to handle.

Today, a wide variety of safe-to-handle oxidizers are available commercially, but care must be taken to choose the right ones for experimentation. Potassium perchlorate and barium nitrate are the best choices.



#### WARNING

NEVER USE CHLORATES! The sensitivity of chlorate compounds to heat and friction makes them DEADLY to handle.

Some formulas call for the use of sulfur. Sulfur comes in two forms...sulfur flowers and sulfur flour.

Differing mainly in color, the two forms can be used interchangeably in most formulations. The sulfur must be finely ground (-120 mesh or finer).

Sulfur helps propagate the flame of an explosion. This sometimes improves the performance of a compound, but frequently an experimenter may find that sulfur slows the explosive reaction.

That is not entirely bad. Very fast-burning powders have their best effect in thin-walled shells. Large, thick shells should use a slower-burning flash powder.

## FORMULATIONS

The following formulations are industry standard mixtures. Proportions listed are by weight.

"Clark Formula" compounds listed are from the notes of the famous fireworks designer Allen F. Clark. The "Maroon" formulas refer to powders used in the manufacture of a large type of fireworks (maroons) used to simulate bomb explosions.

-----

### NAVY M-80 FORMULA:

- 1 Part Magnesium (-325 mesh or finer)
- 1 Part Aluminum (-325 mesh or finer)
- 1 Part Potassium Perchlorate

NOTES: This is the formula originally used in the Navy Gunfire Simulator (M-80). Slow-burning and hard to ignite. Tubes must be capped with hard glue plugs. If using Magnalium, simply use the metal powder in a 2:1 ratio to oxidizer.

-----

-----

COMMERCIAL FORMULA 1:

- 1 Part Aluminum
- 2 Parts Potassium Perchlorate
- 1 Part Sulfur Flour

NOTES: This is a good medium-speed powder for most applications. Flame lasts long enough to be useful in photography.

-----

COMMERCIAL FORMULA 2:

- 1 Part Aluminum
- 2 Parts Potassium Perchlorate
- 0.1 Part Fumed Silica Powder (3% of total weight)

NOTES: High velocity mix. Less sensitive to impact and static build-up than other formulas. Use this in thin-walled tubes.

-----

-----

GENERAL PURPOSE SAFETY POWDER:

- 1 Part Aluminum
- 3.5 Parts Barium Nitrate
- 0.5 Parts Sulfur Flour

NOTES: Very stable and friction-resistant. Can be used in thin-walled tubes.

-----

CLARK FORMULA 1

- 5 Parts Aluminum
- 7 Parts Potassium Perchlorate

NOTES: Good, high-velocity mix.

-----

CLARK FORMULA 2

- 5 Parts Aluminum
  - 3 Parts Barium Nitrate
  - 6 Parts Potassium Perchlorate
-

-----

CLARK FORMULA 3

- 1 Part Aluminum
  - 1 Part Barium Nitrate
  - 1 Part Potassium Perchlorate
  - 1 Part Sulfur
- 

CLARK FORMULA 4

- 4 Parts Barium Nitrate
  - 2 Parts Aluminum
  - 1 Part Sulfur
- 

CLARK MAROON FORMULA 1

- 12 Parts Potassium Perchlorate
- 8 Parts Sulfur
- 1 Part Sawdust

NOTES: Very slow-burning. Use superfine sawdust (available commercially). This is used for aerial bombs.

-----

-----

CLARK MAROON FORMULA 2

- 6 Parts Potassium Perchlorate
- 2 Parts Sulfur
- 3 Parts Antimony Sulfide

NOTES: In this formulation, the antimony sulfide is used to intensify the flame produced by this compound.

-----

CLARK MAROON FORMULA 3

- 32 Parts Potassium Perchlorate
- 3 Parts Charcoal
- 3 Parts Rosin

NOTES: Very slow-burning, also useful for aerial bombs.

-----

CHINESE FORMULA 1

- 3 Parts Potassium Perchlorate
  - 4 Parts Aluminum
  - 3 Parts Sulfur
-

-----

CHINESE FORMULA 2

- 5 Parts Potassium Nitrate
- 2 Parts Aluminum
- 3 Parts Sulfur

-----

CHINESE FORMULA 3

- 5 Parts Potassium Nitrate
- 2 Parts Aluminum
- 3 Parts Sulfur
- 1 Part Potassium Perchlorate

-----

CHINESE FORMULA 4

- 2 Parts Potassium Perchlorate
  - 1 Part Aluminum
  - 1 Part Sulfur
  - 1 Part Potassium Nitrate
-

-----  
CANNON FORMULA 1 (safest)

- 6 Parts Potassium Perchlorate
- 3 Parts Sulfur
- 1 Part Charcoal

NOTES:        A form of gunpowder, but NOT  
               SAFE for use in firearms.

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CANNON FORMULA 2

- 6 Parts Potassium Perchlorate
  - 2 Parts Sulfur
  - 1 Part Metallic Antimony
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CANNON FORMULA 3 (loudest)

- 60 Parts Potassium Perchlorate
- 23 Parts Sulfur
- 5 Parts Antimony Sulfide
- 12 Parts Potassium Nitrate

NOTES:        This is a good powder for use  
               in thick-walled, large aerial  
               salutes.

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## PYROTECHNIC CEMENT

For years, Sodium Silicate (Waterglass) has been used by pyrotechnic engineers as a paper softener and bonding agent. Commercial fireworks still use cement made from Sodium Silicate.

The formula below will mix up an excellent, fast-curing cement for all purposes.

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YOU WILL NEED:

- 2 Parts Calcium Carbonate
- 2 Parts Zinc Oxide (optional)
- 1-2 Parts Sodium Silicate

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In a paper cup, blend the powdered ingredients and add the Sodium Silicate (Waterglass) until your preparation reaches the desired consistency. THIS GLUE CANNOT BE STORED, and it's the real devil to clean up.

When mixed with superfine sawdust, this cement makes rock-hard outer shells for such small devices as smoke bombs. It can also be used to bond paper confetti into a hard coating for Globe Salutes.

## TOOLS AND SUPPLIES

The location chosen for the manufacture of flash powder must be clean, neat, static-free, and completely away from all sources of ignition. There must be no matches, lighters, lit cigarettes, pilot lights, piezo-electric starters, or any other spark- or flame-producing item in the room. IF FLAME IS PRESENT DURING MANUFACTURE, THE RISK OF SERIOUS OR FATAL INJURY IS VERY HIGH.

In addition to a "clean room", you will need a good set of safety goggles (NOT SAFETY GLASSES) and a respirator (NOT A DUST MASK).

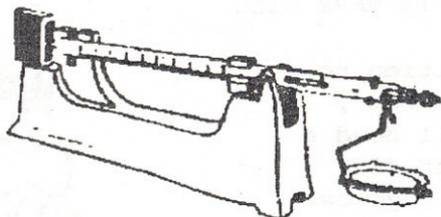


The metal powders used in flash mixtures are dangerous to breathe, and if they enter your eyes they can cause serious damage. Of course, never wear contact lenses while making flash powder!

You should wear rubber gloves whenever handling flash powder ingredients. They will reduce the likelihood of transferring

the powder to your eyes, mouth or nose after the powder has been made.

Your clothing should be cotton, to reduce the hazard of a stray static spark, and it should be kept immaculately clean. Dirty clothes build up oil and can become dangerously contaminated with airborne flash powder.



For measuring ingredients, you will need an accurate, sensitive scale. Any reloader's powder scale will work. It is impossible to accurately guess at the proper proportion of ingredients!

For mixing and drying wet process powders, you will need a wooden or plastic measuring spoon and a hard plastic spatula. You will also need a glass or ceramic cup for stirring the powders together, and a glass cake pan or pie plate for drying the flash powder. If grinding is required, you will also need a ceramic mortar and pestle.

For dry process powders, you will need a supply of resealable plastic bags. One-quart size bags should be sufficiently large for most purposes.

#### WARNING

DO NOT USE GLASSWARE OR PLATES THAT YOU EAT FROM. The metals in flash powder can grind themselves into your dinnerware, and you will end up eating flash powder with your spaghetti! Use a glass marker and label all of your tools "NOT FOR FOOD USE."

## MANUFACTURING FLASH POWDER

### POWDER PREPARATION

The chemicals used in the making of flash powder must be of good purity and extremely fine mesh, or size. The larger the mesh number, the smaller each particle of powder is.

Most chemical supply houses can sell finely divided metal powders in a variety of meshes, from -100 to -800. It should be noted that if a can of Aluminum Powder is labeled as "-170," it can contain particles much finer than the size on the label. It will not, however, have any powder coarser than -170.

This is because these powders are first ground, and then sifted through metal screens. Any particles small enough to pass through the screen will end up in the container. Therefore, many experimenters use relatively coarse metals with good effect. You don't always have to buy the most expensive pyro Aluminum!

Nevertheless, your other ingredients must be very finely ground, and should be very pure. This poses a problem, since most of the chemicals used in the manufacture of flash powder are hygroscopic, and tend to absorb water and get lumpy. Then they don't mix very well.

To help prevent this from happening, buy your oxidizers in small quantities only. Don't open their containers until you are ready to use them. And if they appear too lumpy, be ready to pulverize the chemicals before mixing.

The best way to powder lumpy chemicals is to "screen" the chemicals before weighing. A brass metal screen in a wood fixture (obtainable from sources listed in the back of this book) is used to sift the lumps into a pile of superfine powder. For most applications, a -100 mesh screen will do.

The second technique is to grind the powders in a pestle. These are also available from the commercial sources listed later. If ceramic pestles are unavailable, you can substitute a formica cutting board and a wooden rolling pin or hardwood dowel. Take great care when grinding powders...some of them don't like to be crushed! ALWAYS work on an absolutely clean surface, and ALWAYS WEAR SAFETY EQUIPMENT!

The third technique is applicable to the making of small amounts of powder for experimental purposes. Using a clean resealable plastic bag, pour the lumpy chemical into the bag and crush it with your fingers. It helps if there is no air in the bag when you're grinding this way.

## WET PROCESSES

In order for flash powder to be both predictable and even-burning, all of the components must be held in intimate contact during the explosion. Wet process techniques are used to mix powders which do not blend well through normal (dry) mixing, or for grinding powder mixes which are friction-sensitive when dry (such as black powder).

The aim of wet processes is to dissolve or suspend the powdered chemicals in a solvent during mixing. The resulting paste is then dried out to produce the final form of the powder.

Two major problems plague the wet process. First is safety. Certain powders, when dissolved, can produce dangerous by-products and explosive gases. Aluminum, for example, releases hydrogen gas when mixed with water.

The second problem is that some of the chemicals, especially sulfur, do not dissolve at all. When making cannon powders, for example, the sulfur should be the last ingredient added to the slurry, and the resulting paste has to be mixed by grinding in a pestle.

The wet technique described below is applicable only to ONE SPECIFIC FORMULA. If you intend to use wet mixing with any

other formulas, you may have to alter the sequence or type of solvent.

TAKE EXTRA CAUTION WHEN MIXING METALS WITH THE WET PROCESS. The sample process described below will be used to mix Commercial Formula #2.

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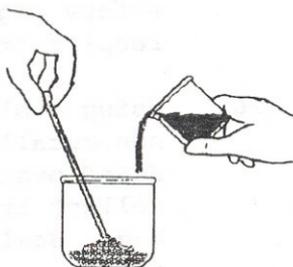
YOU WILL NEED:

- Accurate Scales
- Mixing Glass
- Drying Plate
- Plastic Spatula
- Plastic Spoon
- Safety Goggles
- Respirator
- Latex Gloves
- Resealable Plastic Bag

- =====
1. Remove all tools from the work table. Put on safety goggles, respirator, and gloves.
  2. Cover work table with white paper. Position a clean trash can with a PAPER liner close to the work table. Have a non-water fire extinguisher close at hand.
  3. Set up scales and mixing glass on work table. Wipe the scales clean with a piece of toilet tissue. ZERO OUT THE SCALES.

4. Close and remove the container of Potassium Perchlorate from the work table.
5. Measure out desired amount of Aluminum powder and put into mixing glass. Wipe the scales clean and re-zero them.
6. Measure out desired amount of Fused Silica powder and put into mixing glass. Wipe the scales clean and re-zero them.
7. Seal all compounds and remove them from the work table.
8. Open container of Potassium Perchlorate near scales.
9. Measure out the proper quantity of Perchlorate.
10. Seal the container of Potassium Perchlorate and remove it from the mixing table.
11. Gently pour the Perchlorate into the mixing glass with the metal powder.

12. Stirring gently, add water to the powder. Add just enough to make a thin paste which will pour slowly from the glass. Stir gently for 2-3 minutes, scraping from the sides of the glass.



13. Pour the paste into the glass drying pan. Tilt the pan from side to side to obtain a thin, even coating. The mix may be bubbling slightly at this point, releasing hydrogen gas. THIS GAS IS DANGEROUS IN PROXIMITY TO OPEN SPARKS AND FLAME.

14. Allow the pan to sit outdoors or in a well-ventilated room overnight. There must be NO PETS OR



HUMANS IN THE ROOM. For small applications, two hours of daylight exposure should evaporate the paste. NEVER MICROWAVE THE PASTE!

15. When the paste is dry, put on the safety goggles, gloves, and respirator again.
16. Using a plastic spatula or similar non-metallic instrument, scrape the dried paste from the glass pan and collect it in a resealable plastic bag. Seal the bag when about 1/2 full.
17. While in the bag, grind the dried powder between your hands. Work slowly, grinding down small amounts at a time. Wear appropriate safety equipment. The paste is now flash powder, and is HIGHLY EXPLOSIVE.

## DRY PROCESS

This is a safe, fast method of making most of the flash powders listed in this book.

The dry process is the method used in the mass manufacture of commercial flash powders. In order for the resulting compounds to be effective, you must use extremely fine powders in the mix. These tend to produce, as a side effect, explosive clouds in the mixing room.

Most major commercial disasters can be traced to a spark-induced explosion of these clouds. Pilot lamps, uninsulated fan motors, television coils, cigarettes, and even the static electric spark from walking across the carpet can initiate one of these clouds. BE CAREFUL!

These clouds are not only explosive...they are potentially toxic, and occasionally invisible. USE YOUR LUNG AND EYE PROTECTION RELIGIOUSLY!

Although many compounds formulated in this book can be mixed with the dry method, the specific instructions here will deal with Commercial Formula #1.

Please note that these instructions call for grinding lumpy Sulfur and Potassium Perchlorate before the final mixing. NEVER GRIND THEM TOGETHER! Always make sure your grinding surface is absolutely

clean. Refer to the section on POWDER PREPARATION for more information about grinding and pulverizing mixtures.

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YOU WILL NEED:

- Accurate Scales
- Resealable Plastic Bag
- Plastic Spoon
- Safety Goggles
- Respirator
- Latex Gloves

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1. Remove all tools from the work table. Put on safety goggles, respirator, and gloves.
2. Cover work table with white paper. Position a clean trash can with a PAPER liner close to the work table. Have a non-water fire extinguisher close at hand.
3. Set up scales on work table. Wipe the scales clean with a piece of toilet tissue. ZERO OUT THE SCALES.
4. Close and remove the containers of Potassium Perchlorate and Sulfur from the table.

5. Measure out desired amount of Aluminum Powder on scales. Then put this powder into the resealable plastic bag. Seal the bag.
6. Wipe and re-zero the scales.
7. Seal and remove the container of Aluminum Powder from the work table.
8. Measure out the desired amount of Sulfur on scales. Put this powder into the pestle and carefully grind it until all lumps have disappeared.
9. Transfer the ground Sulfur into the resealable bag containing the Aluminum Powder. Seal the bag.
10. Seal and remove the Sulfur from the work table. Wipe and re-zero the scales. Wipe the pestle clean.
11. Measure out the desired amount of Potassium Perchlorate on the scales. Put this powder into the pestle and grind it until it, too, is a fine, smooth powder.
12. Transfer the Potassium Perchlorate into the resealable bag, and re-seal the bag.

13. Seal and remove the container of Potassium Perchlorate from the work table. Wipe the scales, pestle, and work surface clean.
14. Gently rocking the bag back and forth, allow the ingredients to blend thoroughly. Do not shake or vigorously agitate the bag. Mix the ingredients for at least five minutes. If lumps appear, GENTLY crush them with your fingers.
15. When the powder is completely blended, transfer it to your holding container by cutting off one corner of the plastic bag and pouring out the powder. DO NOT OPEN THE BAG. It now contains highly explosive powder, and will invariably generate a dust cloud if opened.
16. Handle this powder gently, for it is now very explosive. It should be used promptly.

## CONSTRUCTING SALUTES

M-80's, Cherry Bombs, Silver Salutes, and Devil Dogs! In the 1940's, you could walk into any store and buy these off the shelf. Today, they are illegal.

Federal law prohibits the manufacture and sale of certain pyrotechnic devices. Among them are salutes which contain more than 50mg of flash powder. Legal fireworks are those which meet this limitation, and are known as Class "C" fireworks.

You can easily make your own class "C" salutes, but first you should understand how the "classics" were made.

### THE M-80

"It's as powerful as a quarter stick of dynamite!" Everyone who talks about the now-unobtainable M-80 uses this phrase to describe its immense power. They tell tales about blowing up mail boxes (FELONY) and flushing M-80's down public toilets to crack the john in half (MISDEMEANOR).

Near the end of World War II, the U.S. Navy invented the M-80 as a training device which would simulate the report from an M-1 rifle. The .30 caliber ammunition for those rifles was designated "Ball M-80". That's where this great

firecracker got its name.

Basically, an M-80 was an explosive charge of flash powder enclosed in a strong paper tube, plugged securely at both ends. The tubes were constructed of spiral-wound kraft paper...1 1/2 inches long, 9/16 inches inside diameter, 3/64 inch wall thickness.

A fuse inserted into its side would ignite the powder. The Navy Formula flash powder ingredients listed earlier were originally used to fill these noisemakers. End plugs were made of a mixture of pyrotechnic cement and sawdust, and frequently blew out with enough force to injure bystanders. Later flash powder formulations were used which allowed the use of glued-in-place paper end caps.

The M-80 is as loud as a rifle blast. It explodes with a brilliant flash, and has the power to deafen, blind, cripple, or kill. In 1966, Federal law made the manufacture and sale of M-80 and similar firecrackers illegal (except for specific agricultural and display uses...see appendix). To legally construct one of these devices, you must first obtain a Class B fireworks manufacturing permit.

#### THE CHERRY BOMB

In 1930, Alberto Cimorosi invented and

patented the Cherry Salute. Three years later, rights to manufacture this firecracker were sold to the National Fireworks Company, which marketed the firecracker as the Globe Salute. They quit making them in 1939, near the beginning of the Second World War.

Cherry Bombs are charges of flash powder contained in a rock-hard shell. They are very difficult and messy to manufacture by hand.

First, the charge is sealed between two small paper cups. Then, that assembly is coated with a slurry made of pyrotechnic cement and paper confetti. When dry, a hole is drilled into the center of the Cherry Bomb, and the fuse is inserted.

This manufacturing process requires inserting a metal drill into flash powder.

Drill bits get hot, and build up static electricity. The only accident at the National Fireworks Company involving Cherry Salutes came about as a result of the drilling operation.

#### THE SILVER SALUTE

Silver Salutes are a cross between the Cherry Bomb and the M-80. They hold a flash powder charge equivalent to a Cherry Bomb, but are built like a small M-80.

They are constructed of spiral-wound kraft paper tubes...1 1/2 inches long, 1/2 inch inside diameter, 1/16 inch wall thickness. Paper end plugs seal both ends, and a fuse inserted into the side ignites the powder charge.

Silver Salutes are only slightly less powerful than the M-80. The difference in powder charge is hardly noticeable when they explode. (See "How Much Powder")

### THE DEVIL DOG

The Hitt Flashcracka Company of Seattle, Washington, patented a method of making large salutes without using end plugs. One of their most popular items was the "Devil Dog," a two-inch long blockbuster with a looped fuse on one end.

First of all, the looped fuse was an interesting concept. Some powder mixtures (notably the Navy Formula) were finicky about igniting. Two fuses would virtually guarantee ignition. By looping the fuse outside of the tube, Hitt guaranteed two lit fuses every time!

To do away with end caps, Hitt developed a technique whereby the flash powder was folded into a paper satchel. The fuse was attached to one end, and this assembly was then inserted into the hard cardboard tube.

## TUBES AND PLUGS

Commercially-available paper tubes are spiral-wound kraft paper. Depending upon the size of the tube, they cost about 5-6 cents apiece.

Tubes must be adequately plugged if an explosion is going to happen. With slow-burning powders (such as the Navy formula or black powder), adhesive or castable end plugs must be used. Commercial fireworks manufacturers often use this type of plug, since it is fast, easy, and repeatable.

To cast an end plug, you must hold the tube vertically in a jig. The surface which the tube rests on must be covered with sawdust or other type of release agent. Hot-melt glue, castable concrete, or pyrotechnic cement is then squirted down the open end of the tube and allowed to harden. This forms the plug on one end. After filling the tube with flash powder, a small amount of buffering agent is added (usually sawdust), and more cement is poured into the open end. This forms the second plug.

Castable end plugs are quick and easy to make, but suffer from some major drawbacks. First, they are messy. Hot glue guns tend to drip. Pyro cement is time-consuming and can't be cleaned up. Castable concrete is just plain muddy.

Secondly, the castable end plug presents a hazard when firing the finished product. Unless the plugs are very thin, they are ejected hard enough to hurt bystanders.

Finally, the only method which the experimenter might find economical, the hot glue gun, can cause some preparations to ignite while the glue is being applied! What happens next is a mouthful of burning hot glue and flash powder!

Paper plugs are available for commercially-produced tubes, and should be used whenever possible. These cup-shaped seals are glued into place with any general purpose cement or white wood glue. They work best when the flash mixture yields a high-velocity explosion.

If you are using paper plugs in your tubes and they just blow out (without fracturing the tube), then you must either use more cement to hold the plugs or switch to a faster powder.

#### HOMEMADE TUBES

In addition to the amount of explosive charge, the effect of any given firecracker depends upon the makeup of its tube. Small firecrackers, such as the "Black Cat" and ladyfinger styles, have less than 50mg of flash powder enclosed in

a mechanically-wound newsprint paper tube. The walls of that tube are over three times as thick as the inside diameter! That's what makes those tiny fireworks so loud.

Spiral wound tubes used in the construction of high-yield firecrackers have wall thicknesses of between 1/16 and 1/8 inch, depending on the size of the tube. These tubes usually explode completely when loaded with high-velocity powder. Less brilliant flash powder will probably make them crack open along a weak seam, resulting in a single piece of paper shrapnel.

If you don't like the size selections available commercially, tubes are available in your own kitchen. They are also more fun to experiment with. When making home-made tubes, keep in mind that different materials give different results. Test each new type of tube before make a batch of firecrackers. **KEEP RECORDS OF YOUR TESTS!**

Here's how to make tubes which burst into confetti, and allow the flash powder to achieve higher relative pressures than spiral wound tubes can.

The instructions below will make 3-4 tubes of the following proportions:

- 1/2 inch inside diameter
- 1/16 inch wall thickness
- 2 inch length

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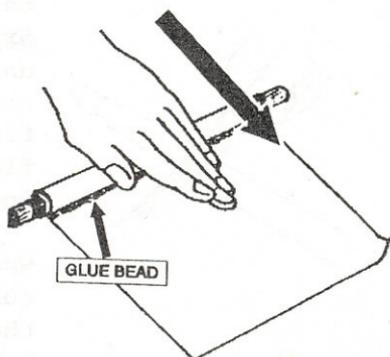
YOU WILL NEED:

- aluminum rod, 3/8 inch diameter
  - white wood glue
  - wax paper
  - cheap bond or copying paper
  - brown wrapping paper (for mailing)
  - inexpensive, sharp knife
- =====

To make the homemade tubes, follow these steps:

- 1) Lay the rod on a flat surface covered in wax paper.
- 2) Roll the bond paper onto the rod until it overlaps itself. The paper must be tight. This may take practice.
- 3) Carefully spread a bead of glue along the junction where the bond paper overlaps itself, just under the rod.
- 4) Applying steady pressure, roll the paper onto the rod. The bead of glue should be pushed slightly ahead as you

progress. Add more glue if necessary. This rolling action presses the glue into the paper fibers.

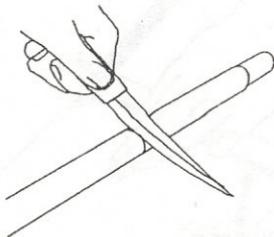


5) When the paper is completely rolled, coat the outside of the tube with glue and wipe it down with your fingers. Let it get tacky before proceeding.

6) Roll the tube in wrapping paper, adding a bead of glue as the wrapping paper overlaps itself. Continue rolling until the wrapping paper has covered about three layers on the rod.

7) Coat the outside of the wrapping paper with glue and let it harden completely.

8) With the rod on a flat surface, lay the edge of the knife against the tube. Roll the rod while pressing down against the knife blade. Repeat this until 3-4 two-inch lengths are cut. Remove the rod and use the new tubes.



For best results, let the newly-cut tubes dry overnight before using. They should be rock-hard, and will fracture well when the flash charge is ignited.

When using homemade tubes, be aware that the thickness of the tube walls is one of the critical factors in the explosive effect of the fireworks. Thin walls require fast-burning powder to achieve the best effect. Thick walls work best with slow powders.

When cutting your tubes, their overall length should be at least three times the inside diameter of the tube. To ensure even burning of the flash powder, the length of the tubes should be no longer than six times the inside diameter.

### FUSES

Fuse comes in a variety of sizes and types. The only type worth considering for large salutes is "Visco" fuse.

Also known as cannon fuse, Visco fuse is waterproof, flexible, and very strong.

It can be purchased from a variety of commercial sources in 1/16", 3/32", or 1/8" sizes. The 1/16" fuse is adequate for most applications, although the larger sizes are more resistant to damage and provide more reliable ignition when using the Navy formula flash powder.

Even though you may have used Visco fuse for years, never rely on manufacturer's specifications. Subtle variations in manufacturing tolerance can show up as dramatic changes in the fuse's burning speed. Always test your fuse by burning test segments cut from each ten foot section of fuse. NEVER ASSUME!

**WARNING**

DON'T USE QUICKMATCH OR PAPER FUSE! These burn irregularly, and have been known to "blow out" and reignite while being examined. A two-inch piece of paper fuse can burn for six seconds or a sixth of a second. DANGEROUS! DO NOT USE!

## HOW MUCH FLASH POWDER?

The relationship between the loudness of the salute and the amount of powder in the firecracker is not linear. That is, twice as much powder will NOT make twice as much noise!

To double the explosive effect from 50 milligrams of flash powder (the maximum allowed under federal law), you would have to use nearly three times as much.

A standard M-80 salute used about 45 grains (3 grams) of flash powder. This is 60 times more powder than the maximum allowed by law for modern class "C" firecrackers. Yet, the resulting explosion was only about sixteen times more powerful.

So if you're making your own fireworks, don't waste powder. Fifty milligrams can be plenty! Use tubes and plugs of the proper proportions, and use the minimum amount of powder necessary to achieve your desired effect.

## MAKING THE M-80 STYLE SALUTE

Salutes can be made in a variety of sizes and shapes. The M-80 style salute is one of the simplest to assemble.

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### YOU WILL NEED:

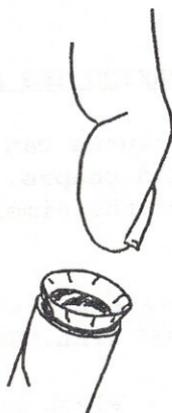
- Flash powder
  - Accurate scales
  - Spiral-wound paper tubes
  - Paper end caps (2 per salute)
  - Visco fuse
  - General purpose wood glue
  - Cotton-tipped swabs
- =====



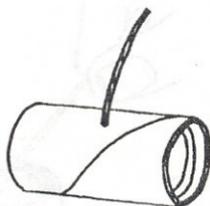
### INSTRUCTIONS:

- 1) With the cotton swab, spread a moderate amount of wood glue inside the first 1/2 inch of one end of the paper tube. This glue will hold the end cap in place.

- 2) Gently coax an end cap into place over the glue. Allow the glue to set.
- 3) Measure 50mg (.77 grains) of flash powder on the scales.
- 4) Pour powder into open end of tube.
- 5) Apply wood cement to outside of second end cap.
- 6) Insert end cap and push it 1/2 inch into tube.
- 7) With a small-diameter awl, make a fuse hole in the center of the tube.



- 8) Cut a two-inch section of fuse and carefully insert it into the hole. Take care not to break the coating as you twist the fuse home.



- 9) Apply a bead of wood glue to hold the fuse in place.

## MAKING A TAPE SALUTE

These are easy and quick firecrackers to make, and they do not require sophisticated equipment. They are easily as loud as conventional class "C" firecrackers.

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### YOU WILL NEED:

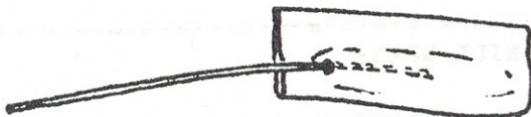
- Flash powder
  - Accurate scales
  - High quality paper fuse
  - 3/4 inch masking tape
- =====

### INSTRUCTIONS:

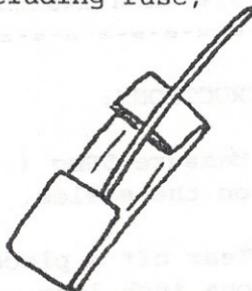
- 1) Measure 50mg (.77 grains) flash powder on the scales.
- 2) Tear off a piece of tape approximately one inch long.
- 3) Pour flash powder in a line down center of tape (sticky side). Leave about 1/4 inch on each end.
- 4) Fold tape in half lengthwise, capturing flash powder loosely.



- 5) Make a small hole near top of flash powder pocket and insert 1-2 inch length of fuse.

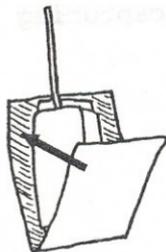


- 6) Fold ends of tape, including fuse, over.



- 7) Wrap package width-wise with another section of tape.

- 8) Make one final wrap perpendicular to the second one. Firecracker should be small, flat, and square.



## EXPEDIENT CHERRY BOMB

While the real thing is beyond the skill level of most experimenters, an expedient and satisfying salute can be constructed of aluminum foil and nylon strapping tape.

These salutes work best with a medium or slow powder, such as cannon powder. If unavailable, commercial black powder can be used. Use grade FFFg or finer.

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YOU WILL NEED:

- Regular aluminum foil
- Slow or medium flash powder
- Visco fuse
- 1" wide nylon filament strapping tape

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### INSTRUCTIONS:

- 1) Using a screwdriver handle or similar form, wrap a 3-4" square piece of aluminum foil around it to make a tube.
- 2) Pinch or fold one end of the tube to make an elongated cup. Remove the tube from the form.
- 3) Pour sufficient powder into the tube to generate an acceptable report. Do not add too much!

- 4) Loosely fold the open end of the tube over the powder.
- 5) Gently crush the shell into a slightly round shape.
- 6) Wrap another small square of crumpled foil LOOSELY around the shell.
- 7) Cut several lengths of strapping tape. Each should be long enough to encircle the aluminum shell once.
- 8) Wrap the shell in a piece of tape.
- 9) Turn the shell 1/4 turn and add another piece of tape. The filaments should be at right angles to the previous wrap.
- 10) Continue to add tape, always at right angles to the previous wrap, until the shell is covered about 5 layers in each direction.
- 11) Using a sharp nail or needle, penetrate the outer layer directly into the center. Insert a piece of Visco fuse into this hole.

This salute doesn't look very neat, but it has enough power to seriously maim anyone foolish enough to hold onto it.

BE CAREFUL.

## WILDLIFE CONTROL FUSE

It is sometimes necessary to force wild animals to move off trails or out of areas used for farming and ranching. Bear, coyote, and other predators can be coaxed to abandon an area if you construct a salute with a wildlife control fuse.

The actual audible device can be any size or shape you want, but these instructions will deal with the standard M-80 style case. When completed, you will be able to attach the salute to a stationary object and explode it by means of a trip wire.

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### YOU WILL NEED:

- Flash powder
  - Accurate scales
  - Spiral-wound paper tubes
  - Paper end caps (2 per salute)
  - General purpose wood glue
  - Cotton-tipped swabs
  - Pull String noise maker ("Pulling Trick")
  - Monofilament Fishing Line
- =====

### INSTRUCTIONS:

- 1) Glue one end plug in place in the paper tube.

- 2) Poke a hole into the center of that plug, barely large enough to fit one end of a pull-string noisemaker.
- 3) Carefully thread one string of the noisemaker through the end plug, and press the body of the noisemaker in place in the hole. Cement the outside of the hole, to seal it. The noisemaker should now rest completely within the body of the salute.
- 4) Poke two small holes in the side of the salute, about 1/4 inch from the outside of the sealed end.
- 5) Thread the string on that side of the tube through one hole, around the edge of the tube, and back through the same hole again. Do this two or three times, and cement the string in place.
- 6) Tie a loop into the remaining length of string.
- 7) Poke a very small hole in the remaining end cap, barely large enough to pass the remaining string on the pull-string noisemaker. It might help to use a large sewing needle, and simply thread the string through the end cap.

- 8) Fill the tube with the appropriate amount of flash powder.
- 9) After applying glue, slide the end cap down the string and press it into the open end of the tube.
- 10) BE CAREFUL WITH THIS DEVICE!  
PULLING THE STRING NOW WILL EXPLODE  
THE SALUTE IN YOUR HANDS!
- 11) Tie a loop in one end of the string, and tuck all of the loose string into the ends of the salute. Put a piece of tape over each end, to protect the strings.

The salute is now ready for use. One example of how it might be employed is to place it near a tree trunk next to a known wildlife trail. One of the loops can be tied to a limb or nail in the tree, and the other attached to fishing line.

Stretch the fishing line across the trail (GENTLY!), and hook it to a solid tie-off on the other side. Any animal crossing this line will catch on the line. After stretching it about 1/4 inch, the salute will explode!

## LEGALITY OF HOMEMADE FIREWORKS

FROM 15 CFR, Chapter II (1-1-85)

### PART 1507 - FIREWORKS DEVICES Consumer Products Safety Commission

#### 1507.2 Prohibited chemicals.

Fireworks devices shall not contain any of the following chemicals:

- (a) Arsenic sulfide, arsenates, or arsenites.
- (b) Boron.
- (c) Chlorates, except:
  - (1) In colored smoke mixtures in which an equal or greater amount of sodium bicarbonate is included.
  - (2) In caps and party poppers.
  - (3) In those small items (such as ground spinners) wherein the total powder content does not exceed 4 grams of which not greater than 15 percent (or 600 milligrams) is potassium, sodium, or barium chlorate.
- (d) Gallates or gallic acid.
- (e) Magnesium (magnesium/aluminum alloys, called magnalium, are permitted).
- (f) Mercury salts
- (g) Phosphorus (red or white). Except that red phosphorus is permissible in caps and party poppers.
- (h) Picrates or picric acid.
- (i) Thiocyanates.
- (j) Titanium, except in particle size greater than 100-mesh.
- (k) Zirconium.

#### 1507.3 Fuses.

(a) Fireworks devices that require a fuse shall:

(1) Utilize only a fuse that has been treated or coated in such a manner as to reduce the possibility of side ignition. Devices such as ground spinners that require a restricted orifice for proper thrust and contain less than 6 grams of pyrotechnic composition are exempted from 1507.3(a)(1).

(2) Utilize only a fuse which will burn at least 3 seconds but not more than 6 seconds before ignition of the device.

(b) The fuse shall be securely attached so that it will support either the weight of the fireworks device plus 8 ounces of dead weight or double the weight of the device, whether is less, without separation from the fireworks device.

#### 1500.17 Banned hazardous substances.

(a) Under the authority of section 2(q)(1)(B) of the act, the Commission declares as banned hazardous substances the following articles because they

possess such a degree or nature of hazard that adequate cautionary labeling cannot be written and the public health and safety can be served only by keeping such articles out of interstate commerce.

(3) fireworks devices intended to produce audible effects (including but not limited to cherry bombs, M-80 salutes, silver salutes, and other large firecrackers, aerial bombs, and other fireworks designed to produce audible effects, and including kits and components intended to produce such fireworks) if the audible effect is produced by a charge of more than 2 grains of pyrotechnic composition; except that this provision shall not apply to such fireworks devices if all of the following conditions are met;

(i) Such fireworks are distributed to farmers, ranchers, or growers through a wildlife management program administered by the U.S. Department of the Interior (or by equivalent State or local government agencies); and

(ii) Such distribution is in response to a written application describing the wildlife management problem that requires use of such devices, is of a quantity no greater than required to control the problem described, and is where other means of control are unavailable or inadequate.

## SUMMARY OF STATE LAWS (effective April 1983)

The following states allow class C (ordinary) fireworks:

Alabama	Louisiana	Tennessee
Alaska	Mississippi	Wisconsin
Arkansas	Missouri	
Florida	S. Dakota	

The following states allow limited types of class C fireworks:

California	Montana	S. Carolina
Idaho	Nebraska	Texas
Indiana	Wyoming	Utah
Kansas	New Mexico	Virginia
Kentucky	N. Dakota	Washington
Michigan	Oklahoma	D.C.

The following states allow only sparklers or snakes:

Colorado	Maryland	Oregon
Illinois	Pennsylvania	
Maine	Iowa	

The following states ban ALL class C fireworks:

Arizona	Minnesota	Ohio
Connecticut	New Hampshire	Rhode Island
Delaware	New Jersey	Vermont
Georgia	New York	W. Virginia
Massachusetts	N. Carolina	

The following states have no fireworks laws, except at county levels:

Hawaii	Nevada
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## SOURCES OF MATERIALS

Chemicals and supplies are available commercially from several sources, including:

FIREFOX ENTERPRISES, INC.  
P.O. BOX 5366  
POCATELLO, ID 83202  
(catalogue \$2)

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FREEDOM PYRO SUPPLY  
ROUTE 3, BOX 163  
MINERAL POINT, WI 53565  
(catalogue \$1)

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SLE, INC.  
BOX 3673  
LOGAN, UT 84321  
(catalogue \$2)

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HAGENOW LABORATORIES, INC.  
1302 WASHINGTON STREET  
MANITOWOC, WI 54220

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CAPITOL FIREWORKS COMPANY  
1805 W. MONROE  
SPRINGFIELD, IL 62704

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CHEM-LAB SUPPLIES  
13814 INGLEWOOD AVENUE  
HAWTHORNE, CA 90250

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