Preparing the Workspace

Work Outdoors. The rubber-stars process requires the use of acetone which puts a lot of flammable vapors rapidly into the air. Additionally, Parlon releases a small amount of toxic carbon tetrachloride into the air when it is dissolved in solvents.

For these reasons, this work should be done outdoors and a good respirator rated for paint fumes and organic-solvent vapors should be worn during this process. Disposable gloves such as the nitrile ones sold in the paint department of Home Depot, rated for working with paint strippers and solvents, should also be worn. And, once again, all of this work should be accomplished outdoors. Don't let these fumes accumulate in an unventilated or poorly ventilated area.

Setting Up. A pop-up tent works nicely for shelter from the sun while working, and for protection from sudden rain showers.

A portable worktable or two will serve as a nice workstation under the tent. Cover the tables with kraft paper, masking-taped down to keep it in place in a breeze. The paper will make the clean-up after star-making easy.

Preparing to Make Rubber Stars

There's a term in French cooking: "la mise en place." (MEEZ-ahn-plahs)

It means literally "putting or setting in place" or "set up." When you see the chefs on cooking shows preparing bowls of diced vegetables, laying out their cookware on a nice clean counter-top, setting bottles of ingredients in a line, and measuring out little bowls of spices, that is what they are doing: putting everything they will need for a dish in place in front of them in the workspace.

(I just knew that watching all those Food Network shows like *Emeril* and *Bobby Flay's Throwdown*would pay off someday.)

Just as in cooking, prior to making a batch of rubber stars it is important to have all the ingredients, tools, and supplies laid out in an organized way on the worktable in front of you.

Your set up includes several steps and practices:

- Read the entire formula and step-by-step instructions
- Prepare the workspace
    - Start with a clean workshop
    - Only have the ingredients and supplies out which will be used
- Do the prep work
    - Weigh out chemicals and mix the dry compositions
- Clean up after yourself as you go. Don't let the workspace get cluttered.

Assemble these tools and supplies in an organized manner on a worktable:

- Nitrile gloves (these are solvent resistant and available at Home Depot) or heavy-duty paint-stripping gloves
- Respirator rated for paint fumes
- 20-mesh screen (Skylighter #TL2002)

- 40-mesh screen (Skylighter #TL2004)
- Waxed paper
- Rolling pin or large wood dowel
- Two 12-inch long, 3/16-inch diameter wood dowels
- Wood stick for mixing composition (Popsicle stick, tongue depressor, etc.)
- Weighing scale (Skylighter #TL5021 or #TL5030)
- Mixing tubs, scoops, paper cups, kraft paper sheets
- Can of acetone (It's nice to put some of the acetone into a little HDPE or LDPE plastic squirt bottle for easy dispensing. Just make sure your plastic bottle is not made of a material that the acetone will soften and eat through.)
- Required chemicals for formulas (see formulas below)
- Trash bag
    - Many pyrotechnic processes such as this star-making one produce "hot trash" which is contaminated with flammable compositions. Such waste is not appropriate for normal methods of household trash disposal. We don't want to be putting explosive materials out on the curb for the garbage-man to pick up. The safest way of disposing of this trash is by burning it outdoors in a safe location. Ignite it in a safe way so that you are not close to it when the pyro compositions burn.
- Wallpaper seam-roller
    -  (available at wallpaper supply stores or online at:http://www.cornerhardware.com/seam_roller/6746_6935/13580)
- Small trigger sprayer filled with denatured alcohol
- Short, 1/2-inch long, 1/2-inch ID paper tubes for shell rising-tails if desired
- A drying screen on which to dry the finished stars (Skylighter #TL2061)
- A large, round, shallow plastic tub, approximately 11-inches in diameter and 4-inches deep, in which to prime stars
- A piece of scrap wood, approximately 4-inches by 12-inches
- Special screen for slicing the stars

- A framed screen similar to this one from Skylighter (#TL2051), mounted *very* solidly in a wood frame, is absolutely necessary for this screen-slicing method. This is a special weave welded-wire, stainless-steel screen. All of the wires on one side of the screen run in one direction. All the wires on the other side run the other direction, and the wires are very smooth. This screen type makes the screen-slicing method work very easily. It must be very thick wire, and able to withstand repeated, heavy pressures during the process you'll see below. Ordinary screens are not made with the correct weave, and will collapse or tear when making these stars.

Drying and Milling Strontium Nitrate

The formula we are about to work with uses strontium nitrate. This chemical makes pure, deep red colors. It is also hygroscopic, which means it will absorb moisture out of the atmosphere which can cause it to aggregate into hard clumps. Also, it sometimes comes as crystals about the size of sugar or table-salt, instead of a fine powder.

If you have a tub of nice, dry, free-flowing, finely powdered strontium nitrate, you're good to go.

If the powder is not very free flowing, or feels a bit damp like moist sand, it must be dried before using it. Spread the strontium nitrate out on a kraft-paper lined baking sheet, and dry it for a day in a drying box or for 2-3 hours in a 225 degree oven. Since the stars we are about to make are rubber-bound, any moisture in the chemicals will be permanently locked into the stars if the chemicals are not dry initially.

Note: Do this only with an *individual*, non-combustible chemical, like this strontium nitrate (don't worry-strontium nitrate will not catch on fire). Do not exceed 225 degrees if you use an oven. Put a piece of masking tape over the oven's temperature control knob so that someone doesn't crank the heat up to cook a pizza.

If it is crystalline or contains hard clumps, it must be milled in a blade-type coffee mill first, a small amount at a time. If you have a ball mill, a clean or dedicated mill jar and media may also be used to ball-mill the crystals to a fine powder.

All of the strontium nitrate should be able to pass through a 40-mesh screen (at least), and the composition will work even better if the chemical will pass through a 100-mesh screen.

You should now have dry, free-flowing, finely powdered, strontium nitrate. If it's not all going to be used immediately, store it in doubled, heavy-duty ziplock baggies to prevent it from absorbing moisture. Putting the bagged chemical in a sealed plastic tub with a bag of desiccant helps too.

Separating Magnesium-Aluminum (Magnalium, MagAlum, MgAl, etc.) Powder from Turnings

I'll be using Skylighter #CH2080 magnalium, 180-325-mesh. But other particle sizes will work as well. The mesh size of the magnalium used in the star formula will determine the burn rate of the

resulting stars. Coarse magnalium, such as 60- or 80-mesh, will result in a slower burning star that leaves a slight trail of silver sparks. Medium magnalium, such as 200-mesh, will result in a star that burns a bit more quickly with no spark trail; and fine magnalium, such as the 180-325-mesh or a 325-mesh, will result in a fast burning star.

Magnalium powder often comes mixed with metal chips due to transportation regulations. You must remove these chips from the MgAl before it is used.

First, sift the metal mixture through a 20-mesh screen, about 1/2 cup at a time, allowing the fine MgAl to sift through onto a piece of kraft paper. Dump the coarse metal chips onto a separate piece of paper and repeat as necessary.

Now using a 40-mesh screen, repeat this process with the fine MgAl powder you separated in the first step to remove any remaining small metal chips. The fine magnalium powder may be returned to the original baggie it came in, and stored in the original plastic tub. The metal chips can be stored in another ziplock baggie.

Fine Magnalium Separated from Coarse Chips

Once you have separated out all the coarse metal chips, they may be returned to Skylighter for a refund (currently about $6.00 per-pound). There are few, if any, pyrotechnic uses for these chips. Skylighter will credit your account for all that you return to them. Please ship using US Mail, Parcel Post only, to:

Skylighter, Inc., PO Box 480, Round Hill, VA 20142-0480

Be sure to include a note with instructions on it, along with your email and address.

Parlon

Parlon is a registered trademark of the Hercules Powder Company, but-like "Kleenex" and "Band-Aid"-"Parlon" has come to be a generic name for any chlorinated rubber used to bind these stars, and to act as a chlorine donor (which enriches their color). Older brands of chlorinated rubber, such as Alloprene and Parlon, are no longer readily available, so what is typically supplied

nowadays is Chlorub, the modern equivalent.

Some Parlon comes as a powder which flows freely through a 40-mesh screen. Other varieties come with granules or small flakes which will not pass the same screen, comprising 10-12% of the total powder.

These larger particles will soften in the star composition we are about to make once the acetone is added, so they may be left in the Parlon as it is weighed. Just remember that as you are mixing the star composition through the 40-mesh screen, these particles will not pass through the screen, and must be added back to the composition after it is screen-mixed.

Alternatively, the larger particles may be removed from the Parlon with a 40-mesh screen and simply discarded. This makes the screen-mixing of the star composition a bit easier.

Recap

To recap the preparations so far:

- The workspace and all the materials and supplies have been prepared
- The strontium nitrate has been dried and milled to a fine powder
- The magnalium has been separated from any packing chips
- The Parlon has had the larger particles removed if desired

Mixing the Star Composition

Here is the formula for our brilliant red stars, and the calculated quantities of each component chemical required to prepare the eight-ounce (225-gram) batch of stars we will be making. The quantities are expressed in both ounces and grams, and are calculated by multiplying the batch size (in this case either 8 ounces or 225 grams) by the "factors" in the third column. As can be seen, the "factors" are derived directly from the percentages in the second column.

Brilliant Red Star Formula for Screen Sliced Stars

Component	Percent	Factor	8 oz	225 g
Strontium nitrate	53%	0.53	4.25 oz	119.2 g
Magnalium	19%	0.19	1.5 oz	42.7 g
Parlon	17%	0.17	1.35 oz	38.3 g
Red gum	11%	0.11	0.9 oz	24.8 g

Mix a batch of the star composition by weighing each chemical individually, then adding it to a mixing tub which has a tight-fitting lid. When finished, re-weigh the total composition to verify it all adds up to the desired batch weight.

Close the mixing tub securely, and shake the composition while holding the lid on the tub tightly.

Screen the composition through a 40-mesh screen.

Put the composition back in the mixing tub and shake again, and repeat the screening and shaking

one more time. Return any large particles of Parlon that did not pass the 40-mesh screen to the composition before shaking it for the final time.

The star composition in its closed tub is now ready to use.

Mixing the Star Primes

The best insurance you have that all of your screen sliced stars will ignite in a shell or mine is to use my double prime method. The two prime formulas below can be used in this project and in the Rainbow Rubber Stars formulas that you will see later.

Primes are compositions which are layered on the outside of stars to ensure ignition. Although this particular red star composition is relatively easy to ignite, the double-prime method employed in this screen-slicing process ensures good star ignition, even when the stars are used in hard-broken aerial shells.

To be sure you get everything you need, get Skylighter's Rubber Stars Prime Kit and save 20%. The priming chemicals are *not included* with the Red Rubber Stars Kit nor the Rainbow Rubber Stars Kits.

Mix up one batch of each of these primes, separately weighing, shaking, and screen-mixing the compositions the same way the star composition was mixed. Keep each prime in its own sealed and labeled tub.

Hot Igniter Star Prime

Chemical	Percent	Factor	3 oz	85 g
Potassium perchlorate	71%	0.71	2.15 oz	60.3 g
Charcoal, airfloat	14%	0.14	0.4 oz	11.9 g
Red gum	9%	0.09	0.25 oz	7.7 g
Magnalium	6%	0.06	0.2 oz	5.1 g

Black Powder Parlon-Star Prime

Chemical	Percent	Factor	3 oz	85 g
Potassium nitrate	67%	0.67	2 oz	56.9 g
Charcoal, airfloat	14%	0.14	0.45 oz	11.9 g
Sulfur	9%	0.09	0.25 oz	7.6 g
Magnalium	5%	0.05	0.15 oz	4.3 g
Red gum	5%	0.05	0.15 oz	4.3 g

Note: The potassium perchlorate, red gum, potassium nitrate and sulfur should all be finely powdered. Use the same magnalium in the primes that you used in the star composition.

Dampening the Star Composition

Note: When working with acetone and denatured-alcohol, work outdoors and wear nitrile gloves

and a respirator rated for paint fumes. Acetone fumes are flammable and toxic.

Open the mixing tub which contains the star composition. Put the star comp into a mixing tub which can be dedicated to these red stars, as the residue from the mixing process will be very difficult to thoroughly remove later.

Add to the star comp an amount of acetone equal to 22% of the composition weight. For our 8-ounce (or 225-gram) batch, that is 0.22 x 8 oz (or 225 g) = 1.75 oz (or 50 g).

Stir the acetone thoroughly into the composition with a wood stir-stick.

Then knead the star putty with gloved hands until it is a smooth dough-ball about the consistency of soft bread dough.

Making the Star Composition into a Dough-ball

(Click Image to Play Video)

Rolling Out the Star Composition into a Patty

Flatten the dough-ball of star comp a bit and place it between two sheets of waxed paper. Place one 3/16" wood-dowel spacer on each side of the ball. Use a piece of scrap wood to further flatten the composition into a flat, relatively round patty, using the wood-dowel spacers to ensure the

correct thickness. Finish the flattening process with a rolling pin or large dowel and the wood-dowel spacers.

Flattening the Dough-Ball into a Patty

(Click Image to Play Video)

Filling the Rising-Tail Tubes (Optional)

If you've cut a couple 1/2-inch ID, 1/2-inch-long paper tubes in which to mold aerial-shell rising tails, now is a good time to fill them. Pinch off a bit of the star composition and fill the tube-molds flush with both ends.

Open the tub of hot-prime composition, and push the exposed damp star comp in one end of each tube into the prime to create a nice layer of the prime on it.

Making Rising Tails

(Click Image to Play Video)

Priming Both Sides of the Star-Composition Patty

With the top of the star-comp patty uncovered, sprinkle a heaping tablespoonful of the hot-prime on its surface to evenly cover it.

Cover the top of the patty with the sheet of waxed paper, flip it over, and uncover the other side of the patty. Repeat the priming process on that exposed side.

Re-cover that primed side with the waxed paper and use the flat piece of wood to gently press the prime into the surfaces of the patty.

Priming the Star-Comp Patty

(Click Image to Play Video)

Using the Screen to Slice the Patty into Stars

Remove the top piece of waxed paper and turn that paper over, placing it on the work table so the prime coated side is up.

Pick up the other piece of waxed paper with the patty sitting on it; slide your hand, palm up, under the patty and the waxed paper. Then lay the slicing-screen, top down, onto the exposed surface of the primed pancake, still in your hand.

Flip the whole shebang over so that the patty is now sitting on top of the screen. Place the screen with its patty over the piece of waxed paper on the work table.

Remove the piece of waxed paper from the top of the patty, which will expose the patty sitting on the screen.

Dust the top of the patty with a little additional hot-prime if its surface looks wet.

Now, begin pushing the pancake through the screen with the palms of your gloved hands. Start with the outside perimeter of the patty to lock it into place in the screen mesh and prevent the patty from stretching out sideways as it is pressed.

Continue to push the patty through the screen with your hands, palms and fingertips until the grid of the screen is easily seen "telegraphing" up through the surface of the pancake.

Use the wallpaper seam-roller to finish pushing the patty through until it is flush with the top of the screen. Roll the roller back and forth in the direction the top screen-wires run. You will begin to see the shiny tops of those wires starting to show through the patty.

Use a smooth, balled up rag, like an old T-shirt, to rub the stars the rest of the way through the screen. You'll see and hear the stars dropping through to the bottom sheet of waxed paper. Continue to rub the screen with the rag, occasionally rapping the screen top with it, until all the stars have fallen completely through the screen.

Pick the screen up and rub the top and bottom of the wire mesh with the rag, which will easily remove any remaining crumbs of the star composition from it.

Note: Forcing the prime-dusted patty of star composition through the screen impregnates the surfaces of the cut stars with the prime, acting as the first "step" in a step-priming process which ensures good star ignition.

Screen Slicing the Stars

(Click Image to Play Video)

Testing the Stars

These stars, fresh out of the screen-slicing process, may be burned on the ground or fired from a star gun to see what their color will look like. This can save you hours, even days, since you do not

have to dry them first, as you do with most methods of making stars. These stars burn extremely brightly. If you are going to test on the ground, it is best to ignite them with a length of visco fuse and view them from a distance of 20 or 30 feet.

Finish Priming the Stars

If these stars are dried with only the thin coating of hot-prime from the screen-slicing process, they will ignite and work in many devices. Soft-broken rocket headings, moderately lifted star-mines, and softly-broken aerial shells will work with these stars as they are now.

But for devices which are to be broken harder, and to ensure reliable ignition in all devices, the following finish-priming process should be completed on the stars fresh from the screen-slicing process while they are still damp.

Put the stars in the wide, flat-bottomed plastic tub, along with the loose prime left on the waxed paper from the cutting process.

Spray just the stars with denatured alcohol from a little trigger-spray-bottle. Swirl the stars in the tub and repeat the spraying until all the loose hot-prime has been picked up by the stars, and they are black and slightly glistening with the alcohol moisture.

Add the remaining heaping tablespoon of the hot-prime to the stars, sprinkling it over all the damp stars. Then add a heaping tablespoon of the black powder prime on top of the powdered hot-prime. Spray and swirl the stars in the tub until all the prime has again been taken up by them. This produces a prime layer which is 50:50 hot-prime and black powder prime.

Repeat these steps with additional heaping tablespoons of the black powder prime until all the prime has been used and taken up by the stars and they are coated with a nice, even, rough, black coating of prime.

You'll end up with stars that are almost spherical and about 3/8-inch in diameter.

Place the primed stars in a single layer on a drying screen. Put the screen in a drying box or in a warm, breezy, and safe location to dry the stars. In 2-3 hours the stars will be very hard and dry, and ready to be used in various fireworks devices.

Final Star Priming

(Click Image to Play Video)

I've gone into quite a bit of detail here, covering each step of the rubber-star, screen-slicing process. But in the end, once you have the steps mastered, the whole process only takes about 20 minutes-from mixing the compositions to slicing the stars and then priming them-to end up with a nice batch of stars ready to be dried and used.

It becomes like a little star-making "dance," but you have to understand and master the steps first.

Using Brilliant Red Stars in Fireworks Devices

This 8-ounce batch of star composition, made into stars and primed with the 6 ounces of the two primes, makes about 14 ounces of dry, 3/8-inch diameter stars.

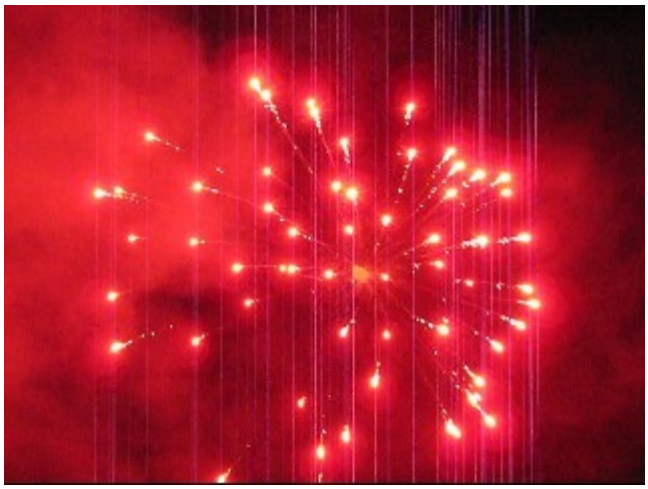
These stars may now be used in various fireworks devices, from rocket headings to mines, and in aerial shells, both spherical and cylindrical.

Here are some typical devices and the amount of these stars required by each:

- 1.75-inch festival ball shells — 1 ounce
- 1.75-inch festival cylinder shells or mines — 1.5-2 ounces
- 3-inch ball shells — 2.7 ounces
- 3-inch cylinder shells or mines — 4 ounces
- 4-inch ball shells — 6 ounces
- 4-inch cylinder shells or mines — 12-14 ounces

Of course, the size of the star composition batches and the accompanying prime batches can be tailored to suit the number of stars needed for any planned devices. The 8-ounce star comp batch in this project is about as large as one would want to work with if it is to be rolled out to 3/16-inch thick and sliced on the 12-inch square, 3-mesh screen as shown above.

Here is the starburst from a 3-inch ball-shell using these brilliant red stars.



Brilliant Red Stars in 3-Inch Shell

(Click Image to Play Video)

Other Colors and Effects

If a tail of silver sparks is desired behind the burning head of the red star, 5% titanium or ferro-titanium may be added to the star formula. Add this metal, if desired, into the plastic tub after the star composition has been screen mixed. Do not put these large, hard metal particles

through your good mixing screens.

Green Stars: And, finally, if barium nitrate is substituted for all of the strontium nitrate in the formula, a brilliant green star will result.

Other Colors: Or substituting barium nitrate for 3/4 of the strontium nitrate, resulting in a 3/1 ratio of barium nitrate to strontium nitrate in the formula, will produce a very nice citron-yellow colored star. Substituting potassium nitrate for all of the strontium nitrate in the formula results in a peachy-lavender colored star. So some nice creativity is possible with this simple formula by simply using other oxidizers. Once again, it always helps to have the chosen oxidizer dry and finely milled. Watch for the follow-on article to this one for more rubber stars colors and effects.