THE FUEL YOU BURN

Keep It Dry

If firewood contains water, the energy produced by burning it is partly used up in boiling that water out of the wood. You lose efficiency dramatically by drying the wood out during burning. The steam so produced can condense inside your flues, rusting them out and dripping from loose joints and inspection holes. So make sure your wood supply is gathered in dry weather and stacked to season in a well-ventilated pile. If cut green—that is, from recently live trees—it should be split open before stacking to allow it to dry out thoroughly for a full year or more before burning; then, in damp climates, store firewood indoors to dry a little more before burning it. Make outdoor wood stacks high and cover the top with something completely waterproof to keep rain off. Keep the sides open so the breeze goes through; thus, wood can continue to dry even in damp weather. Don't throw a plastic sheet over a woodpile; it may trap moisture and condensation from the ground and you could end up with firewood wetter than when you stacked it. If you have any doubts about the dryness of firewood, measure weight loss of a test sample by setting it on your warm stove overnight. If it loses more than 5%, split to thumb thickness and dry it some more.

Kindling Selection

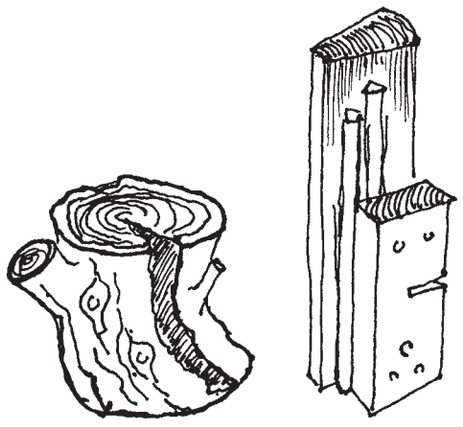
To test the suitability of deadwood as kindling, examine how strong it is. If it doesn't easily break across the grain, it probably has good fiber and will burn well. Kindling should be ***straight, dry, very thin, split, long enough to stand up in the Feed Tube (but not so long that it projects out), strong (difficult to break), fibrous, and roughly square or triangular.*** It sometimes helps if there's a little pitch in the kindling. Conifers such as Douglas fir, pine (except pitch pine), redwood, and fir are good, but red cedar is the king of kindling. Avoid larch (tamarack), hemlock, and spruce. It's tempting to gather twigs, but they have disadvantages. Twigs tend to be crooked and covered in bark. Trees grow bark to protect them from fire and to conserve moisture inside the wood. Splitting firewood accelerates drying and helps it burn better.

If you live in town, you won't need to buy commercial firewood. Your stove will run well on dumpster finds, pallet wood, and the waste that your local arborist generates: straight branches, twigs, and tree trimmings.

Choosing Firewood

When cutting your own wood, choose the straightest pieces, sawing close to knots to leave long pieces easily split from the "not knot" end. Trim branch stubs down flush.

Commercial firewood is normally sold by the cord (a stack 4' x 4' x 8'), yet the energy in it is proportional to its weight, not its volume. So try to buy dense firewood. Heavy hardwoods put out nearly twice as much heat per cord as lightweight species. In a stove with a relatively small Feed Tube, heavier wood such as oak, ash, beech, birch, madrone, or hickory cuts down on how often you need to feed it. Avoid cottonwood, poplar, spruce, hemlock, fir (except Douglas fir), redwood, most pines, and cedar (except for kindling).



Firewood: the Bad and the Good

crooked and knotty	*straight*
short	*long*
fast grown	*slow grown*
thick	*thin*
round	*split*
thick bark	*no bark*
wet	*dry*

Kiko Denzer points out that his Rocket cheerfully burns small-diameter wood that doesn't even interest his neighbors with box stoves. Plantation thinnings and straight branches are sometimes just the right size without any splitting, and they're light enough you can enroll your kids into collecting them.

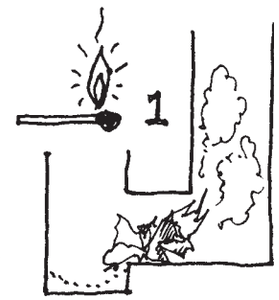
Excessively resinous woods such as pitch pine have trouble burning completely and give off unburnable smoke, which tends to condense inside the flue, clogging it up. Avoid woods impregnated with pitch or creosote, such as railroad ties. Also **avoid pressure-treated lumber and painted wood,** both of which can contain dangerous chemicals. Stay away from plywood, OSB, and other toxic engineered wood products that contain glues.

LIGHT MY FIRE

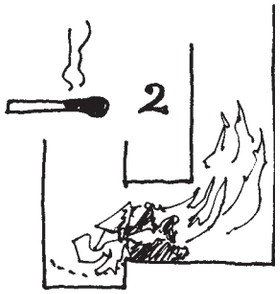
If you're accustomed to lighting fires in box stoves, you're in for surprises. Rocket Stoves function almost diametrically opposite to any kind of stove you've ever lit. The wood stands upright, the air goes down, the kindling goes behind the paper and the firewood behind that. The Feed Tube cools itself so well that you can comfortably sit on the feed barrel. Operation is a brief, very hot clean burn, then you seal the Feed Tube while heat stored in the "battery" slowly warms your home.

First, make sure the draft is leaving your house, not backdrafting up the Feed Tube. If the temperature of the bench gets colder than the outdoor air, a counter-flow can carry air from outdoors down the exhaust pipe and through the intestines to exit up the Feed Tube. This is most likely to happen if you've been gone from your house for a long time in cold weather. Normally, though, you can expect the system to draw air from indoors into the stove. You can tell quite easily by blowing out a match at the entrance to the Burn Tunnel and watching whether the smoke rises or if it falls into the Burn Tunnel.

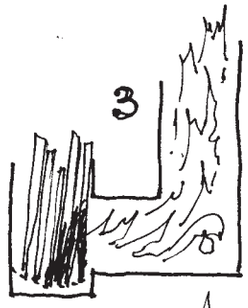
You can also check your indoor stack thermometer. If it reads lower than the air in the room, you may need to prime the system by putting lighted newspaper into the base of the stack.



1. Stuff loose, crumpled newspaper into Burn Tunnel.

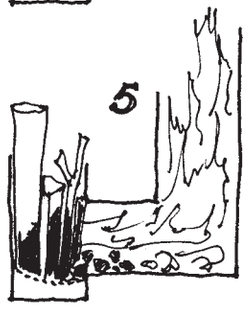


2. When draft is going well, add newspaper balls, not more than half a sheet.



3. Quickly slide in thinnest kindling, thin ends down, tight up against Burn Tunnel and burning paper.

4. Immediately add thicker kindling, all upright and tight against kindling already alight.



5. Now add thicker fuel, gradually cramming the Feed Tube full.

Use of Paper and Preparation for Lighting

Remember that the Heat Riser makes this thing work, not the exhaust pipe. So in normal operation, to heat the riser quickly, I first prepare a few sheets of dry crumpled newspaper (not tissue, thick or glossy paper, nor cardboard). With practice, you can get away with one or two full sheets at most. Try not to use more, as the clays in commercial paper don't burn and can rapidly build up an ash problem in your tunnels. Then I prepare a handful of very thin, very dry, straight kindling with all of the thin ends together, and the matches. I set them all down on the bench alongside the stove. *Kindling needs to be tinder-dry.* Kindling should begin as *slivers* no thicker than a pencil. Use about half a dozen and graduate to finger-thick as they catch fire.

If there's any question about the dryness of the paper, kindling, or matches, I generally leave them in a warm place overnight so as to be dust-dry in the morning. In damp climates such as the Maritime Pacific zone, a kindling shelf or rack above the stove is a good idea, but make sure nothing can fall off it onto the hazardously hot surface of the stove. Safer, perhaps, is to leave paper, kindling and matches on the heated bench.

Now (**1**) I light one of the newspaper crumples and reach down with it so I can stuff it into the horizontal combustion tube, blowing gently down the feed. I wait until the smoke finds the Heat Riser and I hear it burning fiercely, then (**2**) I drop in the other newspaper crumples so they are at the opening of the Burn Tunnel but in contact with the burning piece. If for any reason smoke comes up the Feed Tube, I blow again gently to give it the right idea until it's drawing strongly up the Heat Riser.

Warning: If you burn large quantities of paper, its lightweight ash may float down the stove's intestines and constipate it. After initial ignition, burn only wood.

Adding Kindling

As mentions, kindling must be tinder-dry all through, pencil-thin, straight, split, splintery, and long enough that it can't fall down into the Burn Tunnel or Feed Tube. As the paper ignites, I very quickly stack a fistful of the thinnest kindling **vertically against the exit from the Feed Tube** so the burning newspaper backs up to it. (**3**) The heat of the newspaper ignites the kindling, which burns upstream of it. Then I add more kindling, tight against the opening and upstream of the first load, which as it burns eats its way back into the new kindling. (**4**) Now I add progressively thicker pieces of wood until the Feed Tube is completely full, pushing the fuel up tight against the entrance to the Burn Tunnel. (**5**) The fire chews backward into progressively thicker fuel. Only the bottom end of the wood should be burning. **Always stoke behind the burning pieces,** load the Feed Tube from the end away from the Burn Tunnel, and completely fill the Feed Tube. If you don't, your stove may smoke.

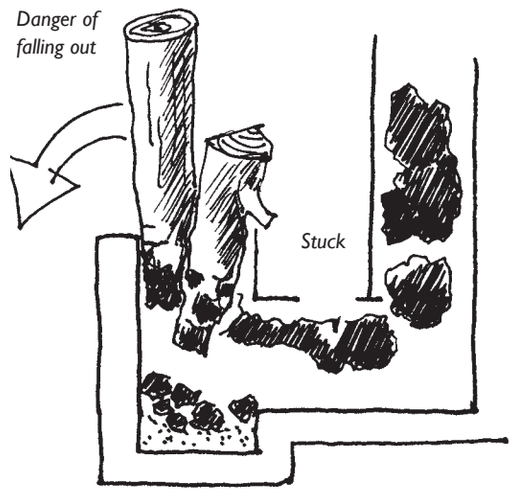
Ideally, as the bottom ends burn off the fuel, pieces drop by gravity into the Feed Tube. Often they jam up, so you may need to shake them down, sometimes quite vigorously. Logjams can be avoided somewhat by (a) choosing straight fuel without side branches, (b) not cutting fuel so long that it cantilevers itself out of the Feed Tube, and (c) feeding fuel **thick end down** so it doesn't wedge itself into the Feed Tube.

Stoking

You can regulate the power output of the stove and therefore how hot the barrel gets by the thickness of the fuel. If you need sudden heat, use a handful of thin, split, really dry, straight kindling up to the size of a child's wrist. The thinner the fuel, the greater the power output and the faster the stove heats up. Conversely, if you want to be able to keep the fire burning for a couple of hours, you can use thicker—and preferably denser—fuel. There's normally enough heat retained in a brick Feed Tube to keep a single log burning for a couple of hours.

For cleanest burning, fires need to be hot and well stoked. Rockets work best if fired at full load for a few hours each day to charge up the Thermal Battery. As soon as the embers die down, close the lid as tightly as possible. This stops the system from sucking air through the bench and cooling off the mass, and prevents heated air being dragged out of your house. To regulate the flow of air onto the fire, over the opening of the Feed Tube I use firebrick or tile, or a flat sheet of cast iron; it is removed for stoking.

Because Rocket Stoves work by gravity feed, the wood needs to be fairly straight, without bumps or side branches which might hook it up as it falls into the Feed Tube. Theoretically, a really straight smooth piece of wood can be quite long and should feed itself into the stove automatically, but in practical terms, it's not advisable to use wood much longer than the Feed Tube. It may burn vertically upwards and fall over, creating a fire hazard or smoke in the house. Worse, if fuel projects out of the top of a Feed Tube, it can ignite outside the tube, flaming up and potentially reversing the fire's flow. At best, you could be smoked out; at worst, it could set your house on fire.



Feed the thick end down.

Here are some situations to avoid. Two or more flat-sided pieces projecting out of the Feed Tube can create a chimney between them, up which the fire can creep against the incoming air. Of special concern would be two pieces of split wood or boards with flat faces, facing each other. Even inside the Feed Tube, try to avoid feeding with flat faces opposing. In Pocket Rockets, a metal stack can get hot enough to ignite (by radiation) fuel that is sticking out of the Feed Tube several inches away. In each case, problems can be avoided by *keeping the fuel length shorter than the Feed Tube* and keeping the cover of the Feed Tube always on top of that barrel, leaving an air crack if needed, but preventing any back-burning.

I keep a chimney thermometer in my exhaust stack inside the building where I can see it, just above where the pipe emerges from my heated bench. I check it regularly. It's a very accurate probe-type thermometer that measures the temperature inside the tube. Because you don't expect high temperatures, it only needs to read between 200 and 300°F. Probe thermometers are a little more expensive but they are very accurate, more durable, and less likely to fall off and break than the magnetized type that sticks to the surface.

The thermometer is useful also because the temperature of the flue gases drops when your stove needs to be stoked. Simply by casual glances at my thermometer, I can see when pyrolysis is no longer happening, which usually means that either the fire is down to embers or the wood is hanging up instead of falling in by gravity. Familiarity with the stack temperature will alert you to inconsistencies in combustion or anything that might be wrong in the system, such as a slowly clogging flue. A stove that normally generates 250°F at the Exit Flue, but suddenly can only be cranked up to 200°F could be evidence that for some reason the draft is not working well.