SKILL GUIDE · ENERGY & HEAT

Building a Rocket Mass Heater

The Energy & Heat chapter's Tier 3 equipment list assumes a standard wood stove, professionally swept and ready for the season. A rocket mass heater is a different, far more fuel-efficient way to burn wood: a purpose-built combustion chamber followed by a thermal-mass bench that keeps radiating heat long after the fire is out. See Stirling Engines for a real way to pull a bonus of electricity out of this same fire while it's burning.

How it actually works

A rocket mass heater burns wood sideways in a J-shaped chamber, then forces the hot gas up through an insulated "heat riser" where it mixes with air and burns a second time, reaching roughly 1,300 to 2,400°F. That near-complete combustion is the whole point: almost nothing is left to condense into creosote further down the line. The hot exhaust then runs through ducting embedded in a large thermal mass, commonly a cob (clay-sand-straw) bench or a barrel-and-bench combination, that soaks up the heat and radiates it slowly for hours after the fire has burned out, rather than losing most of that heat straight up a chimney the way an open fireplace does.

The efficiency claim, and where it comes from

The design traces back to Ianto Evans and the Aprovecho Research Center, and the commonly cited figure, 80-90% less wood than a conventional wood stove for the same heat, comes from that original source lineage rather than an independent lab test of every build. Treat it as the honest claim behind the design's intent, not a guaranteed number for a first-time DIY build; a poorly sealed or undersized heat riser will burn less cleanly and heat less effectively than a well-built one.

What it's built from

Component	What it's typically made from
Burn chamber and heat riser	Fire brick or another refractory (heat-resistant) material able to hold up to sustained temperatures above 1,300°F
Barrel	A steel drum set over the heat riser, both radiating heat directly and acting as part of the ductwork into the mass
Thermal mass	A cob mix (clay, sand, and straw) built up around ducting, commonly shaped into a bench so the stored heat is also a place to sit
Chimney	A standard insulated flue is still required for the small amount of exhaust that exits after the mass has extracted most of the heat

Real dimensions: the ratios that decide whether it burns clean or smolders

The three chambers, feed tube, burn tunnel, and heat riser, aren't sized arbitrarily; a standard J-tube design keeps them in roughly a 1:2:4 ratio of feed tube to burn tunnel to riser height. A 6-inch system, the practical minimum riser diameter and the most common size for a first build, works out to roughly a 12-inch feed tube, a 24-inch burn tunnel, and a 48-inch riser; an 8-inch system scales the same ratio up. Keep the cross-sectional area consistent through all three chambers rather than narrowing or widening partway through, since a mismatched area is one of the most common causes of a smoky, incompletely-burning build.

The riser also needs real insulation, not just refractory mass, to actually reach the temperature that drives clean secondary combustion. Two proven approaches: pack a perlite-and-clay-slip mix (mixed to a milkshake consistency) into the gap between two concentric pipes, or line firebrick with a ceramic fiber insulation blanket at least 1 inch thick, 2 inches performs better. A half-inch layer is a common first-build mistake and isn't enough insulation to reach full combustion temperature reliably.

Sizing the exhaust run and keeping it clear of anything that burns

Match the exhaust ducting's diameter to the riser, 6 or 8 inches for the systems described above. As a rule of thumb, a 6-inch system supports roughly 35 to 40 equivalent feet of horizontal run before draft weakens too much to pull exhaust reliably; an 8-inch system supports up to about 50 feet. Subtract roughly 5 feet of that budget for every 90-degree elbow in the path, and keep the overall horizontal-to-vertical ratio around 1:3, a taller, hotter vertical chimney section buys more horizontal run elsewhere in the layout.

Clearance to anything combustible, framing, furniture, stored goods, isn't optional and isn't a single universal number. An uninspected, non-listed masonry heater generally needs 36 inches of clearance under NFPA 211 unless it qualifies for a reduced-clearance exception (down to 4 inches) by meeting specific masonry-thickness requirements, at least 8 inches of outer wall and 5 inches around the flue channel, verified by whoever inspects the build. Single-wall stovepipe sections of the exhaust run typically need 18 inches of clearance under WETT standards. Don't guess at this figure for your specific build; confirm it against the standard your inspector or building department is actually using.

The test burn: what "small" actually means and what you're checking for

Do a real test burn on the bare core, feed tube, burn tunnel, and riser, before enclosing any of it in the thermal mass. Light a small fire and let it come up to temperature, then watch the exhaust: once the system is properly warmed up, a clean-burning core puts out exhaust that's clear or shows only water vapor, a brief white puff in the first few minutes and again as the fire dies down is normal. Any persistent yellow- or blue-tinged smoke once the system has had time to warm up means something in the riser, insulation, or draft needs fixing before the mass gets built around it and makes that fix far harder to reach.

Building the thermal mass without cracking or steaming it

Build the cob mass in layers rather than all at once, a few inches at a time, letting each layer set up before adding the next; a mass built too fast in one wet mass traps moisture that has nowhere to go. Give the finished mass real dry time, commonly one to several weeks depending on thickness and climate, before the first full-intensity fire. A rushed first fire in a still-damp mass can crack the cob or, in a worse case, generate enough trapped steam to spall material off explosively; a slow initial fire with the damper or airflow kept moderate for the first burn or two is the safer way to dry it the rest of the way.

The legal reality: this isn't automatically a permitted heating appliance

A site-built rocket mass heater doesn't carry a UL listing the way a manufactured wood stove does, and it exists in a genuine gray area for a permanent, code-compliant installation. The real path, rather than assuming either "anything goes" or "it's illegal," is that a rocket mass heater can be classified and permitted as a masonry heater under the International Residential Code's R1002 provision, which references ASTM E1602, the standard guide for solid-fuel masonry heater construction. In practice, that means asking your local building department specifically for a masonry-heater permit citing R1002, and expecting the process to involve either an engineer's stamp, a formal inspection against ASTM E1602's mass and clearance

requirements, or sign-off from a licensed masonry-heater mason, not a standard wood-stove permit application. Meeting that standard's mass, clearance, and construction requirements is what gives a local building department something concrete to inspect and approve against; at least one documented case (Washington state, 2018) shows a rocket mass heater passing permit inspection through exactly this path. Skipping this step matters beyond the legal risk too: some insurers are reluctant to cover a home with an uninspected, non-standard heating appliance.

WARNING

Combustion safety still applies in full

A clean-burning design reduces creosote and chimney-fire risk when built correctly, but it doesn't eliminate carbon monoxide risk from a leaky joint, a botched heat-riser seal, or backdrafting. Install a working carbon monoxide detector in the same room, mounted per the manufacturer's instructions and positioned within 21 feet of any bedroom door on the same floor, matching NFPA 72 and International Residential Code placement rules for any fuel-burning appliance, and have the finished build reviewed by someone experienced with the design, or a certified stove installer, before relying on it as a primary heat source.

Sources

- Design origin, mechanism, and efficiency claims: Wikipedia, Rocket mass heater; Ianto Evans and Leslie Jackson, *Rocket Mass Heaters*; Aprovecho Research Center
- Combustion temperature and clean-burn mechanics: Common Sense Home
- Masonry heater code classification and ASTM E1602: Masonry Heater Association; ASTM E1602
- Documented permit case: The Building Code Forum
- Carbon monoxide and creosote safety practices: permies.com
- J-tube feed/burn-tunnel/riser dimension ratios and minimum riser diameter: permies.com
- Heat riser insulation methods and thickness: permies.com; Green Life Homestead
- Exhaust duct sizing and maximum horizontal run: permies.com; permies.com
- Clearance-to-combustibles requirements and reduced-clearance masonry exception: permies.com; Cornell Legal Information Institute
- Test-burn procedure and what a clean burn looks like: permies.com
- CO alarm placement rules (NFPA 72 / IRC): Merrimack, NH Fire Department