BIOCHAR COALITION / OPERATOR EDITION

FLAME-CAP BIOCHAR PRODUCTION

A field operating guide for flame-cap kilns

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A sustained flame cap over a Ring of Fire kiln in Vermont, USA.

THE CONTROLLING IDEA

Dry material establishes the thermal engine. The goal is a strong FLAME. Add progressively more difficult material only as fast as the flame cap can process its moisture and volatile load.

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01 / QUICK DECISIONS

Quick reference field guide

Start here when you need an answer during a burn.

QUESTION	FIELD RESPONSE
Can we ignite?	Only with authorization, site risk assessment, medical plan, control resources, crew roles, and an approved weather/smoke prescription.
What goes in now?	Use the driest small material first. Feed denser, larger, or conditionally wetter material only after a strong sustained flame cap exists.
Add another batch?	Wait until the current feed is actively flaming and the cap has recovered. A lower feed level alone is not enough.
Heavy smoke after feeding?	Stop feeding. Diagnose moisture, batch size, airflow, and feed rate; allow recovery or stabilize/terminate under the site plan.
Large piece buried?	If safe, probe and lift partly converted material into the active flame zone with a pitchfork; reassess before feeding. If quenching; remove log from coals onto wet ground, stab the partially charred log with a hand tool and extinguish completely with water or dirt. Large partially burned logs can hold significant heat. Take that into consideration.
Ready to quench?	Assess yellow flame, blue flame, remaining wood, black char, and rising ash. Protect a mostly finished char bed from needless oxidation.

NON-NEGOTIABLE

No production target, training objective, grant metric, partner expectation, or schedule justifies operating outside safe control, required authorization, or demonstrated competence.

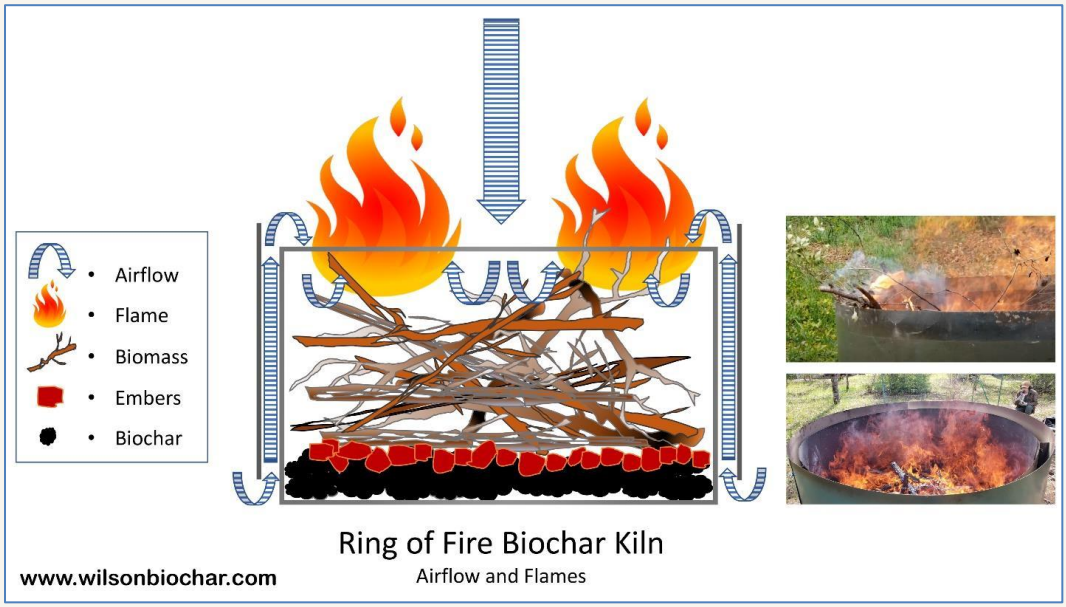
OPERATING LOOP

OBSERVE	INTERPRET	ADJUST	OBSERVE AGAIN
Flame, smoke, wind, char depth, embers	Compare available heat with next batch demand	Feed less, wait, reposition, stabilize, or quench	Confirm the response before continuing

01A / HOW IT WORKS

Watch the top, protect the char below

The active flame above the feed consumes gases released as wood heats. The forming char below should not be left to burn away.



Air enters the top and sustains the flame cap over wood that is converting to char.



Keep a dedicated operator watching the flame-cap, feed level, embers and work area.

THE OPERATING QUESTION

Can this flame cap process the next batch without being buried or cooled? If uncertain, wait.

02 / READINESS

The no-ignition gate

Complete a site risk assessment, crew briefing and emergency medical plan before active combustion.

VERIFY BEFORE LIGHTING	RECORD / ASSIGN
Authority and prescription	Landowner direction, permit/burn-day status, local air and fire requirements; site-specific wind and smoke limits; ignition authority.
Containment and access	Adjacent fuels, overhead hazards, roads, watercourses, utilities, visitors/livestock, escape routes, exclusion zone, parking and safe access.
Control resources	Reliable water, pump/hose/nozzle, hand tools, backup suppression capability and dedicated as needed lookout.
Crew and PPE	Competent operator; assignments, communications, non-melting clothing, boots, gloves, eye protection; task-specific PPE.
Medical plan	Primary/backup communications, exact address/coordinates, access and gate information, receiving facility/transport, first aid/burn care, accountability and kiln handoff.

RESPIRATORY PROTECTION

If exposure assessment or policy requires respirators, follow the applicable program for medical evaluation, fit, filter selection, training and maintenance. Do not improvise respiratory protection during quench.

STOP FEEDING AND STABILIZE OR QUENCH WHEN

CONTROL LOST	PEOPLE OR AUTHORITY	EQUIPMENT OR EXPOSURE
Weather/smoke outside prescription; heat, flame, or embers escape; spot fire.	Exclusion zone intrusion, injury, fatigue, loss of accountability or communications.	Water/suppression fails, critical equipment fails, fuel spill, unacceptable smoke or road exposure.
Operator no longer confident of control.	Permit, command, or landowner direction becomes unclear.	Follow the emergency and incident notification plan; do not leave an uncontrolled kiln unattended.

02A / HAZARD CONTROLS

Protect the crew and the site

Convert the site into clear assignments, and emergency actions.

HAZARD GROUP	CONTROL FOCUS
Fire and embers	Adjacent fuels, containment, lookout, water/tools, ignition authority, escape response and verified cold-out.
Heat, flame and steam	Positioning, exclusion area, tool reach, non-melting clothing, gloves, eye protection, wind direction and burn treatment capability.
Smoke and particulates	Fuel condition, feed rate, flame-cap quality, dispersion, public exposure, repositioning, pause or termination.
Saws and processing	Qualified operators, guards, maintenance, spacing, hearing/eye PPE, fuel handling and shutdown.
Material movement	Lifting limits, mechanical aids, footing, slope, rolling wood, pinch points, repetitive work and crew rotation.
Vehicles and trailers	Qualified drivers, load securement, towing capacity, backing spotters, access, parking, fire exposure and fatigue.
Weather and environment	Repeated forecast and onsite checks for wind, temperature, humidity, precipitation, lightning, heat/cold stress and visibility.
Public and site interface	Traffic, visitors, livestock, structures, utilities, cultural resources, watercourses and neighbors.

INCASE OF SPOT FIRE OR ESCAPE

Cease ignition and feeding; stabilize the active kiln as conditions allow; engage assigned suppression, confirm accountability and make required notifications. Do not abandon an uncontrolled kiln or self-deploy outside assignments except to protect life, limb or property.

02B / SEEING EXPOSURE

Flame height/length and wind change the work area

The photographs show why overhead hazards, wind direction and ember exposure must be assessed at the actual site.



A tall 20-30 foot flame changes the safe working envelope.



Wind can carry the flame sideways and expose surrounding fuels, and people

OBSERVE	ACT
Flame extension, canopy, nearby fuels, wind and changing smoke path	Keep people and fuel outside the approved exclusion zone. Recheck weather and dispersion during the burn.
Flame, embers or heat leave the planned control envelope	Stop feeding; stabilize, suppress or quench according to the incident plan.
Flame Length & Flame Height	If excessive utilize water to calm it down, or terminate the burn by quenching with prepared water source.

03 / SITE AND STAGING

Prepare the operation before ignition

Sort feedstock by behavior so the operator can choose the next batch deliberately.



Open site with no overhead canopy: inspect exposures and access.



Separate staged piles near the kiln, with a clear work route.

ZONE	USE / CONTROL
STARTER • very dry	Small sticks and 1–2.5 in dry wood for ignition and early heat.
PRIMARY • dry	Routine woody batches, mostly up to 6 in diameter.
MEDIUM / LARGE	Separate dense and larger pieces for a strong flame zone; inspect for incomplete conversion.
CONDITIONAL • wetter	Keep apart; use only if strong heat and the approved plan support it. Material above ~20% moisture is generally avoided. If rain is forecasted cover with tarps.
REJECT / HOLD	Material outside the project plan, contaminated material, unacceptable wet feed, and anything that compromises control.

FIELD PRACTICE, NOT A UNIVERSAL CLEARANCE

The field method describes raking debris within 5 ft and pre-wetting a 10 ft radius. The site risk assessment and controlling authority must set adequate clearances, water and containment for the actual fuels, flame, terrain and weather.

How much to stage?

Stage enough sorted feed that the assigned operator can continue controlled batches without leaving the kiln to search for wood. Record pile dimensions and actual material consumed; organize wood but out. Don’t compress material with a tractor, sort wood by diameters.

03A / PUBLIC INTERFACE

Teach the community while maintaining control

A demonstration adds visitors, movement and questions to an active fire operation. Assign a separate person to manage the public interface.



Keep community-event signs outside the operator's work area.



Multiple Kins operating in a close configuration require intensives situational awareness

CREW ASSIGNMENT

The operator remains with the kiln. A separate host manages visitors and questions so the active flame, exclusion zone and adjacent fuels stay under direct observation.

Roles	Responsibility
Kiln Boss	Assemble and inspect the kiln operation area, has permission to ignite the kiln, followed all local ordinances to conduct a safe burn, overseas set up, safety, ignition, quench and cold out.
Educator	Performs and provides education and outreach, is also a Kiln Boss but only supports or shifts attention when primary kiln boss requires such.
Landowner / Tennant	Responsible for site set up, parking arraignments, and various other ad-hoc requirements for seeing the event has site support, works to obtain burn permits and following all local code.
Volunteers	Those who have agreed to the liability sheet, rules and have proper PPE. Are willing to manage the kiln, demonstrated capability.
Spectators	Hands off observers, lack PPE or showcase physical limitations

03B / PUBLIC INTERFACE

Tools, Equipment and PPE

Check the working setup before ignition. Select PPE through the site hazard assessment and the tasks.

EQUIPMENT AT THE KILN	PURPOSE / PRE-IGNITION CHECK
Kiln panels and fastening hardware	Assemble and inspect the kiln by the equipment instructions; check stability, fasteners and the soil seal at the base.
Water source, pump, hose and nozzle	Demonstrate usable water at the nozzle, adequate reach and pressure, water for a full quench and contingency response, and backup capability.
Shovel and garden rake	Stage where the operator can reach them for site preparation, ember control and char spreading.
Long-handled tool; pitchfork or McLeod as needed	Move feed and probe larger pieces from a safe position; inspect handles and keep tools outside travel paths.
Long lighter or approved ignition device	Use the ignition method in the site plan. A torch is task-dependent and does not make unsuitable wet feed acceptable.
Weather and communications equipment	Check onsite conditions during the operation; test primary and backup communication methods.
Medical and contingency supplies	Locate first aid and burn-care capability; brief access, emergency contacts, accountability and kiln stabilization.
Processing and transport gear, when used	Use qualified saw operators, required guards and saw PPE; secure loads and use lifting aids or spotters as conditions require.

PERSONAL PROTECTIVE EQUIPMENT	WHEN / WHY
Non-melting long sleeves and pants	Baseline active-kiln clothing; select protection appropriate to heat, flame and terrain.
Work boots, and gloves	Stable footing and hand protection for feedstock, tools, hot surfaces and the quench task.
Eye protection	Protect against embers, debris, splash and dust; add task-specific face protection if the assessment requires it.
Head, hearing, high-visibility or saw PPE	Add for overhead/material hazards, powered equipment, traffic or saw work under the controlling task standard.
Respiratory protection, when required	Use the project respiratory protection program, including medical evaluation, fit, selected filters, training and maintenance.

GO/NO-GO CHECK

Confirm area control, water at the nozzle, weather, and assigned crew capability and the documented emergency plan.

04 / FEEDSTOCK

What can I feed the kiln?

The site plan and actual flame response govern each batch.

MATERIAL / CONDITION	ROLE AND TIMING	PRIMARY CONCERN
Small, very dry sticks	Ignition and first flame	Fast burnout; keep a continuous flame.
Dry 1–2.5 in diameter wood	Preferred initial loading / early batches	Even ignition and heat building.
Woody material up to 6 in diameter	Routine feed after strong cap	Larger diameter converts slowly.
Very dry, termite, unusually large wood	Conditional in strong flame zone	Long conversion; an exception, never routine permission.
Split firewood	Dense layers after thermal base	Feed a layer, then let flame catch up.
Above ~20% moisture	Generally avoid; conditional later	Cooling, smoke, longer burn.
Fine leafy material	Mix with heavier woody material	Ember ejection and escape.
Partly pyrolyzed large piece	Rework in the active flame zone	Buried hot wood can reignite later.

FIELD FEEDSTOCK GUIDE

Preferred dry feedstock is approximately 20% moisture or less; initial wood ~1–2.5 in; routine diameter up to 6 in (15 cm); typical cut length 6–7 ft. Match every piece to kiln size and approved loading method.



Unusually large, very dry, termite infested wood is a variable fuel type and due to their age and condition - burn quickly.

05 / MOISTURE

Dry wood builds the fire. Wetter wood spends it.

Moisture is a thermal demand placed on the active flame zone.

BUILD THERMAL RESERVE	SPEND THERMAL RESERVE
Fine dry feed → rapid ignition → strong flame → hot char bed.	Water in feed must warm and evaporate before the wood can heat and release volatiles cleanly.
The flame cap can consume gases released from a controlled next batch.	A large wet batch can cool the flame zone faster than it recovers; visible smoke may increase.

CONCEPTUAL CONTROL RULE

AVAILABLE HEAT + ACTIVE FLAME CAP ≥ DEMAND OF THE NEXT BATCH (water + wood mass + volatiles)

Field check before ignition

1 • SAMPLE	2 • SEPARATE	3 • SEQUENCE
Check several representative pieces with the project's meter method or manually; do not assume one pile is uniform.	Stage DRY / INTERMEDIATE / WET fractions apart. Record readings and sampling limits.	Start with driest fine material. Consider wetter fractions only after strong sustained flame and only under the approved plan.

If the next batch dulls the flame and smoke rises, stop feeding. Let the flame recover; then use smaller and drier material if appropriate. Never treat the presence of a torch as a substitute for suitable feedstock and control.



Visible smoke after feeding is a cue to investigate batch size, moisture and flame recovery.

06 / SETUP AND IGNITION

Assembling & Filling the Kiln

Assembly and ignition follow the kiln manufacturer's instructions and the site plan.



Assembled kiln: confirm level site, secure panels and safe access.



"Bird's nest" of small dry sticks supports top-center ignition.

BEFORE IGNITION	OPERATOR ACTION
Assemble and seal	Inspect panel/hardware condition; seal panel-to-ground gaps with a soil berm to avoid unwanted lower air entry.
Load evenly	Use small dry sticks and branches. Arrange an even initial fill without protruding material, maintaining the intended top ignition zone.
Clear and wet	Remove adjacent debris, establish containment and pre-wet as specified in the approved site plan. The 5 ft / 10 ft field practices are not universal clearances.
Light from above	Use top-center ignition with a long lighter. Observe flame growth and the work area immediately.

TRANSIENT SMOKE VS PROBLEM SMOKE

Some smoke may appear before the initial cap develops. Persistent heavy smoke after feeding, especially with a weak flame, is an operational signal to pause and diagnose. No arbitrary time threshold is established.

06A / ASSEMBLY DETAILS

Inspect, fasten and seal the kiln

Follow the equipment manual. Verify stable assembly and close unintended gaps at the base before loading.



Inspect panel edges and fasteners for secure assembly.



Move and assemble panels with stable footing and safe hand placement.



Look down into the assembled kiln to check alignment and the interior.



Seal panel-to-ground gaps with soil so air does not enter below.

BEFORE LOADING

Confirm the kiln is stable, the work area is clear, the water supply works and the crew understands how the panels will be cooled and removed after the burn.

06B / INITIAL LOAD

Build a dry, even starter bed

Fine, dry branches ignite rapidly. An even initial fill helps establish a continuous flame and hot char bed.



Stage split wood nearby for later; begin with the driest small material.



Arrange kindling and small branches across the base.



Fill gaps with similarly dry branches for an even initial load.



Bring the initial fill to the rim without leaving protruding sticks.

DO NOT RUSH IGNITION

The first load defines how the thermal engine starts. Keep the loading method compatible with the kiln design and the site's ignition plan.

06C / TOP IGNITION

Light from a controlled position

The first flame can grow quickly. Confirm containment, personnel position and the approved ignition authority immediately before lighting.



Protruding sticks can fall outside the kiln and continue burning.



Use a safe approach and a long ignition tool.



Ignite near the top center of the prepared load.



Watch the first flame develop through the brush.

EARLY SMOKE

A brief startup plume may occur before a continuous cap forms. If heavy smoke persists or control is uncertain, stop adding biomass and follow the site plan.

07 / VISUAL DIAGNOSIS

THE OPERATOR'S MOST IMPORTANT FEEDBACK

Read flame and smoke together, then act.



STRONG: sustained flame and little visible smoke.



OVERFED OR TOO WET:

A major plume calls for an immediate feeding pause.

WHAT YOU SEE	WHAT IT SUGGESTS	RESPONSE
Strong cap, feed involved, little smoke	Heat and flame keep pace with volatile release.	Observe; feed again only after recovery.
Heavy white/gray plume after a batch	Moisture or batch load exceeds current flame capacity.	Pause feeding; check load, moisture, airflow, and exposure.
Small blue flames, less yellow, black char	Volatiles largely driven off; quench may be near.	Inspect remaining wood and ash trend.
Growing gray/white ash area	Finished carbon is oxidizing.	Do not sacrifice most char for a few unfinished pieces; prepare quench.

PAUSE RULE

WHEN IN DOUBT, WAIT FOR THE FLAME TO CATCH UP. Feed to the fire's capacity, not the operator's speed.

08 / CONTROLLED FEEDING

One batch, then recovery

The kiln is a continuously collapsing reactor: initial fill settles, making room for more feed.

FEED TYPE	PLACE	WAIT / CHECK
Small brush	Layer across the active surface in a controlled batch.	Confirm the new feed ignites and the cap returns before another batch.
Large piece	Put smaller feed below; hold the piece in strong flame and airflow.	Do not let partly converted wood disappear unnoticed into the char bed.
Split wood	Stand pieces around the inside circumference; work toward the center.	Layer 1 → flame catches up → layer 2. Do not bury the active flame.



Larger pieces suspended above small feed in the flame zone.



Full kiln, filled, last batch before it's allowed to burn for an hour or 2 ceasing the feeding - till we quench During these final hours we poke the coals with a pitchfork to find buried unfinished wood and bring it to the top. If we find multiple pieces, we will set up a secondary burn apparatus to remove the material from the first kiln to the secondary. We then quench the coals inside the kiln, once all the half-baked material is removed. This method allows us to quench and continue carbonization without affecting the flow of work.

PROBE → IDENTIFY → LIFT → RETURN → REASSESS

Use a suitable tool and safe position to expose half-converted larger pieces to active heat. Large pieces have less surface area per mass and need more time; avoid unstable leaning loads and unsafe reach.

08A / FEED PLACEMENT

Place difficult wood where the flame can work

Long, dense or large pieces consume more of the kiln's thermal reserve. Their position and the next batch size matter, especially with split wood or heart wood material.



Large branches stay exposed to active flames and top-entry air. Material is also burning and falling on the ground, always keep the kiln area relativity quenched and clear, and place material into the kiln.



Split wood burning clean in a kiln, Stage split wood separately so the operator can feed one controlled layer at a time.



Large branches stay exposed to active flames and top-entry air. Material is also burning and falling on the ground, always keep the kiln area relativity quenched and clear, and place material into the kiln.



Larger logs are stacked vertically, burn more efficiently.

ONE LAYER, THEN RECOVERY

When feeding split wood vertically around the inside edge, let the flames catch up to the first layer before placing the next. Keep unfinished large pieces visible and accessible.

09 / RESPONSE

I JUST ADDED A BATCH. WHAT HAPPENS NEXT?

Use this sequence each time the fuel changes.

OBSERVATION	DECISION / ACTION
Flame promptly returns and feed is actively involved	Keep watching. Prepare the next controlled batch, but wait for recovery.
Flame drops or smoke grows	Stop feeding. Check whether the batch was too large, wet, or dense. Let the cap recover.
Smoke cannot be corrected promptly or affects people/roads	Apply the project stop-work and smoke plan; stabilize, suppress, or quench as directed.
Large pieces sink under flame before conversion	If safe, probe and move them back to the active surface.
Char level falls below rim while the cap is strong	Consider a controlled next batch; falling level alone is not approval to feed.
No useful feed remains or ash is increasing	Let the final feed finish as appropriate, then quench before needless carbon loss.

DO / AVOID

DO	AVOID
Begin with dry, small material; allow flame recovery.	Build the initial fire from the wettest slash on site.
Keep unfinished large wood in the active zone.	Bury dense pieces by continued feeding and assume they are fully converted. Poke the pile.
Quench a mostly finished char bed.	Burn the whole bed to ash while chasing the final logs.
Stand clear of flame cap	Don’t stick your face, arm or body inside the kiln unless you are expertly trained or advised on safety.

10 / END OF BURN

Recognize the quench point

Quenching is simultaneously a safety step and a carbon-preservation decision.



Late burn: blue flame and glowing char, with whitening on exposed surfaces.



Final stage remains : look for unfinished yellow flame and settling, white ash forming, unfinished quenched wood emits blue smoke.

SIGN	INTERPRETATION
Many vigorous yellow flames	Remaining feed may still be releasing volatiles; continue controlled observation if safe.
Small blue flames / predominantly glowing char	Late conversion; inspect the larger pieces and decide when to quench.
Surface whitening and rising ash	Some carbon is oxidizing; do not pursue perfect conversion of every last log at the expense of the batch.
Unconverted large logs	Separate, rework safely if feasible, or quench separately; record remaining material.

JUDGMENT, NOT A TIMER

An almost finished bed may be quenched even when a few pieces still show yellow flame, to preserve the converted carbon. The project plan and authority govern timing and method.

11 / COLD-OUT

Quench in stages; verify cold-out

Control steam, hidden heat, falling panels, carbon dust, and reignition.

STAGE	ACTION
1 Stop oxidation	Wet exposed char from a safe position, using the approved water supply and nozzle.
2 Cool hardware	Cool the fasteners and panel connections before handling. Follow the manufacturer's dismantling method.
3 Expose the bed	Open panels only after stabilization; keep a safe approach and suppress newly exposed embers.
4 Spread thin	Field practice: spread char to about 1 in so water can penetrate.
5 Agitate and wet	Turn and wet the bed to expose hidden hot pockets while controlling steam and char dust. Work Slow. Charcoal dust is hazardous.
6 Isolate large pieces	Remove incompletely converted pieces and quench them separately; they can reignite.
7 Verify and document	Recheck for heat, steam, embers and reignition under the adopted cold-out and patrol plan. Record final inspection and custody.



Wide spray from a safe position during quench.



Move the char while wetting; steam can hide persistent heat.

VERIFY COLD-OUT

Monitoring duration and inspection method must be set in the site plan. Time alone does not establish cold-out. Respirator use follows the applicable program.

11A / OPENING AND FINAL COOLING

Expose hidden heat before releasing the site

Cool panels, move the bed and wet incompletely converted pieces separately. Steam can indicate a remaining hot spot, blue smoke is incomplete.



A mostly converted bed can be approaching quench.



push the kiln body in to loosen the panel.



Once pushed in from the top you can pull the kiln body away



Wet the exposed bed while identifying large pieces for separate quench, Spread and turn the char while wetting; check for heat and steam.

COLD-OUT IS DEMONSTRATED

Document the final inspection, any needed recheck and who retains responsibility for the site. A fixed wait time by itself does not prove extinguishment.

12 / Kiln Capacity and Wood Throughput

Understanding Kiln Capacity and Wood Throughput

KNOW YOUR SPACE

The kiln's physical volume is not the same as the amount of wood processed or the amount of finished biochar produced. During operation, material collapses as water and volatile compounds leave, allowing additional wood to be added.

MEASURE	VALUE	WHAT IT MEANS
Physical kiln volume	≈ 5.6 yd^3	Approximate internal geometric volume of the kiln. This is not total wood throughput.
Observed finished biochar	≈ 3 to 4 yd^3 per burn	Approximate bulk volume of quenched finished char under experienced operation.
Estimated incoming wood	≈ 4,600 to 6,100 lb per burn (4-6 hours)	Planning estimate for wood at approximately 20% moisture, based on the assumptions below.

5 × 5 × 5 FEEDSTOCK PILE	APPROX. WOOD PACKING	APPROX. DRY WOOD IN PILE*	APPROX. PILES TO EQUAL 2 DRY TONS	WHAT IT LOOKS LIKE
Very loose branch slash	10%	300 to 350 lb	**11 to 14 piles**	Crooked branches, lots of open air, needles and small limbs
Typical hand-piled conifer slash	15%	445 to 525 lb	**8 to 9 piles**	Mixed branches and small stem wood with moderate voids
Tight mixed slash	20%	590 to 700 lb	**6 to 7 piles**	Better bucked and organized material, fewer large air spaces
Clean, compact small stemwood	25%	740 to 880 lb	**4.5 to 5.5 piles**	Straight rounds or pieces packed much more efficiently
Dense hardwood, 20 to 25% packed	20 to 25%	≈900 to 1,130 lb	**≈3.5 to 4.5 piles**	Heavy bole and heartwood-rich material with relatively little air



Slash Piles Near a Kiln

13 / THROUGHPUT

ONE KILN SPACE, MANY FEED BATCHES

MATERIAL	USDA OVEN-DRY WOOD DENSITY	DRY WOOD IN ONE 5 × 5 × 5 PILE	PILES FOR 2 DRY TONS
Ponderosa pine	23.7 lb/ft^3	≈593 lb	≈6.7 piles
Douglas-fir	28.1 lb/ft^3	≈703 lb	≈5.7 piles
Tanoak / dense hardwood example	36.2 lb/ft^3	≈905 lb	≈4.4 piles

BURN TIMES

Burn time and windows must be calculated, wet wood takes roughly 30-50% more time to burn than dry. Burns can last up to 8 hours, Burns are always conditional on environmental factors, safety, logistics, local ordinances and regulations,

FEEDSTOCK CHARACTER	PILE CHARACTERISTIC	MASS PER PILE	EFFECT DURING KILN OPERATION
Fine dry slash	Very bulky, high air content	Low	Ignites readily and collapses quickly. Requires frequent feeding because a large-looking pile may contain relatively little wood.
Mixed branch slash	Moderate air space	Low to moderate	Good general kiln feed when sorted by diameter. Represents the USDA reference operating condition reasonably well.
Small rounds / stemwood	More solid wood per pile	Moderate to high	More energy and mass enter with each layer. Individual pieces take longer to carbonize than fine slash
Split bole wood	High mass and relatively little air	High	Useful for larger stem material, but pieces should be reduced to the acceptable kiln size. Dense layers should not be loaded so heavily that the flame cap is smothered.
Heartwood-heavy / dense wood	High solid-wood density	High to very high	Same apparent pile may contain substantially more dry biomass. Allow more time for complete conversion of individual pieces.
Wet slash	Volume may look unchanged, but water adds mass	Variable	More heat is spent evaporating water. Feed more carefully and expect reduced tolerance to rapid loading.
Oversized rounds	High mass concentrated in thick pieces	Very high per piece	Published USDA Ring of Fire specification lists a 4-in maximum diameter. Split or reduce oversized material rather than assuming normal burn performance.



An initial branch fill illustrates static volume; later batches reuse the same space.

14 / NUMBERS

Field numbers at a glance

Every number below retains its provenance and practical limit.

ITEM	VALUE	STATUS / LIMIT
Preferred feed moisture	~20% or less	Field practice; meter method and material variability matter.
Initial dry wood	~1–2.5 in diameter	Field practice.
Routine diameter ceiling	6-8 inch	Field practice; also reported in a published protocol.
Typical cut length	~6–7 ft	Field practice; verify site handling and kiln fit.
Clear debris / pre-wet	5 ft / 10 ft radius	Field practice; not a universal safety setback.
Field char output	~3-4 yd^3	Experienced-operator observation; conditions not controlled.
Field woody input	~6,000 lb maximum stated	Field estimate; measurement basis and kiln applicability unverified.
Quench spread depth	~1 in	Field practice; verify full extinguishment.
Current product geometry	7.6 ft Ø × 40 in; 5.6 yd^3	Manufacturer's current model; not necessarily the field unit.

15 / LOGBOOK

Field record • before and during

Copy this worksheet for each kiln and burn. Use measured values where possible.

BEFORE IGNITION	ENTER
Date / site / coordinates	_____
Kiln ID, model, inside dimensions	_____
Lead, crew, ignition authority	_____
Permit / burn-day / plan reference	_____
JHA + medical plan / communications	_____
Weather source, onsite readings, smoke plan	_____
Water, suppression, backup verified	_____
Feedstock species / condition	_____
Meter readings / sampling method	_____
Dry / intermediate / wetter fractions	_____
Pile A L × W × avg H → loose yd^3	_____
Pile B L × W × avg H → loose yd^3	_____
Known mass (basis) / estimate source	_____

DURING THE BURN

IGNITION / FLAME CAP	BATCHES / OBSERVATION
Time _____ initial feed _____	Cap established _____ Major batches _____
Wet-feed batches _____ final feed _____	Smoke events / cause / corrective action _____
Weather rechecks and stop triggers	_____

16 / LOGBOOK

Field record • quench and release

No departure until the applicable cold-out and transfer criteria are met.

AFTER THE BURN	ENTER
Quench start / finish	_____
Water used, if measured	_____
Final char bulk volume / measurement	_____
Unconverted material / separate quench	_____
Ash fraction or observed ash trend	_____
Hot spots / steam / rechecks	_____
Final inspection time and method	_____
Responsibility transfer / authority	_____
Incident, smoke, weather, material notes	_____
Operator signature / reviewer	_____

USE RECORDS TO ESTABLISH LOCAL PERFORMANCE

After repeated measured burns, compare pile dimensions, known feed mass, moisture classes, batch counts and char output. Until that dataset exists, leave pile-to-burn and cord-to-char factors unspecified.

TECHNICAL VERIFICATION REGISTER

OPEN ITEM	HOW TO RESOLVE
Wind go / no-go and smoke limits	Adopt site- and authority-approved numerical prescription and monitoring interval.
Cold-out and patrol duration	Adopt appropriate verification, revisit, and handoff requirements for local conditions.
Actual kiln geometry and throughput	Measure this unit; log staged loose volumes, weighed feed and repeated burns.
1,600 lb and ~3 yd^3 field claims	Locate underlying field records and define mass moisture basis / output measurement.

REFERENCES / WORKING LIMITS

Where the measured figures come from

Apply manufacturer specifications only to the model in use. Field estimates should be checked against measured burn records.

SOURCE	USED FOR / LIMIT
Wilson Biochar, Ring of Fire kiln, wilsonbiochar.com/ring-of-fire-kiln/ (accessed 23 Sep 2026).	Current manufacturer product dimensions and stated capacity; actual deployed unit must be checked.
Wilson, Bekker & Feher (2024), Journal of Visualized Experiments, doi:10.3791/65543.	Published Ring of Fire research protocol, including the 15 cm routine woody diameter.
USDA Forest Service, National Forest Log Scaling Handbook, ch. 81, fs.usda.gov/im/directives/fsh/2409.11/2409.11-NF%20LOGSCALING%20HDBK.pdf.	Definition of a standard cord as 128 ft^3 of stacked wood, which includes voids.

Before using this guide

This guide supports trained crews working under their approved site plan, equipment instructions and local authority. Confirm permits, weather and smoke prescriptions, medical arrangements and cold-out criteria for every deployment.

OPERATING OBJECTIVE

Establish and maintain a clean, hot, sustained flame cap that combusts released gases while protecting developing char from unnecessary oxidation. Observe → interpret → adjust → observe again.

MEASURE YOUR ACTUAL UNIT

Deployed kiln ID _____ measured inside diameter _____ ft usable depth _____ ft. Record serial/model and changes to assembly. Repeat field trials to relate measured piles, feed mass, batches, and finished char.