

# Build a Pallet Fueled Outdoor Wood Stove

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### **Introduction**

This will be a very rewarding project, if you require a high capacity outdoor wood burning stove, but are concerned about the cost of commercial units. This unit was designed to accept 10 -13 full size pallets, and was built for about \$1600. You should also budget an additional \$300 - \$600 to plumb the completed unit into your existing heating system. These costs will vary, depending on your current or proposed heating system design.

This stove features:

- A large 90 cubic ft. firebox measuring 1/4" thick by 52 " wide x 50" deep x 60" high
- A 280-gallon capacity water jacket
- A large, water filled, loading door
- Automatic, adjustable, thermostatic control of the water jacket temperature
- A blower induced, powered damper, draft control system
- An adjustable door hinge system
- A complete design requiring no additional housing
- An open vent design, preventing the possibilities of dangerous pressures
- The ability to burn any type of pallets or other wood without the worry of creosote build-up and potential chimney fire

Included in this plan set is:

- A complete material list, including sources
- Construction tips learned from building prototypes
- Step by step construction drawings
- Electrical and plumbing schematics
- Start up and maintenance instructions
- An extensive photo gallery of the stove construction
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This project may seem challenging at first, but with time and patience, you'll be able to build your own outdoor heating plant, to meet your home heating needs. You can then; take comfort knowing that your home heating bills can remain safely, controllable.

This is a faxable list of the plate and structural steel required for this project.

### Plate Steel List

Quantity	Size (L x W x Thickness)
2	60" x 50" x 1/4"
1	62" x 52" x 1/4"
2	50" x 52" x 1/4"
2	66" x 60" x 3/16"
2	66" x 53" x 3/16"
2	60" x 54" x 1/8"
1	58" x 50" x 3/16"
1	51"x 46"x 1/8"

### Structual Steel List (Boiler)

Quantity	Size (L x W x Thickness)
2	1"x 3/16"x 10' Flat
3	1"x 1/4"x 10' Flat
3	1"x 1"x 1/8"x 10' Angle Iron
4	1"x 1"x 3/16"x 10' Angle Iron
2	1-1/2"x 1-1/2"x 3/16"x 10' Angle Iron
1	1-1/2"x 1-1/2"x 1/4"x 10' Angle Iron
2	1-1/2"x 1-1/2"x 1/4"x 10' Square Tube
1	2"x2"x 4' Square Tube

### Structual Steel List (Boiler Enclosure)

12	1-1/4"x 1-1/4"x 1/8"x 10' Angle Iron
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From: Build a Pallet Fueled Outdoor Woodstove  
<http://www.deb-design.com>

## Damper/Other Parts List

### Damper Parts List

Quantity	Description	Specifications
1	Blower	Grainger part # 4C447
1	Damper	Made from coffee can bottom or similar ( 5" diameter)
1	Damper motor	Alliance Laundry Systems part # F380932
1	Damper linkage	12"x 12" key stock
1	Connecting arm	1/8" x 1/2" x 2" metal flat stock
2	Motor housing	Weatherproof electrical boxes
4	Motor mounting screws	10-32x3/4"
2	Linkage mounting screw	1/4"x4" carriage bolt, nuts, and washers
1	Motor shaft connecting screw	6-32x1" stainless screw with locknut
5	Connecting screws	1/4"x 1" screws
1	Motor cover	Coffee can or similar
1	Damper housing cover	1/8"x 12"x12" metal flat stock or similar
30'	Electrical wire	14 guage
10'	Flex-power wire sheathing	1/2"
3	Weatherproof connectors	1/2"
<b>Other Materials</b>		
1 pc.	Thermostat	Local Hardware store or Grainger part # 2E050
1 pc.	Circulator pump	Grainger part # 2P310
1 pc.	Cast iron flange set for circulator pump	Grainger part # 4RC79 (1-1/4")
1 pc.	Purge pump	Salvaged jet pump or similar
4 pcs.	Hose bibs	1-1/4 inch
1 pc.	Gate valve for boiler drain	3/4 inch
2 pcs.	Gate valves for boiler inlet/outlet lines	1-1/4 inch
10 ft.	Reinforced PVC hose	1-1/4 inch
4 pcs.	Stainless hose clamps	1-1/4 inch
1 pc.	Electrical service box with cover (optional)	40 amp/2 breaker
2 pcs.	Junction box with cover	4"
4 pcs.	Cable clamps	1-1/4"
4 pcs.	Stove gasket kits	(Thermoseal #206 1" thick X 6' long) available at most hardware stores, or building centers

## Damper/Other Parts List

Miscellaneous 1-1/4" galvanized pipe and fittings (nipples, elbows, unions, etc)		
Miscellaneous electrical supplies for control circuitry from the house		
Stove thermometer (optional) Grainger part # 2A611		
2 Rolls	Non-faced fiberglass insulation	6" thick x 24" wide
8 pcs.	Steel Panels for Stove Sides	36" wide x 8' long
2 pcs.	Steel Panels for Stove Roof	36" wide x 8' long
2 Boxes	Panel Screws	1-1/4" long

Note: To find an Alliance Laundry Systems parts dealer near you, use the form located at:

<http://www.speedqueen.com/vend/locator.htm>  
or contact Customer Service at 920.748.3121

To located a Grainger branch store, please go here:

<http://www.grainger.com/Grainger/locator.jsp>  
or visit your local hardware store and ask if they have a catalog.

## Numbered Parts List

**The following "Item Numbers" are noted on the Drawings**

Item Number	Description	Specifications
1	Firebox Bottom	50" x 52" x 1/4"
2	Firebox Side	60" x 50" x 1/4"
3	Firebox Side	60" x 50" x 1/4"
4	Firebox Top	50" x 52" x 1/4"
5	Firebox Back	62" x 52" x 1/4"
6	Water Jacket Front	66" x 60" x 3/16"
7	Water Jacket Bottom	60" x 54" x 3/16"
8	Water Jacket Side	66" x 53" x 3/16"
9	Water Jacket Side	66" x 53" x 3/16"
10	Water Jacket Rear	66" x 60" x 3/16"
11	Top Support	1-1/2"x 3/16"x 58" Angle Iron
12	Flue Pipe	8" Diameter x 8" High x 1/4" Thick Tubing
13	Water Jacket Top	60" x 54" x 1/8"
14	Outer Door Gasket Channel (Top)	1"x 1/4"x 54" Angle Iron
15	Outer Door Gasket Channel (Bottom)	1"x1/4"x 54" Angle Iron
16	Outer Door Gasket Channel (Side)	1"x 1/4"x 62" Angle Iron
17	Outer Door Gasket Channel (Side)	1"x 1/4"x 62" Angle Iron
18	Inner Door Gasket Channel (Top)	3/4"x 1/4"x 54" Flat Steel
19	Inner Outer Door Gasket Channel (Bottom)	3/4"x 1/4"x 54" Flat Steel
20	Inner Door Gasket Channel (Side)	3/4"x 1/4"x 62" Flat Steel
21	Inner Door Gasket Channel (Side)	3/4"x 1/4"x 62" Flat Steel
22	Door Frame (Top)	1"x 1/4"x 54" Angle Iron
23	Door Frame (Bottom)	1"x1/4"x 54" Angle Iron
24	Door Frame (Right Side)	1"x 1/4"x 62" Angle Iron
25	Door Frame (Left Side)	1"x 1/4"x 62" Angle Iron
26	Fire Door Back	58" x 50" x 3/16"
27	Fire Door Front (Door Cutout Remnant)	Approximately 59" x 52" x 3/16"
28	Firedoor Top	1"x 1/4"x 52" Flat

## Numbered Parts List

29	Firedoor Bottom	1"x 1/4"x 52" Flat
30	Firedoor Side	1"x 1/4"x 60" Flat
31	Firedoor Side	1"x 1/4"x 60" Flat
28A	Draftway Top	1"x 1/4"x 16" Flat
29A	Draftway Bottom	1"x 1/4"x 16" Flat
30A	Draftway Side	1"x 1/4"x 6" Flat
31A	Draftway Side	1"x 1/4"x 6" Flat
32	Fire Door Upper Support	1-1/2"x 1/4"x 60" Square Tube
33	Fire Door Lower Support	1-1/2"x 1/4"x 60" Square Tube
34	Firedoor Hinge Side Support	1-1/2"x 1/4"x 60" Square Tube
35	Firedoor Upper Latch Side Support	1-1/2"x 1/4"x 30" Square Tube
36	Firedoor Lower Latch Side Support	1-1/2"x 1/4"x 30" Square Tube
37	Firedoor Handle	1-1/2"x 1/4"x 60" Square Tube
38	Crank Screw	3/4-10 x 16" Long Threaded Rod
39	Crank Handle Support	1"x 1/4"x12" Flat Steel
40	Inner Crank Screw Stop	3/4-13 Nut
41	Inner Crank Screw Washer	3/4" Flat Washer
42	Outer Crank Screw Washer	3/4" Flat Washer
43	Outer Crank Screw Stop	3/4-10 Nut
44	Crank Screw Weld Flange	3/4-10 Nut
45	Door Handle Bolt	7/16-18 x 4-1/2" Long Bolt
46	Door Handle	3/8"x 2" Pipe Coupling
47	Door Handle Lock Nut	7/16-18 Nut
48	Door Handle Lock Nut	7/16-18 Nut
49	Door Latch Support	1-1/2"x 3/16"x 6" Angle Iron
50	Door Latch Nuts	3/4-10 Coupler Nut (2 Required)
51	Lower Hinge Support Bracket	2"x 1/4"x 12" Square Tube (Cut in half lengthwise)
52	Upper Hinge Support Bracket	2"x 1/4"x 12" Square Tube (Other half of item 51))
53	Adjustable Hinge Bolt (4 Required)	1/2 x 4" Carriage Bolt
54	Lower Door Hinge	2"x 1/4"x 16" Square Tube
55	Upper Door Hinge	2"x 1/4"x 16" Square Tube
56	Door Water Inlet	1-1/4" Pipe Coupler
57	Door Water Outlet	1-1/4" Pipe Coupler

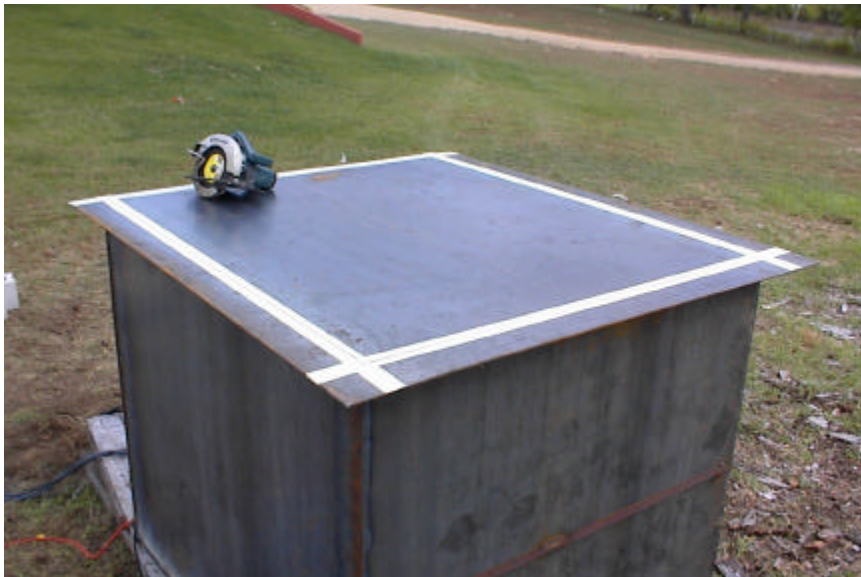
## Numbered Parts List

58	Upper Door Hinge Pin	5/8 x 5" Machine Bolt
59	Lower Door Hinge Pin	5/8 x 5" Machine Bolt
60	Overflow Coupler	3/4" Pipe Coupler
61	Upper Draftway Cover Support	2"x 1/8"x16" Angle Iron
62	Lower Draftway Cover Support	2"x 1/8"x16" Angle Iron
63	Draftway Side Cover Support	2"x 1/8"x6" Angle Iron
64	Draftway Side Cover Support	2"x 1/8"x6" Angle Iron
65	Boiler Inlet Coupler	1-1/4" Pipe Coupler
66	Boiler Outlet Coupler	1-1/4" Pipe Coupler
67	Fill Tube Coupler	1-1/4" Pipe Coupler
68	Drain Coupler	3/4" Pipe Coupler
69	Left Baffle Support	1"x 1/4"x 46" Angle Iron
70	Right Baffle Support	1"x 1/4"x 46" Angle Iron
71	Baffle	51"x 46"x 1/8"

## Construction Tips

- ◆ If you have access to a wire feed welder, try and use it, or better yet, if you don't know how to weld, have a friend do it for you. I used an arc welder, which did the job, however, a wire feed would have sped up the welding process and yielded less initial leaks.
- ◆ Plan on a minimum of 80 hours to construct the firebox, jacket, and firedoor assemblies. This does not include water-testing/re-welding, insulating, or construction of the housing.
- ◆ Take your time. Start many months before winter. Make it a fun project. Invite some friends over to help, especially to help rotate and handle the boiler as it takes shape. Completed, it will weigh a minimum of 2300 lbs.
- ◆ I used c-clamps, pipe clamps, and a floor jack, to help force and hold components into position, for welding.
- ◆ I used a sabre saw with a fine tooth metal cutting blade, to cut the flue pipe opening in the jacket top, and a circular saw with a 7 inch abrasive metal cut off blade for the firedoor, and similar cuts. Make sure the saw has a metal guard, as the sparks made from cutting metal, would quickly destroy a plastic guard.
- ◆ Weld all joints on both sides, if possible. If you use an arc welder with welding rods, chip off all slag before water-testing, as the slag will conceal leaks. Be patient during all water-testing phases. This is the obviously, the most important part of the construction. If water is able to leak into the firebox, the life of the stove will be severely shortened. Water leaking from the water jacket to the outside, however, is not as much of a threat, but rather a nuisance.
- ◆ Place your completed boiler to the southeast of your house, if possible, with the loading door facing west. This will keep smoke away from your residence a majority of the time, and also tend to minimize smoke, during loading. If you plan to use your stove to heat your pool, plan the stove location so that exhaust smoke doesn't blow across the pool area. This stove design is to be placed outdoors, not inside a building.
- ◆ Use this procedure to weld pipe couplers:
  - a) drill and tap the coupler location, for a 1\4-20 bolt
  - b) secure the coupler with a bolt and fender washer
  - c) weld the coupler to the boiler and allow to cool
  - d) remove the bolt and enlarge the hole ( weld or drill )

Fully weld the front to the firebox assembly. This may require rolling the assembly so that all welding is done in a horizontal direction. The author flipped the assembly forward with the front down to facilitate the final welding process as shown here.



Orient the firebox so the front is skyward. Mark the fire door opening on the face of the front. The mark should be 1/2" inward on each side so a welding flange will be available after the door opening is cut. The author originally planned to use 2" wide masking tape to facilitate the marking but found a black magic marker to work the best.

Cut the door opening. The author used a circular saw with abrasive metal cutting blades. The saw needs to have a metal blade guard as a plastic guard will heat up and deform from the heat. This is a slow job and you could use 4-6 blades during the process. Check your progress periodically to insure you are not cutting into the side-wall. This is why straight firebox side-walls are necessary.



Move the stove to its final destination and raise it stove to the desired level.



The author used solid 8" wide x 16" long by 4" thick solid concrete blocks on solid, undisturbed ground along with varying thickness' of plywood and shim material. The stove should be level and solidly supported around the entire perimeter.

The completed stove with water will easily weigh more than 2 tons so take your time with the support installation and leveling.



### ***Construct the Damper Assembly***

This damper assembly is built with a blower fan that utilizes a small gear motor to open and close the damper. The design uses a 2-stage draft control system. When the primary boiler thermostat closes, the damper is energized allowing airflow into the firebox. If insufficient natural draft occurs and the boiler water temperature drops further, the blower fan is energized by a secondary thermostat, insuring continued combustion and coal life.



The following procedure documents the construction of the damper assembly.

- 1) Fasten 2 weatherproof electrical boxes together with small metal straps as shown in Figure 1.
- 2) Print the motor template from the following page, cutout the template, and fasten it to the box assembly as shown with tape or glue.(See Figure 1)
- 3) Mark the spots to be drilled with a center punch or nail, and drill out the holes to the diameter specified on the motor template.
- 4) Remove the template and disassemble the 2 electrical boxes.

### **Operation of your new heating plant**

Initially, check the water level and reload the firebox every 12 hours, until you are satisfied that the system is functioning properly. At this point the loading could be done daily, depending on the heat load, with a water level check, weekly. If you are burning pallets be alert for flare-ups when you open the fire-door. It is advisable to only fill the stove when the firebox is near empty. The author usually also positions all the pallets close to the stove to minimize the amount of time the fire door is open. Rake some of the coals towards the fire door prior to loading. This helps get the new load started quickly. As a rule, you'll only have to start a new fire, once per season. Coals last a long time so even if the fire seems dead, you'll be surprised how easily a new load starts after stirring the coals.

Once per week or two, clean out the firebox by removing all but a couple inches of the firebox ashes. Leave some embers so that the fire will restart, after reloading.

During the off season, add some automotive cooling system rust inhibitor to the stove, and circulate it, prior to turning the pump off.

### **Cutting wood for your new heating plant**

Since the author has been using these types of stoves, there has been no need to split wood. The firebox can accommodate pallets as well as extremely large logs, however you still need to lift them. If you have a large diameter log, 30 inches as an example, simply cut the log into 3-4" pancakes, or what ever thickness you can easily lift. This may mean more saw cuts, but this is much easier than splitting wood, even with a power splitter. You are not limited to only hardwood with this stove. It will burn anything, including unseasoned wood.

### **Additional uses for your stove**

- ◆ Heat your domestic hot water using a "side arm water heater" coupled to your stove.
- ◆ Heat your pool or spa using a liquid to liquid heat exchanger coupled to your stove.

Construction plans for both of these projects are available through DEB Design, at <http://www.deb-design.com/>

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