## HOW TO BUILD A HOPS BALER <br> WITH A LOG SPLITTER

## By Ian Pfeiffer and Brian Pinand




The
UNIVERSITY of VERMONT EXTENSION

## USDA

 National Institute of Food and Agriculture
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## THANKS AND DISCLAIMER

Brian and I would like to extend our sincere thanks firstly to Heather Darby and Rosalie Madden of UVM Extension, our advisors for this project. The guidance and patience they provided was indispensable to the completion of the baler. This project was funded in part by the Vermont Agricultural Innovation Center through the United States Department of Agriculture, Rural Development. These funds were secured through the efforts of Senator Patrick Leahy. Without these funds, the opportunity for this project would not exist. We would like to extend a heartfelt thanks to Professor Mike Rosen, our senior project advisor and a veritable font of knowledge and expertise. We would last like to thank UVM Senior Experience in Engineering Design (SEED), which provides all UVM engineers with senior projects and guidance to encourage completion. Without the friendship, funds, and guidance from all these great people and agencies, we would be lost. Thank you for everything.

> Sincerely,
> Ian Pfeiffer and Brian Pinand

This report and associated design documents are provided "as-is" without guarantee or warranty of any kind to communicate the findings of a research project with the aim of developing a small-scale hops baler for use in the Northeast US. The design is based on standard practices in agricultural equipment operation. This description of the machine is based on the first year of operation (one harvest season), during which several modifications were made. The design team expects future modifications will also be made as improvements are sought to the machine's functionality and as maintenance is required. Additionally, the design should be reviewed for relevance to the user/reader's specific location and operation. The design of this machine assumes experienced and attentive operation teams who demonstrate safe practices when using equipment. The machine is not intended to be operated unattended or by unskilled operators. Risks of bodily injury include, but are not limited to, those that may occur as the result of various pinch points and the pressure and temperature of hydraulic fluid while operating the equipment. Any deviation from the design may create safety risks that are unknown to the designers. UVM, NeHA, their employees and their contractors do not assume liability for any actions or machine assemblies that result in personal injury or loss of property or damage to property on the part of the user of these documents or any operators of the equipment.

## PARTS LIST

- $21 / 2$ in. $1 / 4$ in thick box steel- $61 / 2$ feet
- $\frac{1}{8}$ in thick 2 in angle iron- 22 ft
- $\frac{1}{8}$ in thick $1 \frac{1}{2}$ in wide flat bar- $71 / 2 \mathrm{ft}$
- $\frac{1}{4}$ in thick 2 in angle iron- 10 ft
- $4^{\prime} X 4^{\prime} 1 / 2$ in thick food grade plastic
- $1 / 4$ in stainless steel bolts and nuts-30 of each
- $\frac{1}{8}$ in diameter steel wire
- 2-wire clamps
- 4 clamps
- 1 fence wire puller
- 2-1 $1 / 2$ in diameter 400 lb pulleys
- 1- $\frac{3}{8}$ in stainless steel bolt and nut
- $2-\frac{3}{8}$ in 1 ft in length threaded rod
- $2-1 / 4$ in 1 ft length threaded rod
- 2-10 $1 / 2$ in long 250 lb turn buckles
- $1-1 / 4$ in thick 14 " X 14 " steel plate
- $2-\frac{5}{8}$ in diameter pintle
- Full over lay cabinet hinges


## THE FRAME

Cut 4 pieces of $\frac{1}{8}$ in thick angle iron to a length of 16 in .
On two of the pieces remove a $17 / 8^{\prime \prime}$ in. piece from one face of the angle iron on both sides (see figure A )


Align the 16 in. pieces into a square with the two cut pieces on opposite ends.
Weld together the intersections on the outside of the box.(See figure B)

(B)

## Cut 7 pieces of the $1 / 4 \mathrm{in}$. thick angle iron to a length of 16 in .

On one of the pieces cut $1 \frac{13}{16}$ in. off of both ends similar to the pieces cut previously
(See figure A)
Align the cut piece and two of the other pieces in a square and weld.
Place a 16in. length behind the three assymbled pieces and weld.(See figure C)


Cut four pieces of the $\frac{1}{8}$ in thick angle iron to a length of $301 / 2$ in long.
On two of the pieces cut a 15in section of off one side of the angle iron (See figure D)

(D)

Place the front face in between the two uncut $301 / 2$ in pieces of angle iron Line up the edges and get square than clamp and weld on the outside of the front face Next do the same thing with the back face making sure that the open side of the face is opposite the welds (See figure E)


Now using the two cut $301 / 2$ in. pieces align the uncut ends with the front face clamp in place and weld.

Next align and weld the cut ends to the top and bottom of the open side of the back face
(See figure F)


## SUPPORTS

Take one of the 16 in long pieces of the $1 / 4$ in. thick angle iron and weld onto the back frame with the corner of the iron 7in. away from the open side of the back plate. (See figure G)

Next take another $1 / 4$ in piece and weld it $21 / 2$ in away from the first so the two edges are adjacent.
(See figure G)


Weld the last piece of $1 / 4$ in thick angle iron to connect the two sides of the box that have been cut with the corner of the iron away from the opening. (See figure H)


Cut 4 pieces of $1 \frac{1}{2}$ in wide $\frac{1}{8}$ in thick flat bar to a length of 16 in.

Place one of the pieces of flat bar so it is connecting a cut side to a non-cut side, the bar should be placed $4 \frac{1}{2}$ in from the back of the box when it's in place weld. (See figure I) Another piece should be welded leaving a $51 / 2 \mathrm{in}$ gap from the first. (See figure I)

This is now the top of the box


The two remaining pieces of flat bar should be welded to connect the two uncut sides at the same measurements as the top two pieces. (See figure I)

## EJECTOR AND GUIDES

Cut three pieces of $\frac{1}{8}$ in thick angle iron, one $8 \frac{1}{2}$ in long piece and two 4 in long pieces.
Cut one piece of flat bar to a length of $81 / 2 \mathrm{in}$.
Weld the $81 / 2$ in piece of angle iron so the corner of the iron is towards the top of the baler and the flat surface is $71 / 2 \mathrm{in}$. from the bottom of the box. (See figure J)

Next weld the piece of flat bar so there is a 2in. gap above the angle iron. (See figure J)
Center the two 4in. pieces of angle iron so there is a 3in gap between them. (See figure J)


Cut a 2 foot piece of $\frac{1}{8}$ in thick angle iron
Cut one 1 foot section of flat bar and two $51 / 2$ in long pieces of flat bar
Align the two $51 / 2$ in pieces on both sides of the 1 foot piece of flat bar to make $a+$ and weld. (See figure K)

Next attach the angle iron to the + with the flat sides of the angle iron in line with the two sides of the $+($ See figure K$)$


Weld a pulley on the horizontal flat bar guide so that the center of the pulley is 2 in above the flat part of the angle iron and centered. The Pulley should just touch the corner of the angle iron. (See figure K)

Weld a second pulley on the top of the box in the opposite orientation of the first. The second pulley should be directly over the first.(See figure L)

(L)

Next take your fence wire puller and remove the rivet at the end of the bar so it can be removed from the handle. A grinder and a hammer work best. (See figure M)

(M)

Next remove the wire holder on the handle (See figure N ) by the same method used to remove the rivet there are three attaching the wire holder. Also grind down the curved edge on the back of the handle for a flat surface. (See figure O)


Next put the bar back into the handle, hold the puller next to the baler with the bar parallel with the top of the box and mark two holes.(See figure P) Drill the holes using a 3/8in bit. Cut a 4 in piece off of the 15 in scrap piece of angle iron from the frame and weld it to the top about lin behind the top support. (See figure P)


## Turnbuckles for Stress Relief

Drill two $1 / 2$ " holes on the top corners of the Baler Frame
Drill two corresponding holes into the wedge of the logsplitter
Attach the $10.5 " 250 \mathrm{lb}$ turnbuckles between the holes and tighten the turnbuckles


## THE SPINE <br> Cut a 30in piece of the box steel.

At one end drill $2,1 / 2$ in diameter holes through both sides of the steel The first hole should be placed in the center of the steel and the center of the hole should be $21 / 2$ in from the edge of the steel. The second hole should be centered at 5 in from the edge. (See figure Q)


Then the box steel should be centered on the bottom of the box with the holes at the front and welded into place.

Cut the box steel into two 13in pieces, two 6 in pieces and one $71 / 2$ in piece.
On both of the 13 in pieces cut a $45^{\circ}$ angle on one side, on the other side drill $2,1 / 2$ in diameter holes the first should be centered $11 / 2$ in from the uncut end, the next hole should be centered $51 / 2$ in from the uncut end. (See figure R )

Cut the $7 \frac{1}{2}$ in piece with a $45^{\circ}$ angle on both sides and on the same face. (See figure R)
The two 6 in pieces need to get a $45^{\circ}$ cut on both sides but on different sides consult figure R .


The legs for the log splitter should fit over the spine on the box and the holes should match. (see figure $S$ )


BEFORE WORKING ON THE LOG SPLITTER DRAIN THE HYDRALIC FLUID AND DISASYMBL THE SPLITTER

Remove the current legs of the log splitter with a grinder and remove paint from the bottom of the splitter. Center the legs you've just built and mark where you want to weld make sure the box can be attached with this leg location. Weld the legs to the body of the splitter.
(See figure T)


## THE RAM PLATE

Cut 4in off of the other 15in scrap piece from the frame, both pieces should now be 11in long. Weld these two pieces to the $14 \mathrm{X} 14 \frac{1}{4}$ in thick steel plate so they are centered and have a space between them of 8in.

Cut two 8 in pieces of the $\frac{1}{8}$ in thick angle iron. The placement of these as a bracket depends on the $\log$ splitter you are using make the measurements and weld in place.(See figure U)


## THE INTERIOR OF THE BOX

With your $4^{\prime} \mathrm{X} 4^{\prime}$ sheet of high density plastic you need to cut
Two pieces measuring 30 " X 16 "(top, bottom)
One piece measuring 15 "X16"(front left wall)
Two pieces measuring $15^{\prime} \mathrm{X} 15 "$ (door, front right wall)
One piece measuring $15 " \mathrm{X} 151 / 2 "$ (back wall)
One piece measuring $14 " \mathrm{X} 15^{\prime \prime}$ (ejector plate)
To attach the plastic to the box put all the pieces in place and clamp pieces may require some sanding to fit. When the pieces are in place using a hand drill and a $1 / 4$ in bit drill four holes to put bolts. Do not drill holes in the door piece.

## THE DOOR

Line up one pintle with the back edge of the box so that the flat edge is seven inches from the bottom and the pintle is on its thin edge, do the same on the other side. (See figure V)


Cut a piece of the $\frac{1}{4}$ in thick angle iron to a length of 20 in this will be the lock for the door. Install the full overlay cabinet hinges so when the door is open there is a smooth interface with the back wall.

## OPERATION

1) Loosen hydraulic relief nut on the front of the log splitter
2) Attach the box and the $\log$ splitter with $3 / 8$ " rod through both holes
3) Attach the steel ram plate to the front of the $\log$ splitter
4) Attach the turn buckles connecting the box to the wedge of the log splitter
5) Make sure the ejector plate is flush with the wall and the door is closed and locked
6) Fill the entire box with hops when full replace the lid and compress by pulling down on both handles, to return the ram release both handles
7) When the ram face is back at its original position remove the lid and fill the box with hops again
8) Repeat steps 5-7 until the bale is at the desired weight ( $15-25 \mathrm{lbs}$ )
9) When the bale is at the desired weight move the ram plate forward until aligned with the door opening.
10) When the ram plate is in the correct position stop it by releasing only one handle and securing the other in the down position with the wire loop.
11) Remove the door lock and attach the bag using the clamps one at each corner of the opening
12) With the bag in place use the fence wire puller to eject the bale into the bag
13) When you have the bale out vacuum seal the bag
14) Reset the baler by retracting the ram plate and the ejector, than close and lock the door
