




# PP Shredder Pro

This tutorial documents the build process of Precious Plastic Pro Shredder, as supplied by Citizen Scientific for the North American context.

 Difficulté **Difficile**

 Durée **5 jour(s)**

 Catégories **Machines & Outils, Recyclage & Upcycling, Robotique**

 Coût **5000 USD (\$)**

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## Introduction

Required skills:

Basic tools

Metal tapping

Power tools

Welding

## Matériaux

## Outils

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### Étape 1 - Tools

Hammer

(punch) for knocking out leftover metal slugs

Files

Mallet

Socket wrench( 2x)

Vice Grips

Files

Tape measure

Screwdriver

Marker

Angle Grinder

Bandsaw

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## Étape 2 - Table Parts

Parts Needed:

Aluminum Extrusion

Profile	Length (mm)	Quantity
8080	520	4
8080	600	4
8080	1200	2
4080	520	1
4080	455	1

data-sheets-value="{\"1\":2,\"2\":\"Corner Plates\"}"

## Étape 3 - Table Construction - Legs

### Tools

XX Socket Wrench

Screwdriver

### Parts

4x 8080\*600mm

2x 8080\*1200mm

4x Side Plates

32x + 13x T nuts

32x Washers

32x M8x16mm Bolts

### Steps

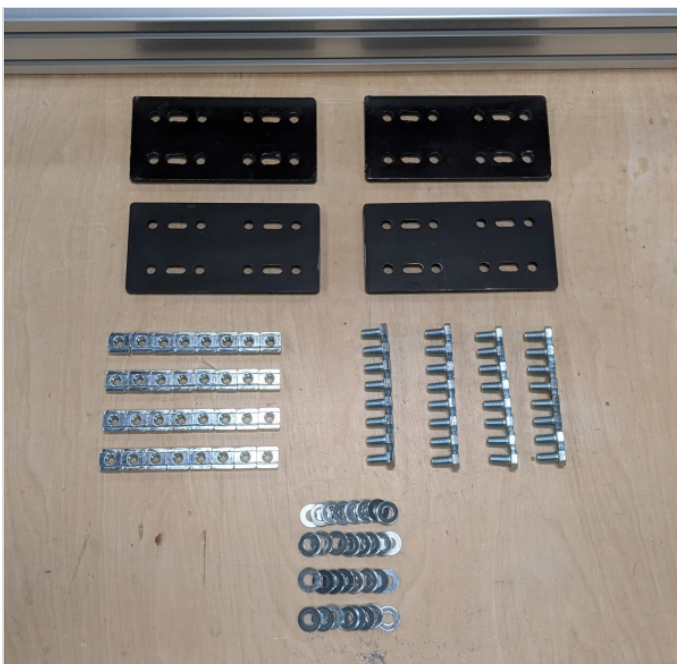
1. Lay one 1200mm beam horizontally in your workspace. Add a 600mm beam perpendicular at each end, forming a **staple shape**. (see image 5 for final shape reference)
2. Using 8 total washers, slide 2 at a time into each rail at the corner, approximating the hole pattern on the side plates. (image 2)
3. Using a screwdriver to position the T-nuts, add an M8x16 Bolt and washer through the side plate into each T nut. (images 3 and 4)
4. Secure with a socket wrench. Repeat on the other side of the 1200mm beam.

You now have a **staple shape**. Repeat.

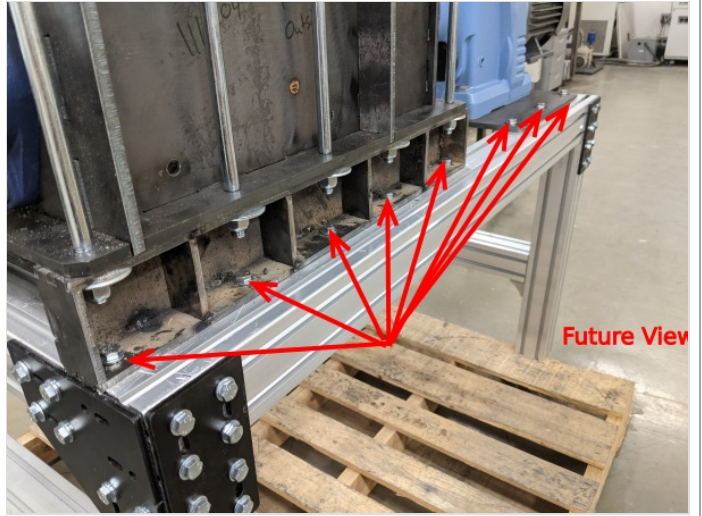
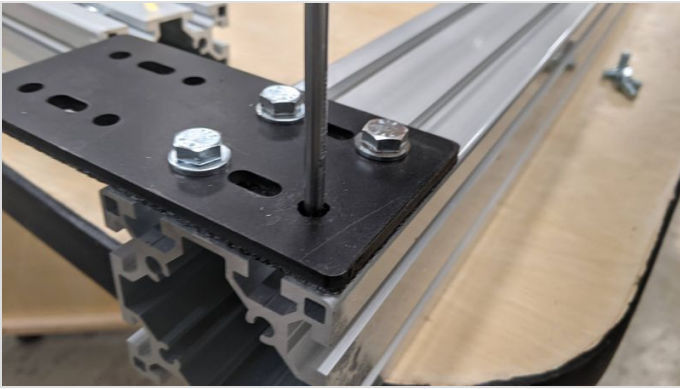
It is important to now denote which one of these will be your front and which will be your back. Just pick.

1. On the **BACK** staple, top side, inner track, add 8 T-nuts for later use. [image 6 shows what they'll hold in a future step]
2. On the **Front** staple, top side, inner track add 5

\*make sure these stay in place as you rotate the leg pieces and continue to build in following steps.







# Étape 4 - Table Construction - Side Joints

## Tools

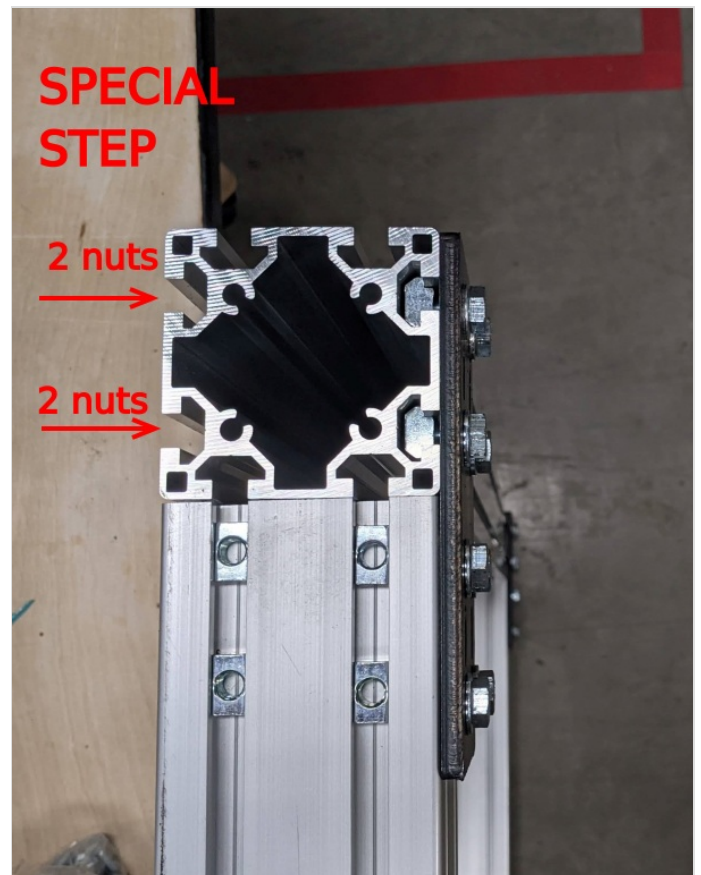
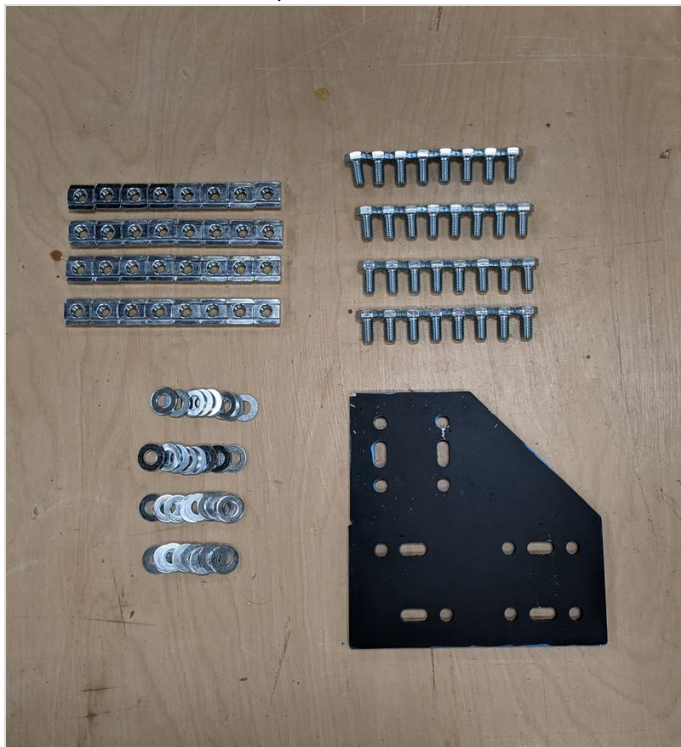
1/2" Socket Wrench  
Screwdriver

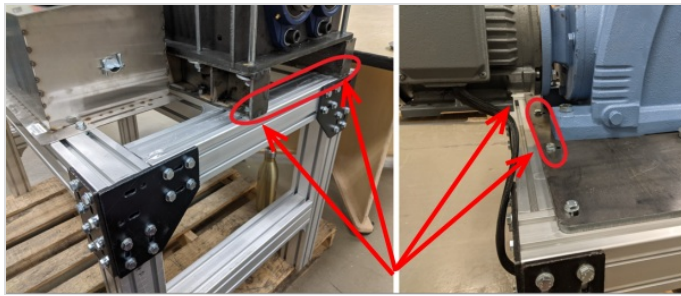
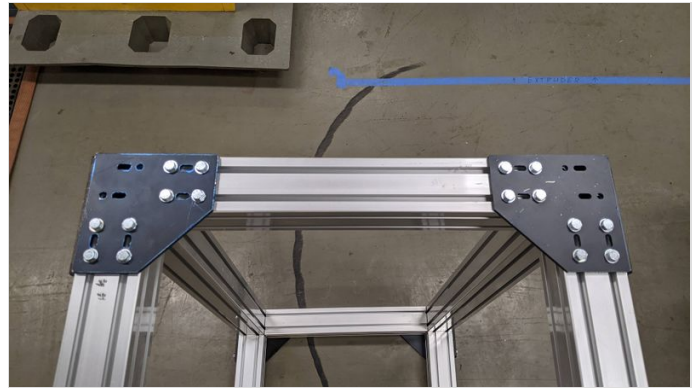
## Parts

2x 8080\*520mm  
4x Corner Plates  
32 + 12 + 4 (48x) T nuts  
32x Washers  
32x M8x16mm Bolts

## Steps

1. Stand one leg unit upward, so you can see down the 1200mm section. Slide 4 T-nuts total (2 in each rail) up to the corner joint. (image 2)
  2. **SPECIAL STEP:** on the 1200mm beam, opposite side from where the side plate was installed - Slide 2 nuts into each of the rails. These will be used in a future step. Repeat on the other 1200mm beam.
  3. Attach the side plate (image 3) using 4 M8x16 Bolts with 4 washers.
    1. NOTE: the 45° side should face the "bottom" of the eventual table.
  4. Repeat on the remaining three 600mm legs.
    1. NOTE: ensure that each corner plate **mirrors** each other across the 1200mm beam axis. They should be facing the same direction and away from the side plate from the previous step.
  5. Slide 8 total T-nuts into a 520mm beam. They should be split in half, 4 at one end, and 4 at the other. (Image 4)
  6. **SPECIAL STEP:** On only **ONE** of the 520mm beams, add 4 T-nuts, 2 in each rail on the opposite side that you used for Step 5. This will become the inside of the **right side rail**.
  7. (image 5 left) On the top of this rail, slide 2 more t nuts in the outside channel.
  8. (image 5 right) On the left side rail, slide 2 nuts on the top surface, inside channel.
  9. Combine the two "**staple**" sections by adding the 520mm beam (pre-loaded with T-nuts) using the same M8x16mm, washer combination as before. (image 5)
  10. Repeat on the other side. (image 6)
- You should now have a very solid table base!





## Étape 5 - Table Construction - Side Braces

### Tools

1/2" Socket Wrench  
Screwdriver

### Parts

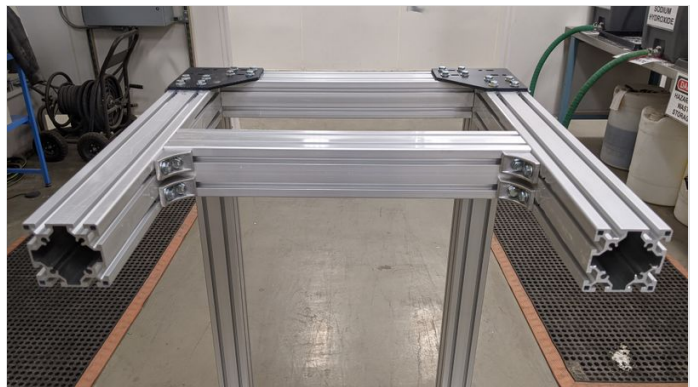
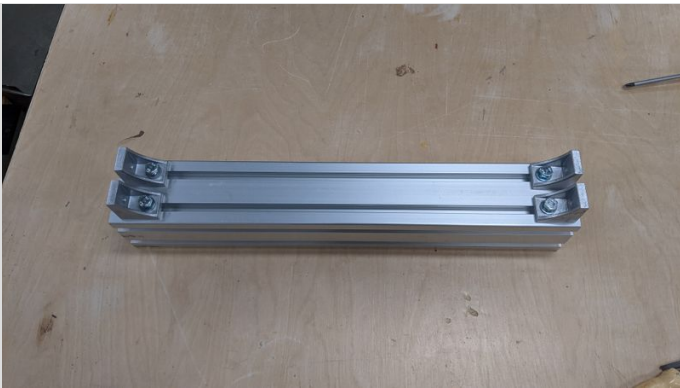
2x 8080\*520mm  
8x Brackets  
16x T nuts  
16x Washers  
16x M8x20mm Bolts

\*A quick note about bracket orientation. In image 2 you will see that the brackets are not the same on both sides. Here we have flipped one, so you can see the difference. One of the holes sits atop a raised lip, while the other is flush. The raised lip hole is *closer* to the brackets outside edge. The flush hole is *farther* from the outside edge. This matters for order of operations. When installing, you must install in the flush hole **first**, and the hole with the raised lip **second**. If you do it in reverse the bolt will block access to the other hole. :)

### Steps

1. Slide 4 nuts into the 520mm beam (2 in each rail).
2. Attach the 4 brackets loosely using M8x20mm bolts and washers. (image 3)
  1. Note the orientation of the holes. All 4 bolts should go in flush holes, not raised-lip holes. (figure 4)
3. With the table flipped on its end, position the 520mm beam in place, and slide 2 T-nuts in the rails to meet the brackets. Secure with same M8x20 bolt washer combo.
4. Repeat this process on the other side of the 520mm beam.
5. Repeat steps 1-4 on the opposite side of table.





# Étape 6 - Table Construction - Center Struts

## Tools

1/2" Socket Wrench  
Screwdriver

## Parts

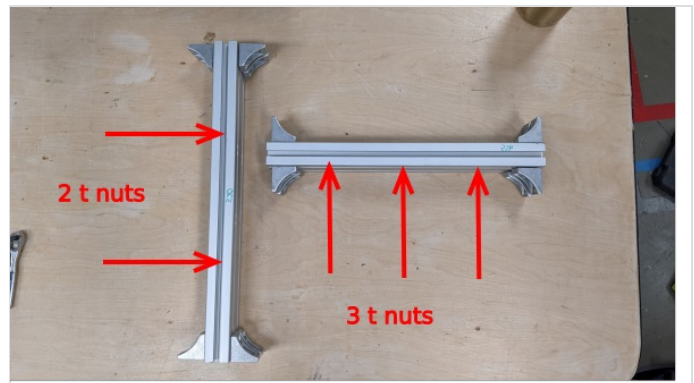
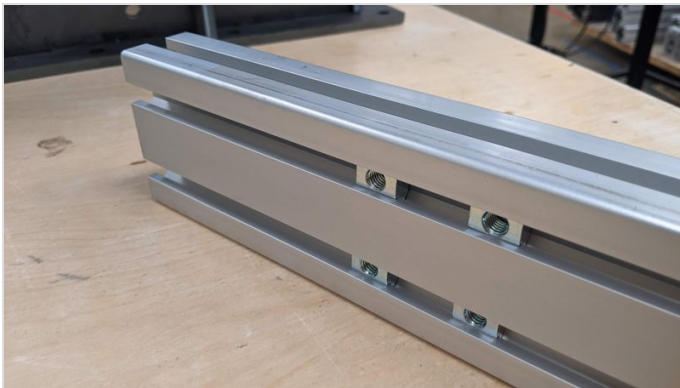
1x 4080\*520mm  
1x 4080\*455mm  
16 Brackets

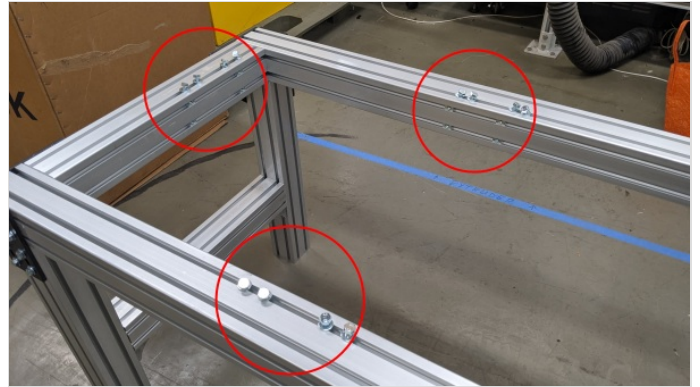
20x T nuts  
32x Washers  
32x M8x16mm Bolts

**\*Construction note:** Until the very end, keep ALL of these bolt joints **LOOSE**. They will need to slide around to get everything in place. Once the location has been set, then you can tighten them down.

## Steps

1. Insert 4 T-nuts (2 in each rail) on one side of the 520mm 4080 (image1 )
2. For both beams, attach brackets (using the flush hole) at all 8 corners. (image 2)
3. Arrange the beams so the 520mm beam is vertical, and the 455mm beam is horizontal, intersecting near the middle of the 520mm beam on the left hand side.
4. Insert 3 t nuts into the top rail of the 455 horizontal beam, and 2 t-nuts into the top rail of the vertical beam
5. *Loosely* attach the horizontal beam to the vertical beam. (images 3 and 4)
6. Remember all those T-nuts we hid in the frame in step 4? Now we are going to connect this sub-assembly to them.
7. Place 4 bolt/washer combos at each of the 3 locations designated in image 5.
8. Drop the sub-assembly into the table frame, and loosely connect the brackets into the pre-loaded T-nuts
  1. This is easier with 2 people.
  2. You only need 1 bolt at each of the three locations to hold the weight of the sub-assembly.
  3. After those first three bolts are in, you can easily go back and connect the others.





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## Étape 7 - Shredder Box Layout 1

### Tools

none

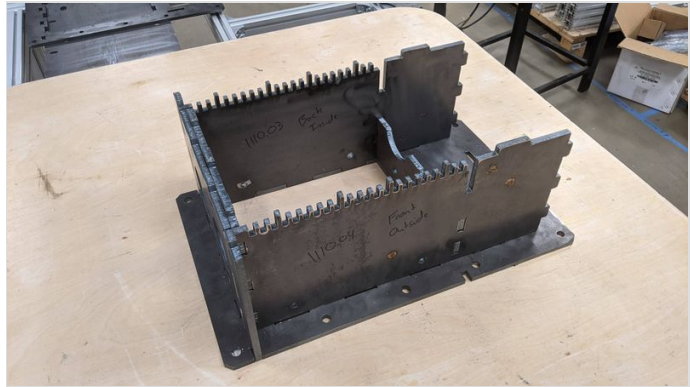
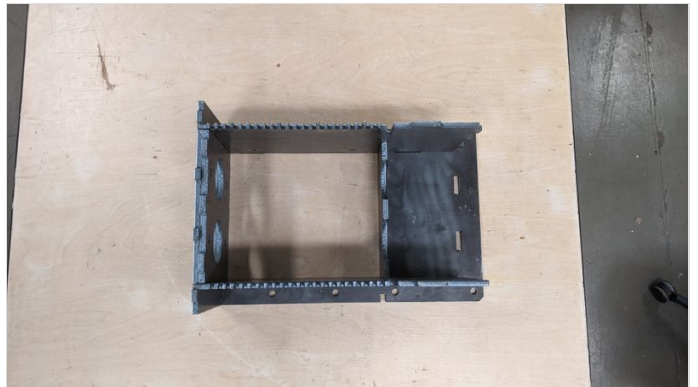
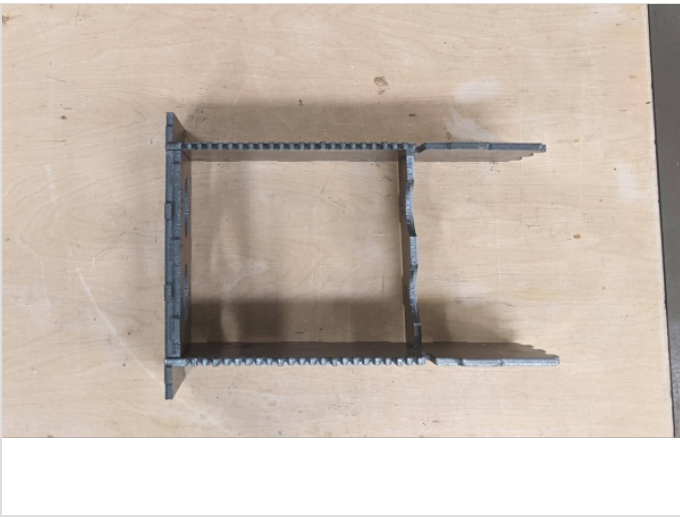
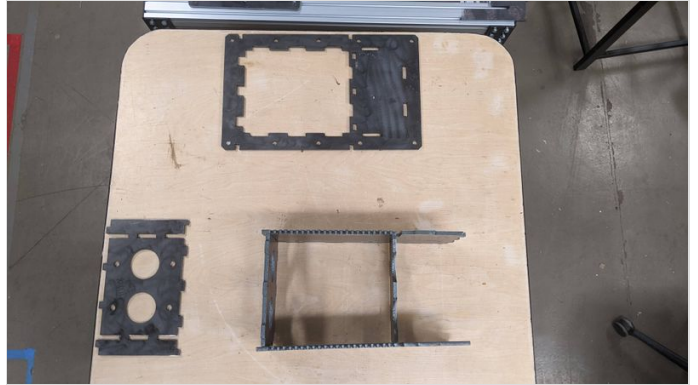
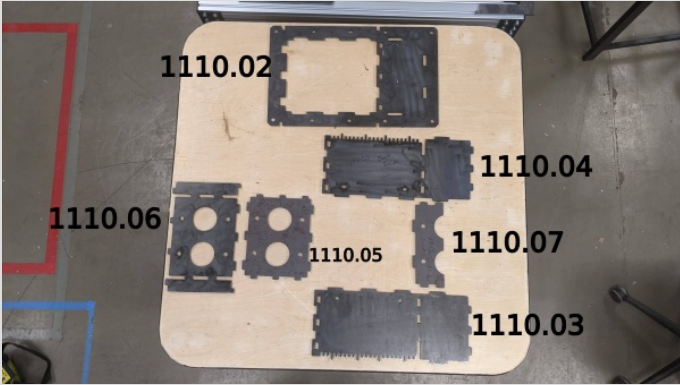
### Parts

- 1110.02 - Bottom Plate Box
- 1110.03 - Fixed Blades plate 1
- 1110.04 - Fixed Blades plate 2
- 1110.05 - Bearing Side Plate 1
- 1110.06 - Bearing Side Plate 2
- 1110.07 - Bearing Side Plate 3

\*this is much easier with two people to hold the plates before they are locked into position. It is also heavy metal, and a dropped plate is enough to cause injury.

### Steps

1. Layout the parts as seen in image 1, ensuring that the fixed blade plates are mirrored.
  1. Teeth should be pointing away from each other.
2. Fold up both plates so the teeth point upwards while your helper inserts the tabs from pieces 1110.07 and 1110.05. You should now have a 4 walled box as seen in image 2.
3. Fold up plate 1110.06 to meet the left end of the box.
4. CAREFULLY slide the bottom plate underneath this sub-assembly, aligning the tabs until it drops into place.



# Étape 8 - Shredder Box Layout 2

## Tools

none

## Parts

1110.08 - Bearing Side Plate 4

1110.09 - Bearing Side Plate 5

1110.10 - Bearing Side Plate 6

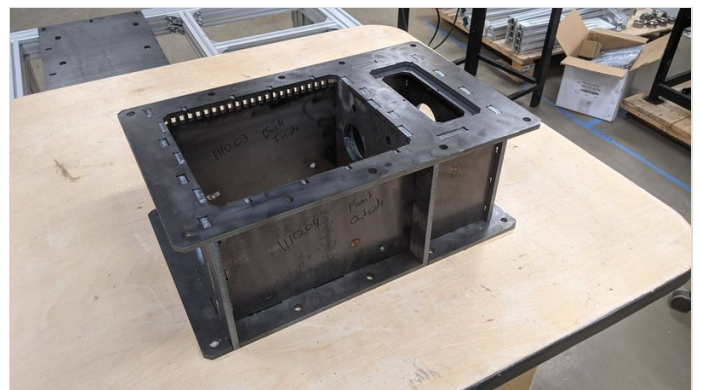
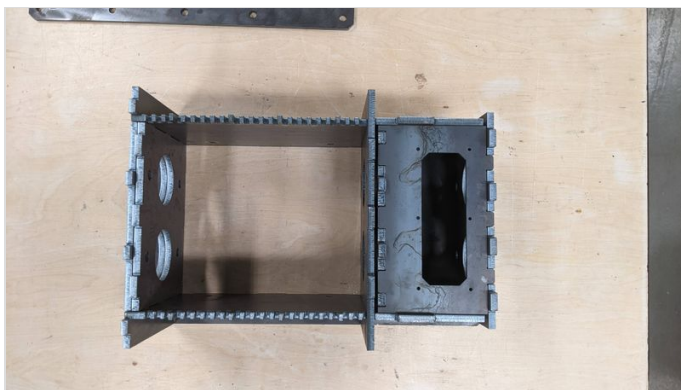
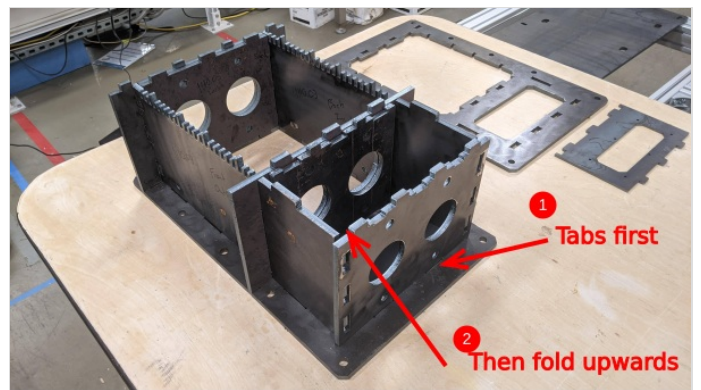
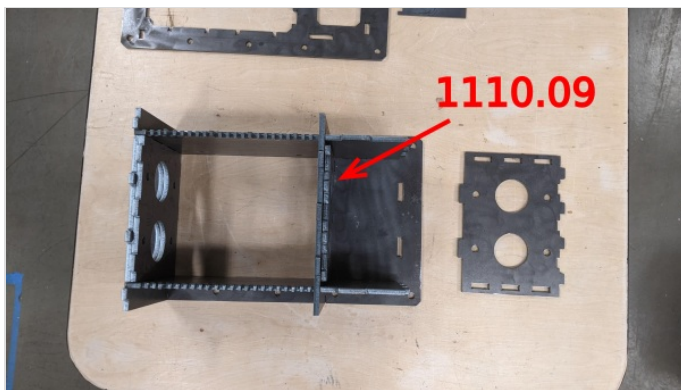
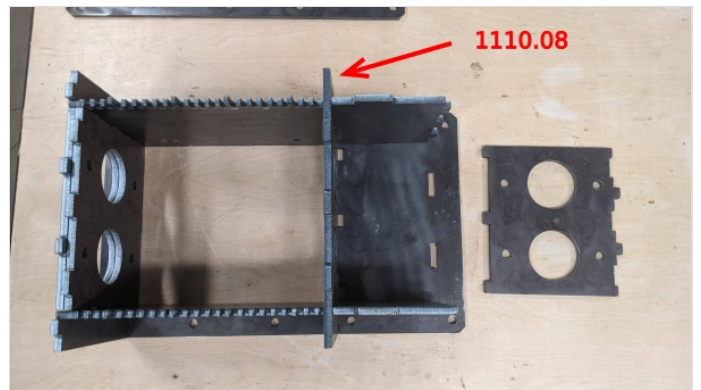
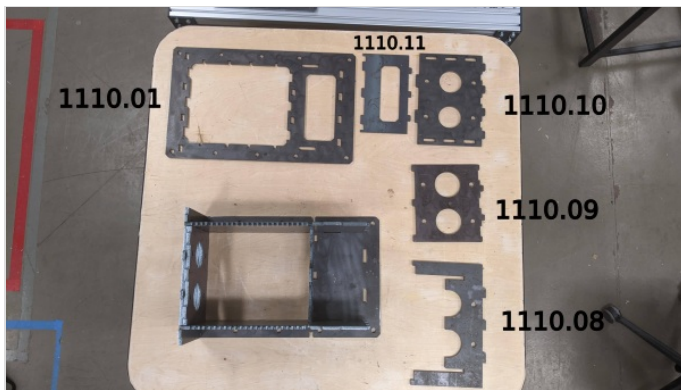
1110.11 - Gear Plate

1110.01 - Top Plate

## Steps

1. Layout the remaining pieces as seen in image 1.
2. Slide plate 1110.08 directly on top of piece 1110.07
3. Drop in plate 1110.09 directly next to 1110.07/08 in the open tabs.
4. Place the bottom tabs of plate 1110.10 into the bottom plate, and then fold the plate upwards into place.
5. Place plate 1110.11 on top as seen in image 5.
6. Place plate 1110.01 on top, securing the entire box in place.

\*Note - in the next steps, you will dismantle these last few steps, but it is important to understand how the box comes together.



# Étape 9 - Tapping bearing holes 1

## Tools

M16 x 2 Tap

Tapping oil(optional but recommended)

2 medium/large clamps

## Parts

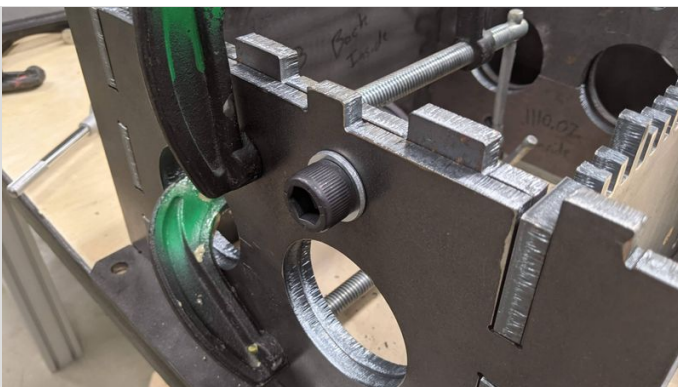
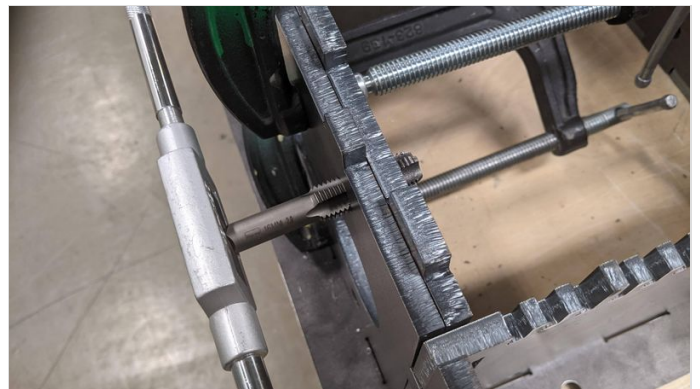
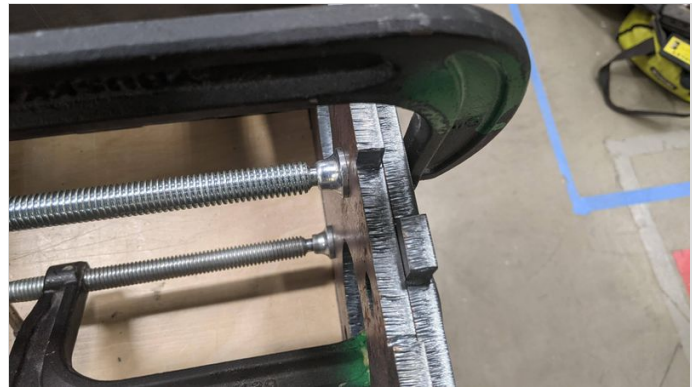
4 M16 x 40mm Socket head cap bolts

4 M16 washers

Shredder box assembly

## Steps

1. Remove the top plate from Step 8 above.
2. Secure parts 1110.05/06 (Left end of shredder box) using 2 C-clamps.
  1. \*Be sure to leave yourself room to turn the tap.
  2. \*It is important to have a tight fit. If your steel parts have burrs or scratches that prevent a tight connection, remove those first!
3. For each hole, tap both plates in one consecutive operation. Remove burrs and clean the hole.
4. Check the hole by securing the M16 bolts.



# Étape 10 - Tapping bearing holes 2

## Tools

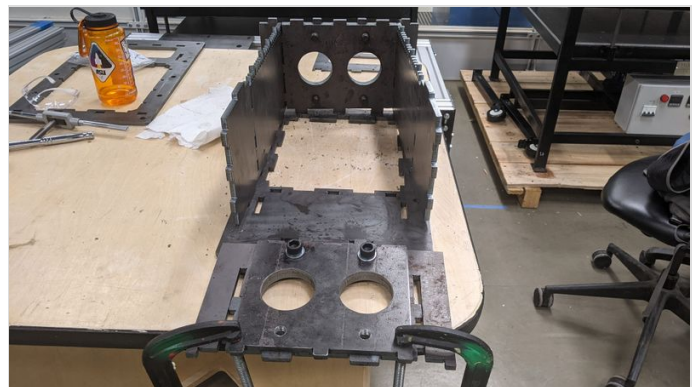
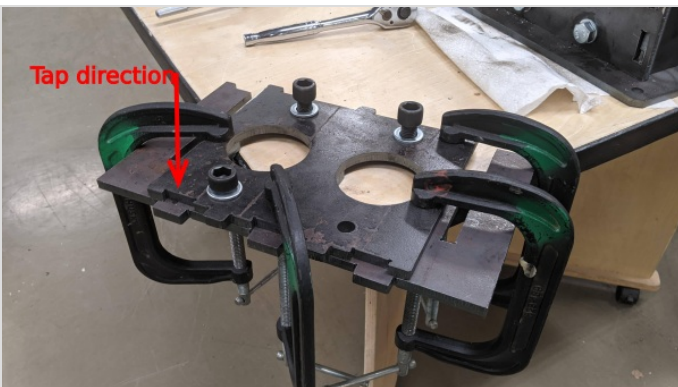
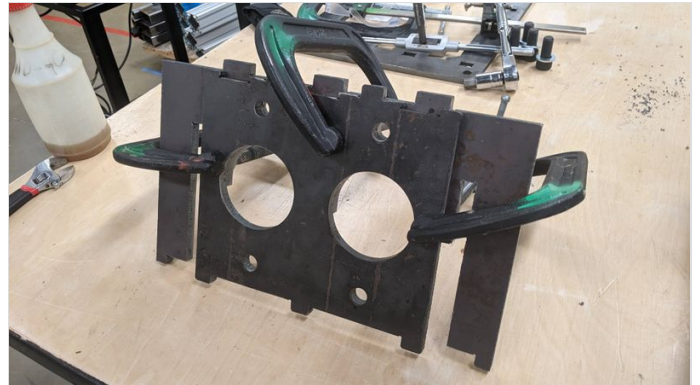
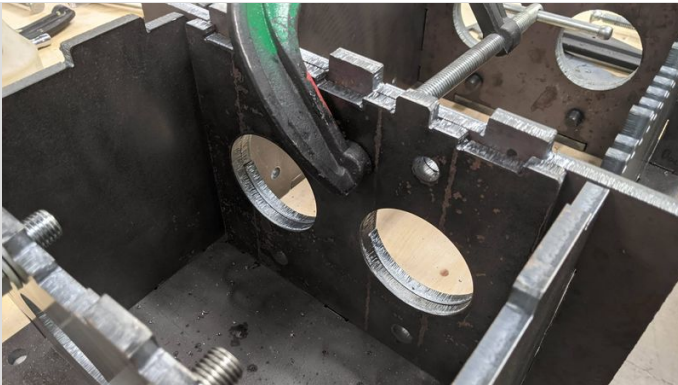
M16 x 2 Tap  
Tapping oil(optional but recommended)  
2 medium/large clamps

## Parts

4 M16 x 40mm Socket head cap bolts  
4 M16 washers  
Shredder box assembly

## Steps

1. If not already perfectly aligned, ensure that the bearing holes on parts 1110.08/09 are perfectly aligned. This will ensure the tapping process goes smoothly and the parts are in a straight line.
2. Tightly secure parts 1110.08/09 with C-clamps while they are still inside the shredder box.
3. Lift the two plates out with the clamps.
4. Repeat the tapping procedure as before, ensuring that you begin the tap on the face of part 1110.09. Tap all 4 holes.
5. Add bolts to the top two holes.
6. [image 4] Breakout piece 1110.07 from the shredder box. Align it with the clamped assembly, ensuring that the circle openings are perfectly matched.
7. Clamp piece 1110.07 to the newly tapped assembly. [image 5]
8. Continuing from the pre-tapped holes of piece 1110.09, tap into piece 1110.07.
9. Remove all bolts, and return the shredder box plates to their appropriate location.



## Étape 11 - Tapping bearing holes 3

### Tools

M16 x 2 Tap

Tapping oil(optional but recommended)

2 large bar clamps

### Parts

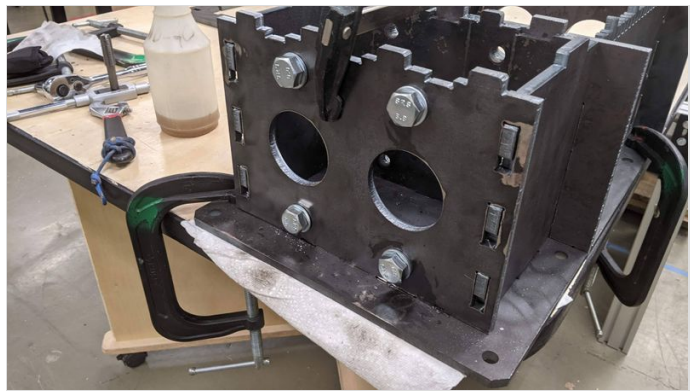
4 M16 x 30mm Socket head cap bolts

4 M16 washers

Shredder box assembly

### Steps

1. Secure plate 1110.10. (This can be done in place, or by removing it and attaching it to the table)
2. Tap all 4 holes.
  1. In the photo, we used hex heads as opposed to button cap sockets.





# Étape 12 - Shredder Box Risers (part 1)

## Tools

Welding machine

C-Clamps

## Parts

2x Riser assemblies. For each:

- 2x end caps
- top plate
- bottom plate
- large side plate
- 4 support plates

## Steps

- Layout the box pieces as seen in Image 1, ensuring that the bolts holes are aligned.
- Fold the pieces into place and secure with 2 C-Clamps
- Tack weld the box together
- Insert the 4 spacers evenly, ensuring not to block any of the bolt holes in the top and bottom plates.
- Apply pressure to the box with C-Clamps, ensuring the support pieces remain vertical.
- Weld in place.
- Repeat for the other support.



## Étape 13 - Shredder Box Risers (part 2)

### Tools

1/2"Socket Wrench

### Parts

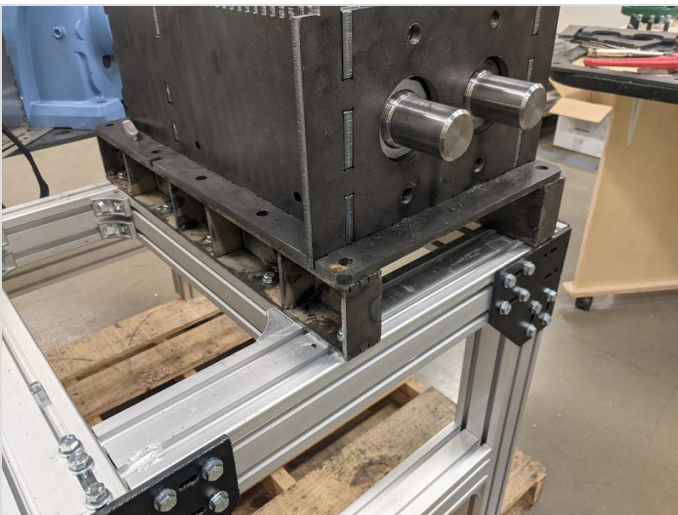
2x Riser assemblies.

10x M8x16mm Bolts/ Washers

(T-nuts should all already have been installed)

### Steps

1. Slide the horizontal aluminum extrusion from step XX to about 1 foot from the back of the table base.
2. Position a riser on this beam, aligning the in-set T-nuts to the bolts holes on the riser. The larger holes on the riser should be on top. (image 1)
3. Position the the other riser on the back of the table in the same way. (image 2)
4. (with a friend) lift the shredder box onto the risers. (ignore the shafts in the picture, we'll add those next)



# Étape 14 - Shaft Assembly Preparation 1

## Tools

Industrial Band Saw (roll-in, horizontal band, etc.)

Benchtop Grinder

Handheld Angle Grinder

Metal files

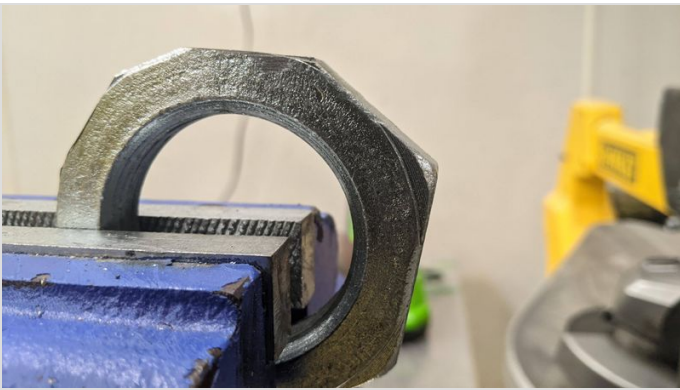
## Parts

2 Nuts

## Steps

1. Split the nut in half with whatever method you can :)
  1. we used a roll-in saw, but a horizontal band saw, or a hand saw could be used.
2. Grind or cut the corners off of the half nut until it fits within the shredder box hole openings. (repeat for all 4 nuts)





# Étape 15 - Shaft Assembly Preparation 2 (short shaft)

## Parts

2 Nut halves from previous step

1120.13 Short Shaft

2x 1120.01 6-Teeth Blade 1

2x 1120.02 6-Teeth Blade 2

2x 1120.03 6-Teeth Blade 3

2x 1120.04 6-Teeth Blade 4

2x 1120.05 6-Teeth Blade 5

2x 1120.06 6-Teeth Blade 6

2x 1120.07 6-Teeth Blade 7

2x 1120.08 6-Teeth Blade 8

2x 1120.09 6-Teeth Blade 9

2x 1120.010 6-Teeth Blade 10

2x 1120.011 6-Teeth Blade 11

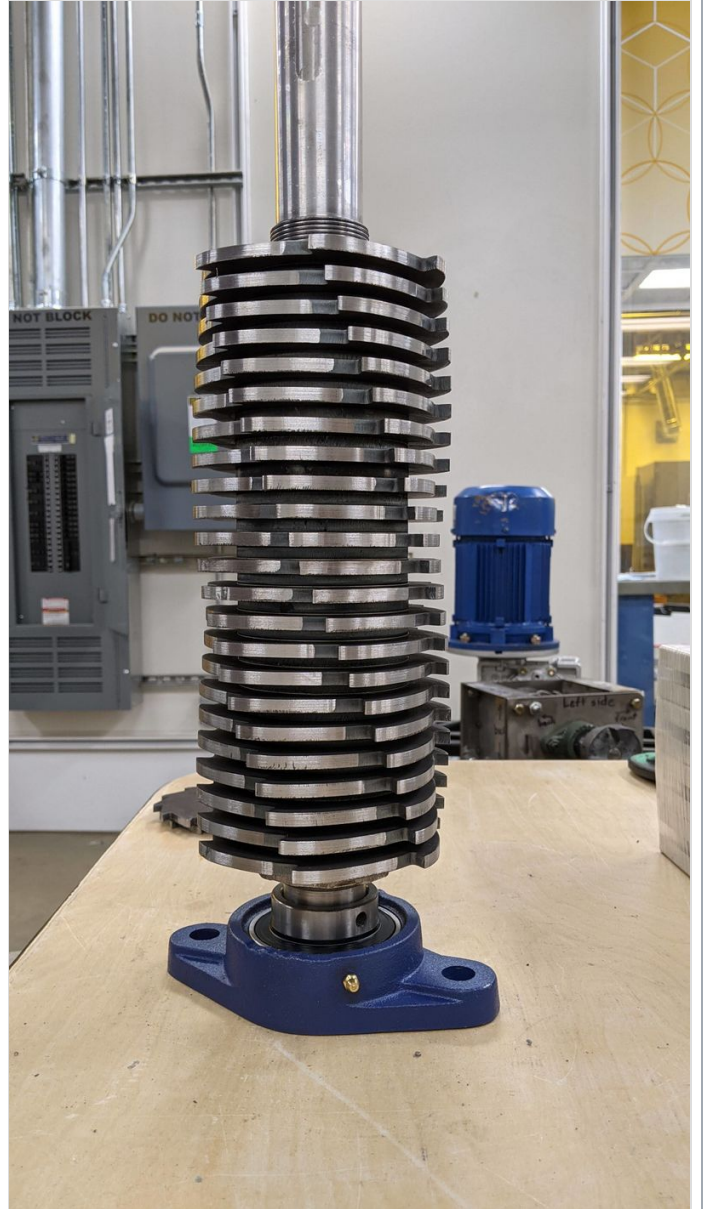
1x 1120.011 6-Teeth Blade 12

22x 1/4" spacer

22x thin spacers

1. Identify each of the twelve unique blades by the small cut markings on their interior.
  1. Blade #1 will have 1 mark. It is important to note where this mark is, as this will be our **Reference edge**.
  2. Blade #2 will have a 2nd mark rotating clockwise. The **reference edge** still stays at the top.
  3. Blade #7 will start a new pattern of two markings per face, again continuing clockwise.
2. Screw one of the nut halves to the short end of the shaft.
3. Label one of the sides of the shaft as a **reference face**.
4. Now slide Blade #1 onto the shaft ensuring that the teeth will rotate towards the center of the box when installed and that the **reference edge** of the blade matches the **reference face** of the shaft.
5. Follow this blade with 1 large and 1 small spacer.
6. Repeat this for the other blades 2-12, then beginning again with 1 and ending on blade 11.
7. Do not install spacers after blade 11. Instead cap the entire shaft with the other nut half.
8. Set aside





# Étape 16 - Shaft Assembly Preparation (long shaft) and install

## Tools

Chain, nylon strap

## Parts

2 Nut halves from step 12

1130.02. Shaft 1:

22x 1130.01 13-Teeth Blade

24x 1/4" spacer

24x thin spacers

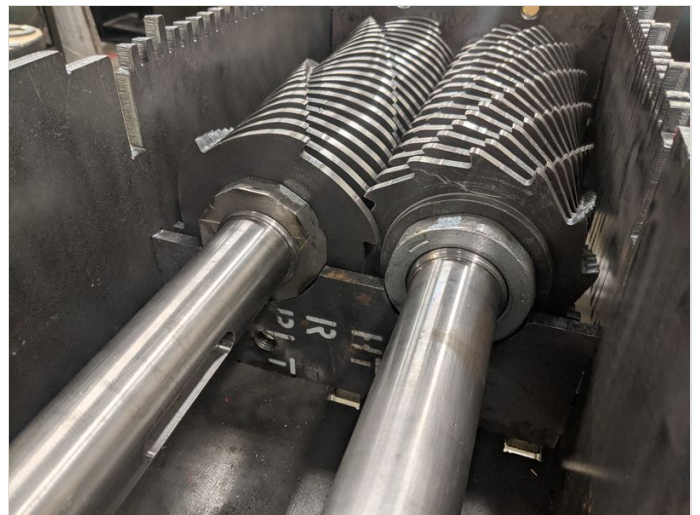
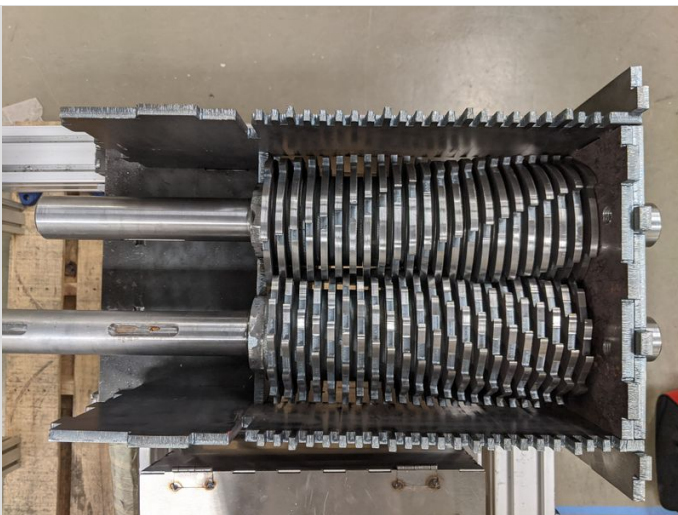
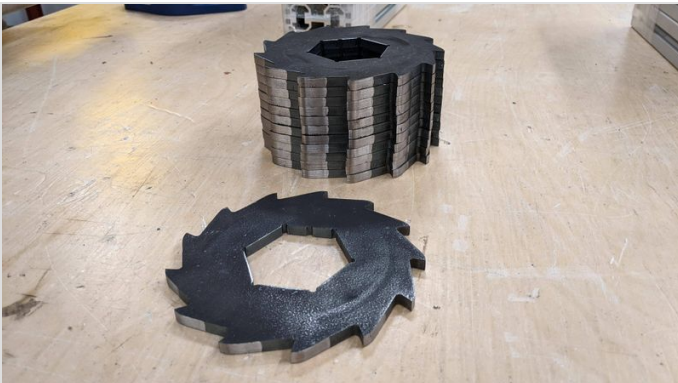
## Steps

1. Add a nut to the short end of the shaft.
2. Add both large/small spacers first.
3. Again choose a **reference face** on the shaft.
4. This time, each blade will be rotated one face away from the previous **reference edge**.
  1. Image 2 shows how the marking travels up the spiral pattern.
5. Repeat by adding blades and double spacers until all blades are placed. ending the shaft with a double spacer.
6. Add the 2nd half nut.

You now have 2 complete shafts ready to drop into your shredder box. This is very difficult to do alone, and can also be hazardous due to the heavy weight and sharp edges.

To install:

1. Mesh the two shafts together **outside the box**.
2. With a partner, lift the double shaft assembly as far into the box as you can, leaving room to escape your hands.
3. Thread a chain, rope, nylon strap, or anything that can drop below both shafts and that can serve as a handle to lift the assembly up and into its final position.
4. Unthread the rope assist seat the shaft nuts into the openings in both ends of the shaft box.
5. Replace pieces 1110.08 and 1110.09





## Étape 17 - Bearing Prep

### Tools

Bench Vise

Angle Grinder with flap disk

(Digital Caliper helps)

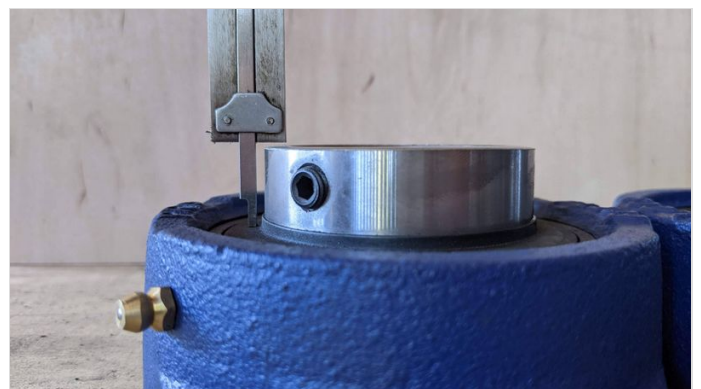
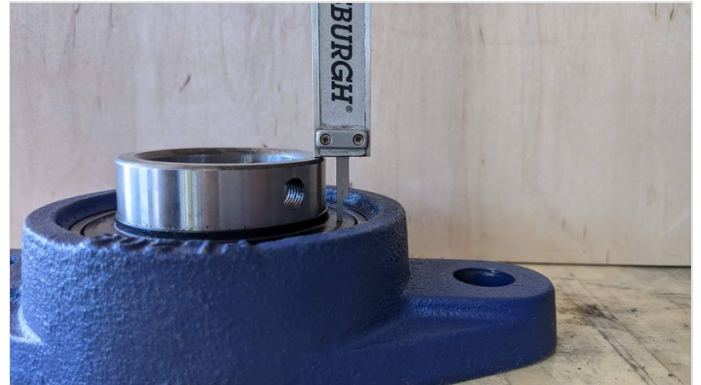
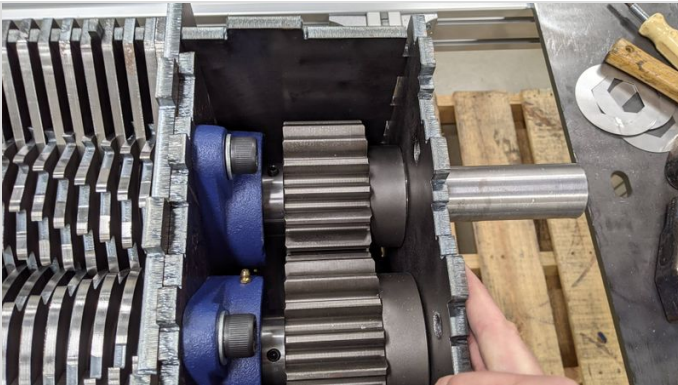
### Parts

2 Bearings

### Steps

As is, the bearings and gears *do not fit* inside the shredder box. about 1/8" of an inch of material must be removed from the bearing sleeve.

1. Measure the depth of the sleeve before grinding. Use the thumb screw on your digital caliper to lock this distance.
2. Using an angle grinder, remove the necessary material.
3. Recheck the distance, ensuring you've removed at least 1/8".





# Étape 18 - Shredder box final assembly (Step 1)

## Tools

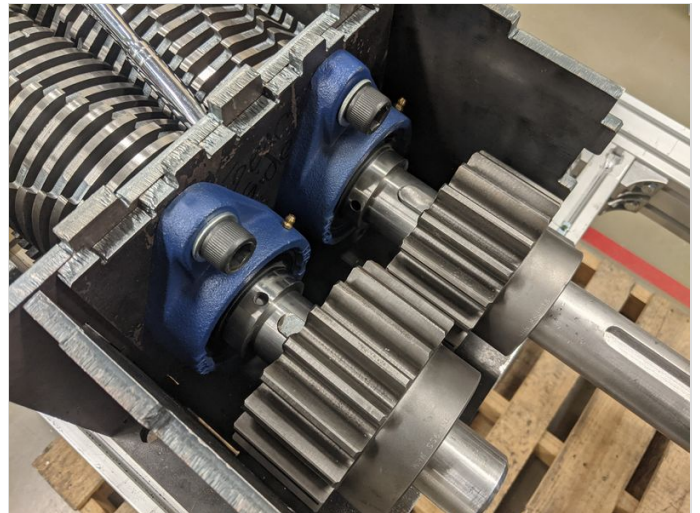
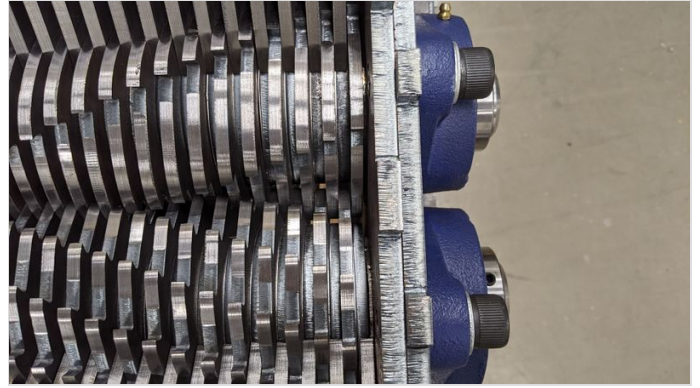
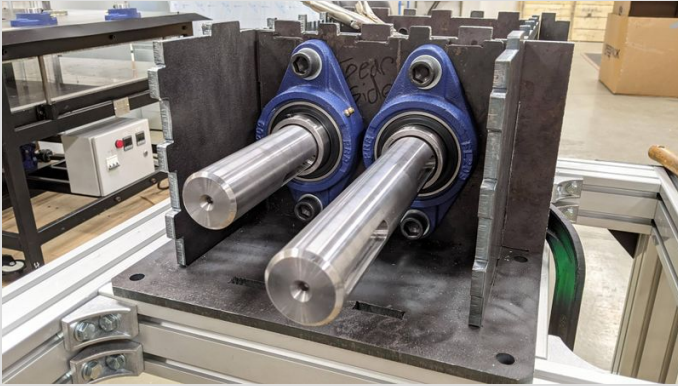
14mm Hex Socket Wrench  
Socket Wrench extension  
Mallet  
File

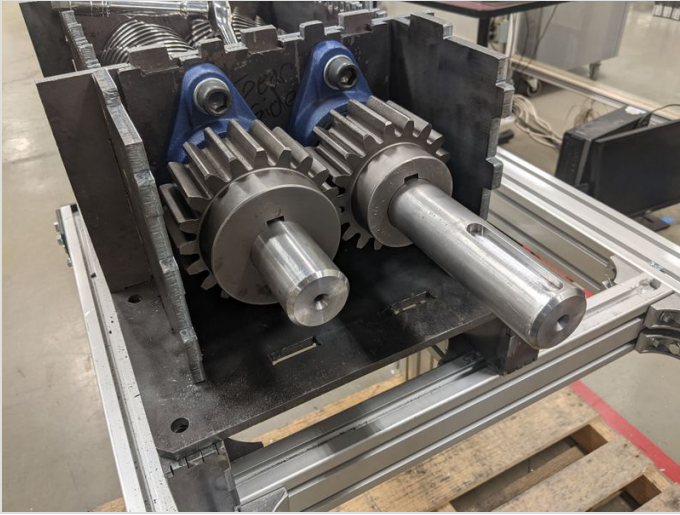
## Parts

8x M16x40mm socket head cap bolts  
8x M16 Washers  
2x 1/2" x 2.5" keys with rounded edges (these may need ground down to fit...)  
4x UCFL 209 Bearings  
20 tooth gear  
18 tooth gear

## Steps

1. One at a time, slide the bearings over the shafts and align them with the previously tapped bolt holes.
  1. • its a good idea to put the lubrication inlets facing up
2. Use the M16 bolts to secure the bearings in place.
3. insert the keys into the the key slots on both shafts.
4. slide the larger(20 tooth) gear into place on the upper/shorter shaft.
5. slide the smaller(18 tooth) gear into place on the lower/longer shaft.





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## Étape 19 - Shredder box final assembly (Step 2)

### Tools

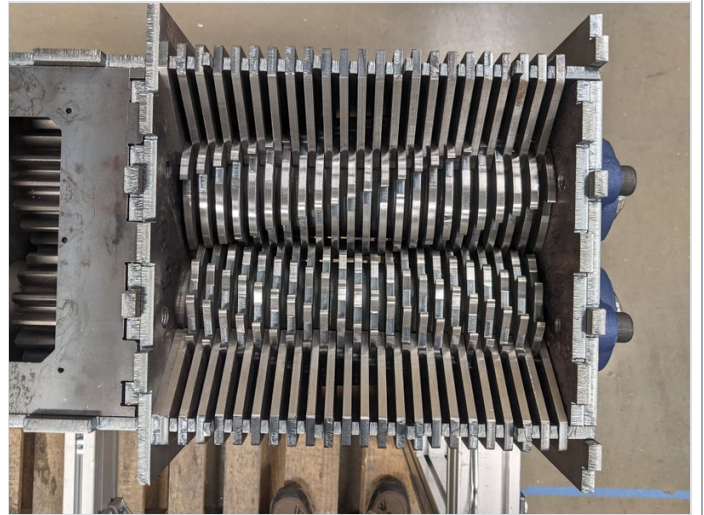
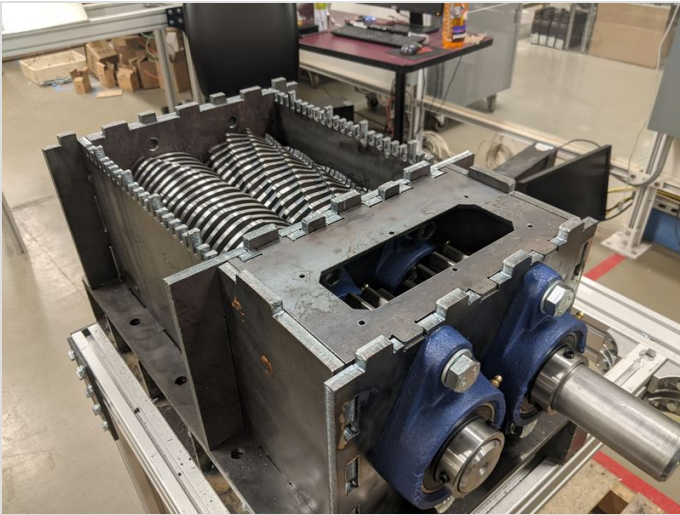
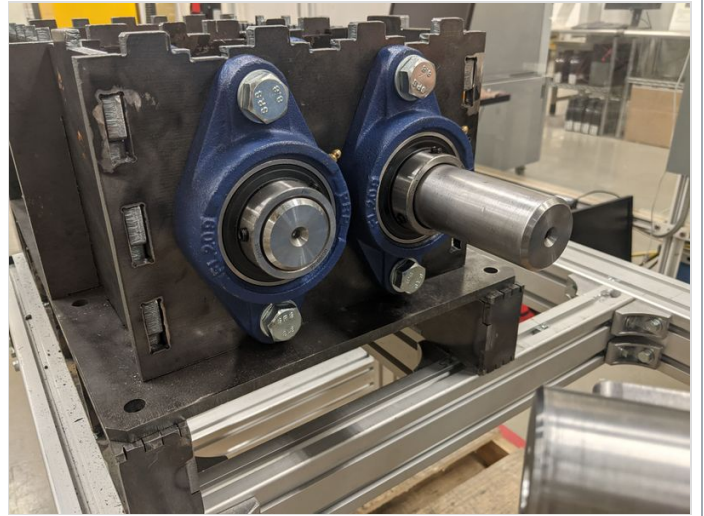
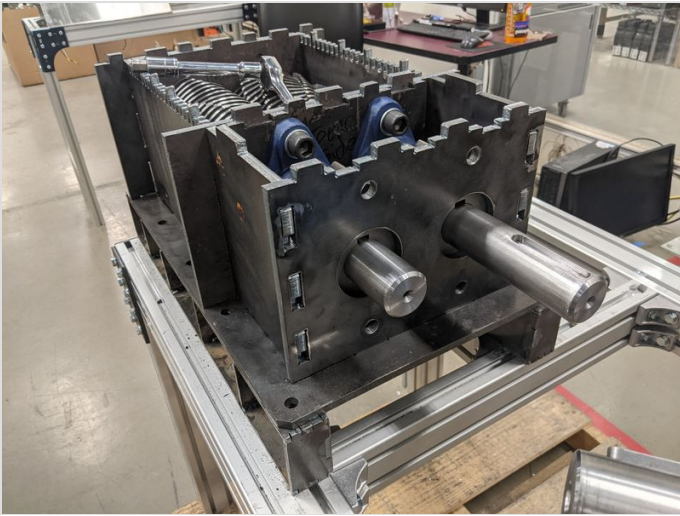
15/16" Socket Wrench  
Large Bar Clamp  
Mallet/Small Sledge hammer  
(optional) flat prybar

### Parts

4x M16x30 bolts (we used hex head)  
2x UCFL 209 Bearings  
1110.10 - Bearing Side Plate 6  
1110.11 - Bearing Side Plate 6  
1110.01 - Top Plate  
47x 1100.01 -Fixed Blades

### Steps

1. Slide part 1110.10 into place, closing the shredder box.
2. Slide the final two bearings into place.
  1. \*its a good idea to put the lubrication inlets facing up
3. Secure in place with bolts.
4. Place part 1110.11 in place on top of the gear housing.
5. Drop the fixed blades into place on the top row (23 blades) and bottom row(24 blades)
  1. This may require some shifting of the blade assembly positions.
  2. We use a flat prybar to do this as needed.
6. As needed, use the bar clamps to squeeze the box lengthwise, ensuring that the top plate can drop into place.
7. Use a mallet to lightly tap the top plate in place



## Étape 20 - Shredder box final assembly (Step 3)

### Tools

(maybe) Benchtop Grinder

3/4" Socket wrench

Adjustable Wrench

### Parts

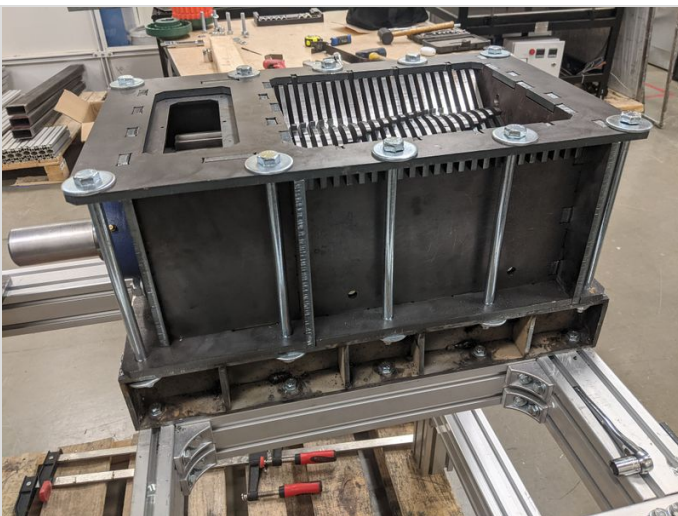
10x 1/2"x10in bolts

10x nylon lock nuts

20x washers

### Steps

1. (as needed) grind down one edge of the flat washers so they can fully seat underneath the shredder/riser.
2. Add a 10" bolt and washer down into the perimeter holes on the top of the shredder box.
3. Secure the box to the riser with a washer and nylon lock nut.
4. (repeat for all 10 holes)



# Étape 21 - Position the gearbox/motor

## Tools

1/2" socket wrench

## Parts

Gearbox plate

8x M8x20 bolts

8x M8 washers

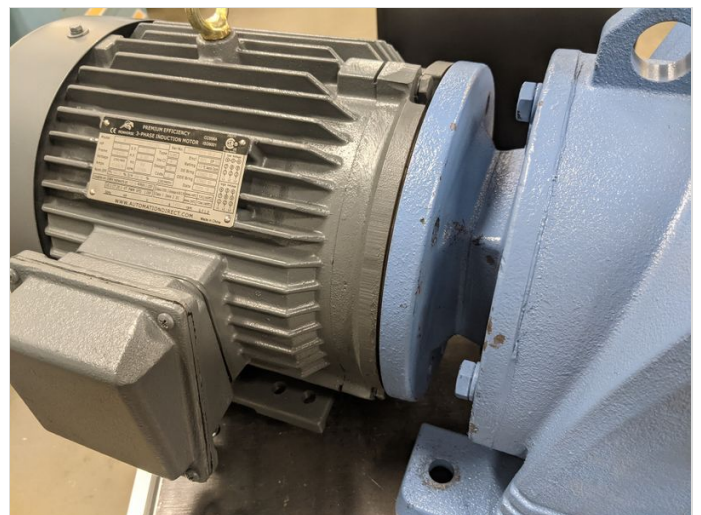
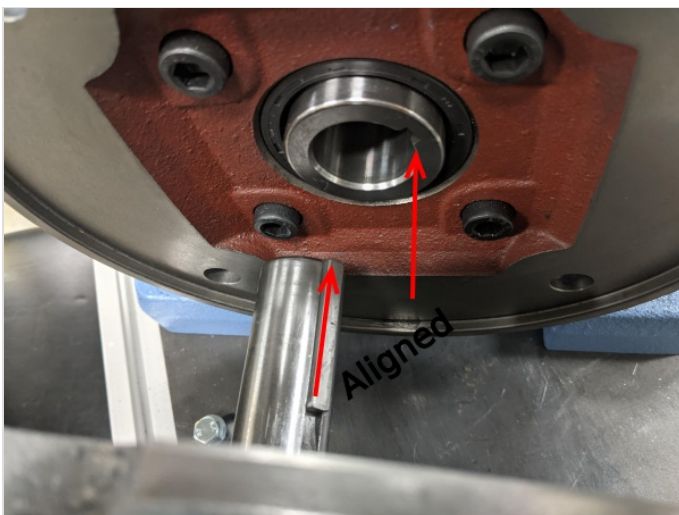
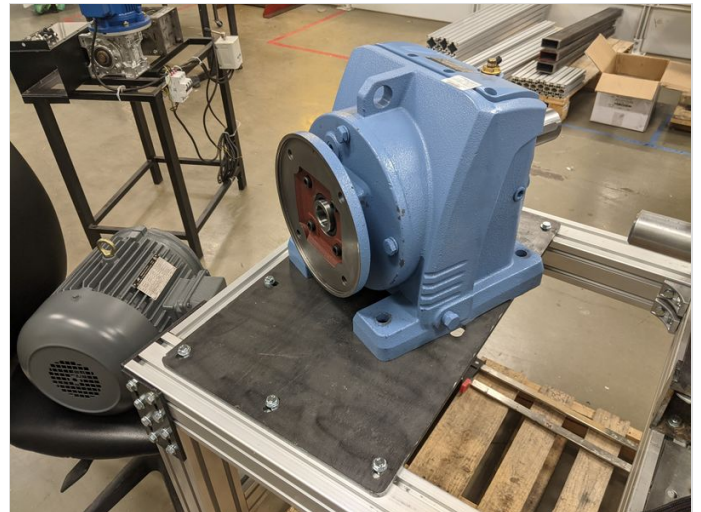
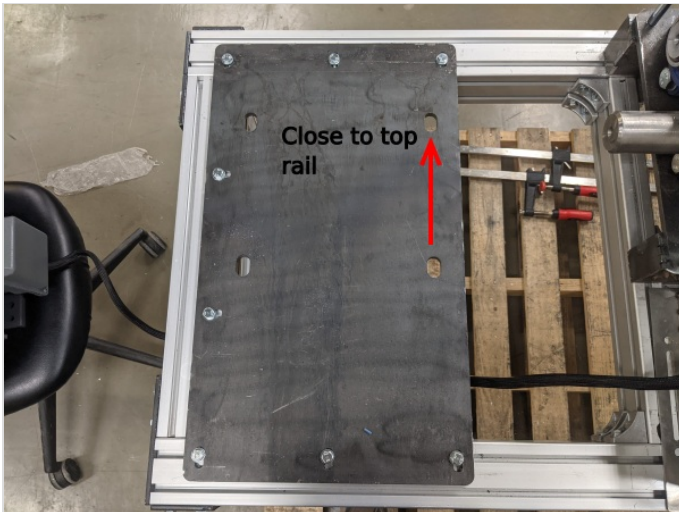
Gearbox

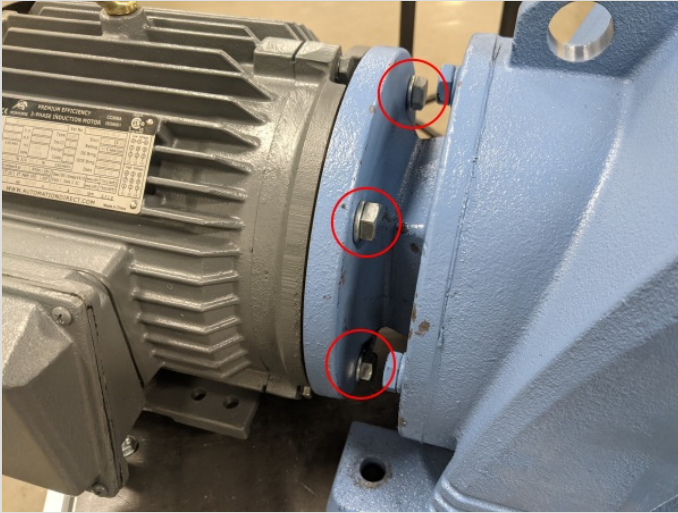
Motor (w/keystock)

4x included motor bolts

## Steps

1. Slide the gearbox plate into position as seen in figure 1.
  1. Ensure that the gearbox mounting holes are closer to the top rail.
2. Secure the plate with the pre-slotted t-nuts and the M8x20 bolts/washers.
3. Slide the gearbox onto the plate.
4. Orient the motor on the plate so that its keystone is aligned with the keyway in the gearbox (image 3)
5. Lift and slide the motor into the gearbox.
6. Secure with the 4 supplied bolts





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## Étape 22 - Coupler Install

### Tools

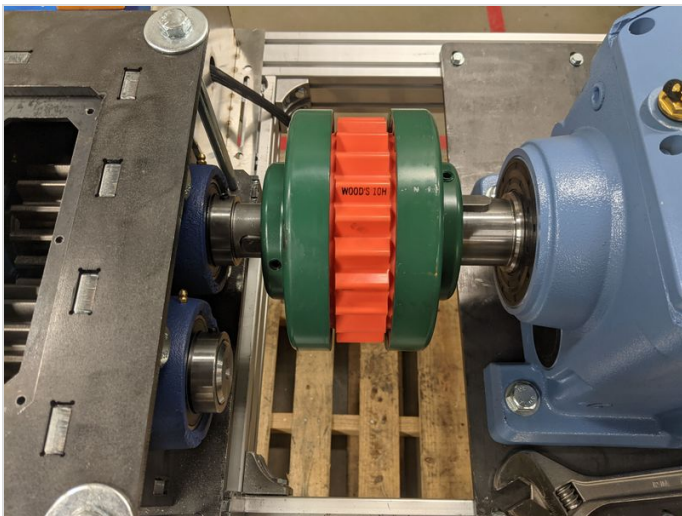
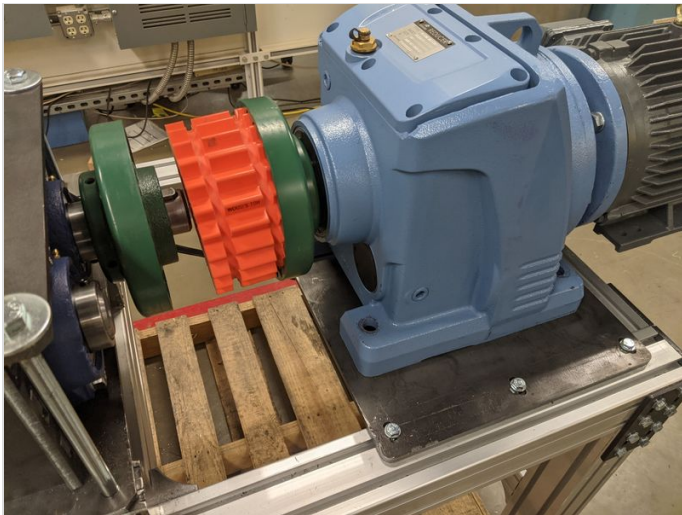
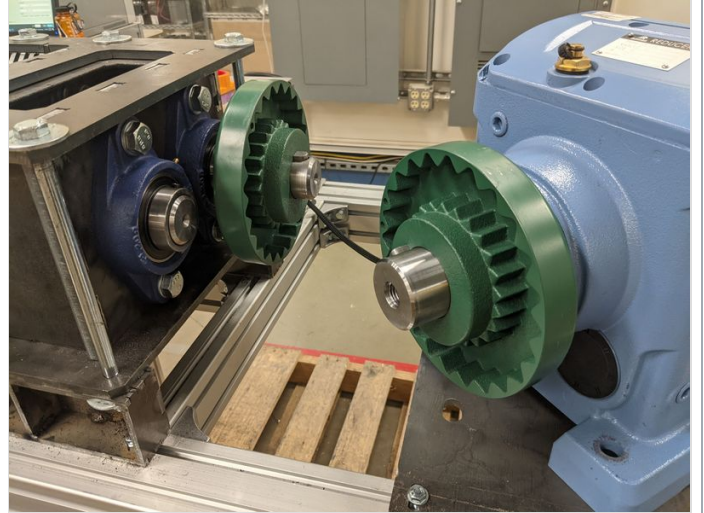
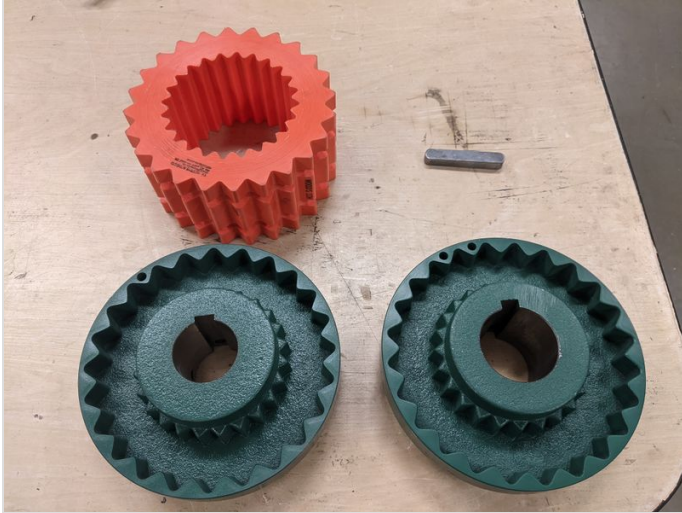
15/16" socket wrench  
Adjustable wrench  
Allen Wrench Set

### Parts

Coupler  
Coupler  
Coupler sleeve  
2x (1/2")Key (1 comes with gearbox unit)  
4x 5/8 x 2 3/4 Hex bolts  
4x 5/8 washers  
4x 5/8 lock nuts  
Gearbox/Motor combo

### Steps

1. Identify which coupler will match with each shaft.
2. With the keys in place, slide the couplers completely onto the appropriate shafts, keeping them apart to leave a large gap.
3. Slide the Hytrel sleeve into mesh with one of the couplers.
4. Slide the entire gearbox/assembly into position on the steel plate, aligning its mounting holes with the plate's.
5. Slide the other coupler onto the sleeve.
6. Position the coupling unit so that it equally splits the gap between the two shafts.
7. Secure the gearbox assembly in place with the 5/8" bolts/washers/ nuts.
8. Secure the couplings to the shaft with the grub screws.



# Étape 23 - Electronics - motor setup

## Tools

Wire strippers/crimps  
12AWG ring terminal  
Screwdriver  
4x Wire nut connectors

## Parts

12-14AWG wire  
Motor

## Steps

1. Check the motor plate to ensure you're aware of the motors specifications and hookup.
  1. for this guide, we'll be using the low-voltage configuration.

We will be combining the internal wires, with 3 wires of our own supply that will run back to the control box.
  2. Identify wires 1 and 7. Feed your wire (green) through the motor control box and next the ends of wires 1 and 7.
  3. Strip and combine these three wires together with a wire nut.
  4. Repeat according to the motor plate:
    - L1: 1/7 (green)
    - L2: 2/8 (blue)
    - L3 3/9 (red)
    - internal only - 4/5/6
  5. Strip one additional wire, and using a ring terminal, secure this wire to the ground pin on the right side of the gearbox.

