



Set-Up Guide for

The XL Frame

A guide to assembling the 12ft top beam frame for maximum edge to edge cutting area (just over 4x8ft) using our MakerMade M2 CNC Kit.

Note: 15ft chains are required (purchased separately)

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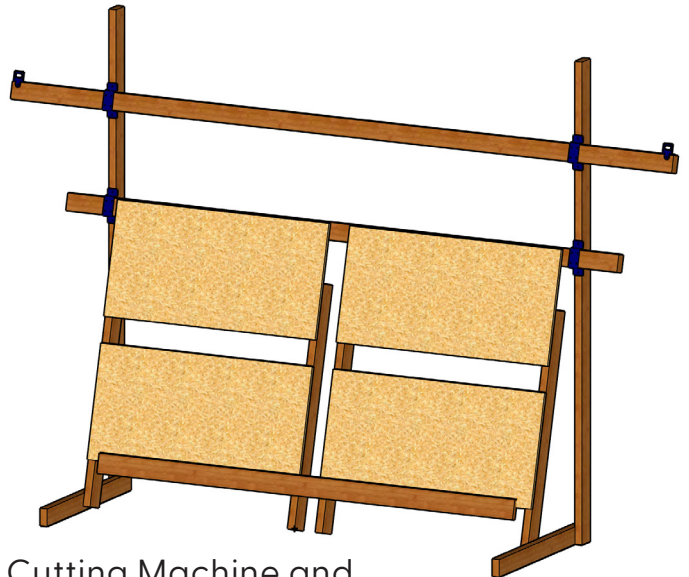
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INTRODUCTION



Thanks for buying the M2 CNC Automated Cutting Machine and welcome to the MakerMade family! The following instructions are intended for beginners - with no prior CNC experience.

Here are some notes on the layout...

1. Setting up the M2 can be broken down into three main parts: building the M2, building the frame (or mounting it on an existing Maslow frame), and calibration. This guide covers the XL frame.

2. I'm Drew and I made this guide! My notes are tips and tricks to help you along. They are in a different blue font and look like this:

Drew's Note: Let us know how this guide can be improved. We love to hear from you!

Drew's notes are meant to answer some of the "why" questions you might have and give you tips to get started. We suggest printing the guide in color, if you want a paper copy.

3. Each step contains written instructions, a visual rendering of those instructions, color coded pictures of **sub-steps** or parts needed for that step, the **hardware bag** where you'll find the parts you'll need, and underlined words are something that you should write on your frame in pencil for reference.



Here's me and Spaghetti,
he's not impressed with CNC



Like this Bag G in
orange

We hope you enjoy setting up your kit, happy making!



ASSEMBLING THE XL FRAME

The biggest step to starting your M2 CNC adventure is to build the frame that will hold your material and the M2 while it cuts. The M2 mounts for your frame are included, but you will need to purchase the following from a local hardware store to build the XL frame to cut over 4ft x 8ft.

Drew's Note: We recommend reading this entire section before beginning.

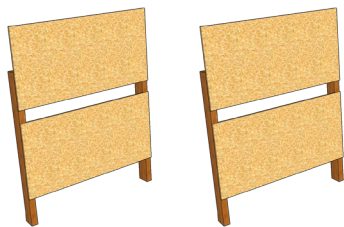
12ft XL Frame - Materials Needed			Tools for Building the frame	Tools for M2 operation
Amount Needed	Type	Purpose		
1	2in x 4in x 12ft	Top Beam	Wrench	Router
1	2in x 4in x 10ft	Bottom Beam	Hammer	Dust Collection System
2	2in x 4in x 8ft	Vertical Frame Legs	Phillips Screwdriver	2 Standard (4-5lb) Sized Bricks
4	2in x 4in x 4ft	Canvas Legs	Drill / Impact Driver	2+ Clamps
2	2in x 4in x 3ft	Horizontal Frame Legs	Tape Measure	Material to Cut
4	24in x 48in x 5/8in Particle Board (1/2in thick particle board, MDF, or plywood will also work)	Canvas Wasteboards	Speed Square	
1 (a second one is optional)	1in x 6in x 8ft	Bottom Skirt and optional top skirt (see Part 6)	Level	
2 (optional)	1in x 6in x 4ft	Side Skirts (Cut a 1in x 6in x 8ft in two, if not available in your area, see Part 6)	Pencil	
			Extra 1.5in and 2in screws	

Drew's Note: Nearly every step uses short (1.5in) or long (2in) wood screws. So, I'm going to leave the bag picture out of the steps for redundancy's sake. Just know that you'll need a lot of short and long wood screws are from Bags C and D (and some extras). If you're experienced with woodworking, feel free to use any wood screw of your choice to build the frame.



Short/Long frame mounting screws
Bag C and Bag D

Building the canvas



Drew's Note: Labeling the ends of the board ensures that we are measuring from the same end of each board. This mitigates small height differences in the 2in x 4in boards, so the canvas wasteboards are the same height from the floor on each canvas. I labeled my ends on the canvas legs, 'giraffes' because giraffes are awesome!

1. **(A)** To build the canvas, lay the four 2in x 4in x 4ft canvas legs on their 2in edges and mark with the word giraffe (or bottom) on one end of each.



(B) Measuring from the giraffe/bottom end on each, draw a line using a **speed square** at 9in and 37in.

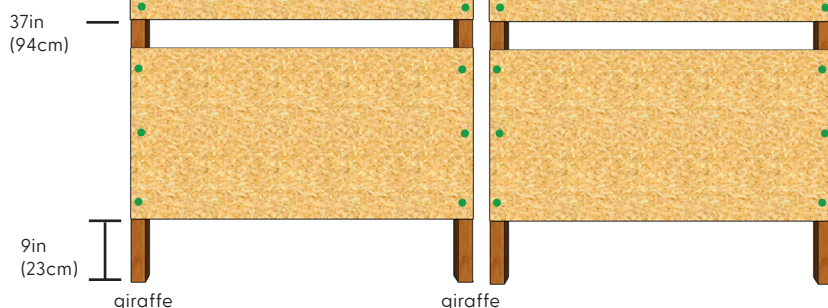


(C) Position two canvas legs about 4ft apart. Lay one of the 24in x 48in x 5/8in canvas wasteboard on them with the legs flush with the 48in ends. Use the speed square to make the wasteboard flush on the 9in line and screw it into the canvas supports with three long wood screws, evenly spaced on the leg. Repeat with the other two legs with another canvas wasteboard.

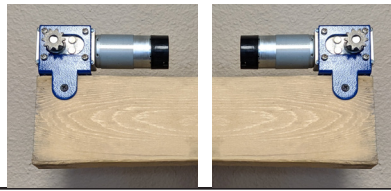
(D) On the 37in line, position another canvas wasteboard with the speed square and use a 2in x 4in board to support the top edge of the wasteboard while aligning and attaching. Use two **long wood screws** per side. Repeat with the other canvas wasteboards and legs to build the second canvas.



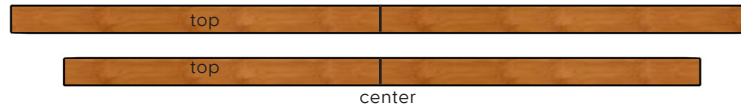
2in long wood screw



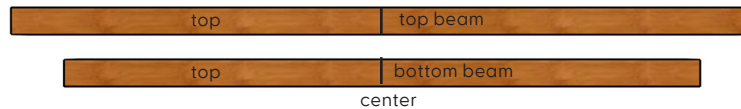
Attaching the motors



2. (A) Measure the actual length of the 2in x 4in x 12ft and 10ft beams and mark the exact center of each on a 4in face. Draw a straight line across the center with the speed square. Write top on a 2in edge of each and extend the center line around the beam and across the top with the speed square.



(B) On the 12ft beam, write top beam next to the center line. On the 10ft, write bottom beam next to the center.



3. (A) On the top beam, measure 6ft out from center on each side and draw a straight line with the speed square on the top edge.



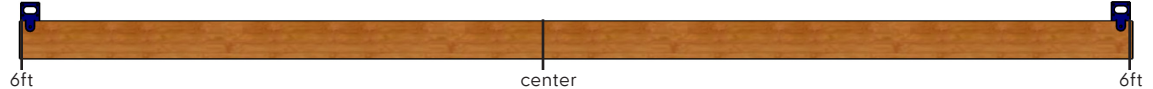
(B) Align the outside edge of the **motor mounting brackets** flush with the 6ft lines (as shown), and attach them to the top beam. Use one **short wood screw** in the front and two in diagonal holes in the top.



motor mounting brackets



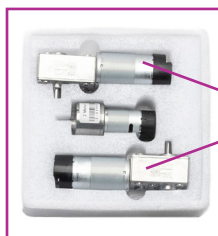
1.5in short wood screw



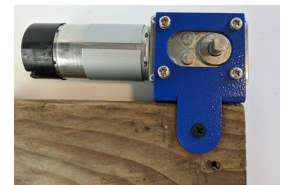
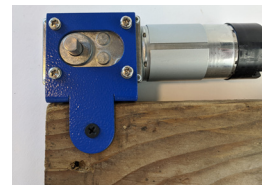
(C) Place one **X/Y motor** in each bracket, with the black, cylindrical ends toward the center. Use the **motor washers** between the bracket and the screw head and fasten the **motor screws** to the brackets.



X/Y Motor
Hardware Bag E



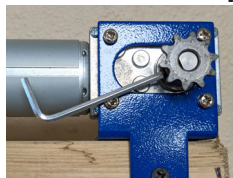
X/Y motors



(D) On each motor, attach the **motor sprocket** by inserting the **set screw** partially into the gear hole. Align the set screw with the flat side of the motor shaft, push it all the way down, and tighten it with **3mm hex wrench** to prevent it from slipping.

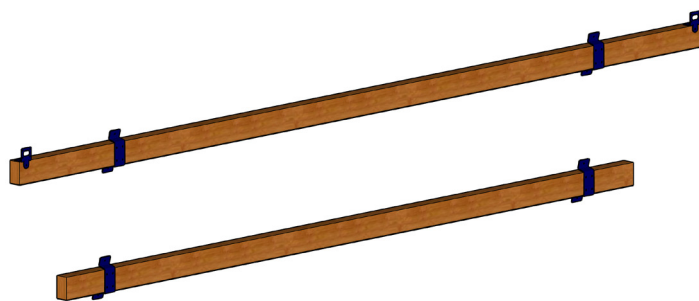


X/Y Motor
Hardware Bag E



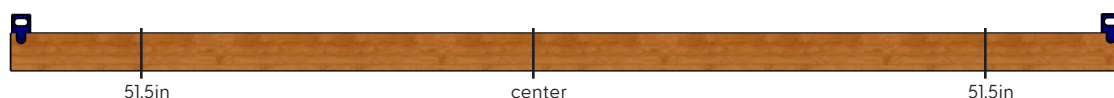
Drew's Note: If you have Loctite, placing a bit on this set screw is a great way to prevent it from loosening over time.

Attaching the stud mounts



Drew's Note: For the M2's alignment calibration calculation (that's fun to say), we have to make sure that the stud mounts are exactly perpendicular to the beams. To ensure this, attach each screw part-way before moving to the next. Repeat on the other two holes and screw in each from opposite sides by small increments until they are all tight - just like changing a tire.

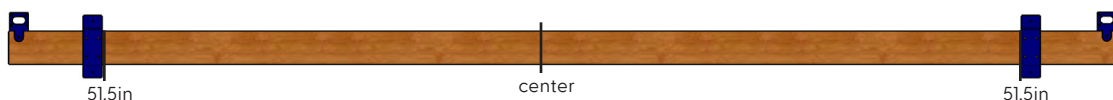
4. **(A)** On the front face of the top beam, measure and mark 51.5in (130.8cm) from the center on each side. Draw a straight line with the speed square.



(B) Position a **stud mount** on the outside of each 51.5in line, with the shorter angle of the stud mounts toward the top. On one side, push the bottom of the mount against the bottom of the top beam, use a speed square as a guide to keep it on the 51.5in line, and screw it into the top beam with four **short wood screws**. The bottom of the mount should be as flush as possible with the bottom of the top beam and exactly perpendicular to the beam. Repeat on the other side. Use the above Drew's Note for mounting tips!



stud mount

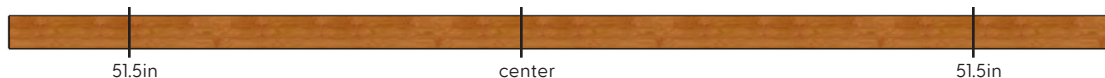


1.5in short wood screw



Side view

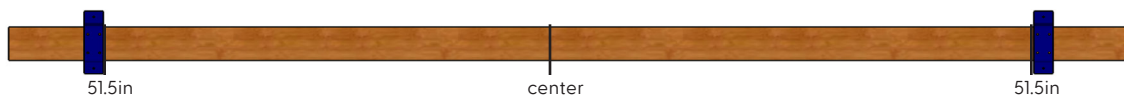
5. **(A)** On the front 4in face of the bottom beam, measure and mark 51.5in (130.8cm) from the center on each side. Draw a straight line with the speed square.



(B) Exactly like attaching to the top beam, position a **stud mount** on the outside of each 51.5in line, with the shorter angle of the stud mounts toward the top. On one side, push the bottom of the mount against the bottom of the top beam, use a speed square as a guide to keep it on the 51.5in line, and screw it into the top beam with four **short wood screws**. The bottom of the mount should be as flush as possible with the bottom of the top beam and exactly perpendicular to the beam. Repeat on the other side.

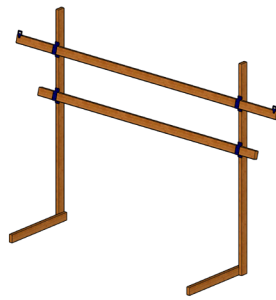


stud mount



1.5in short wood screw

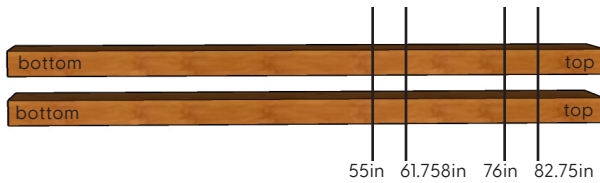
Frame legs



6. (A) Lay the 2in x 4in x 8ft vertical frame legs on the floor, on their 2in edges. Label them something fun, so you remember that they are, or just vertical frame legs. On each board, write bottom on one end and top on the other.

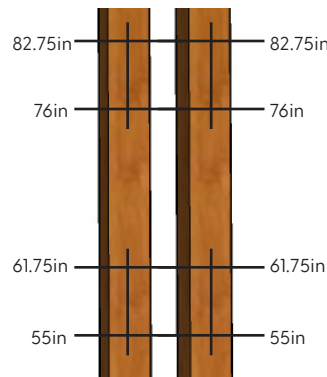


(B) Measuring from the bottom end, measure and mark at 55in (139.7cm), 61.75in (156.8cm), 76in (193cm), and 82.75in (210.9cm) up. Use the speed square to draw a straight line at each mark.



Drew's Note: The actual thickness of your 2in x 4in is around 1.5in. We want to find the center to ensure that the stud mounts are mounted perpendicular with the floor and in the center of your 2in x 4in.

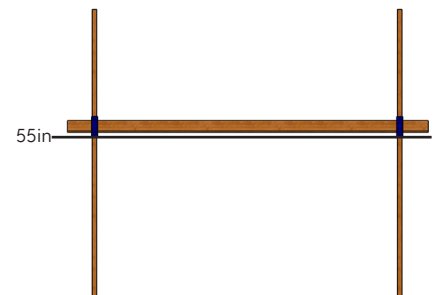
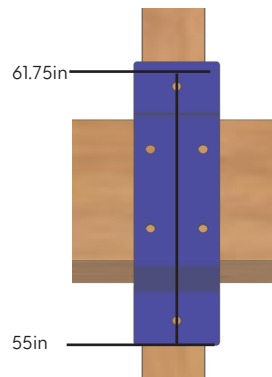
(C) Measure the actual center of each line across the side. Use the speed square to draw a perpendicular line through the center of the 55in and 61.75in lines. Use the speed square to draw another perpendicular line intersecting the 76in and 82.75in lines. Repeat on the other leg.



7. Arrange the vertical frame legs parallel on the floor, resting on their 2in edges. Position the bottom beam on the legs, with the taller ends of the stud mounts flush with the 55in line. Center the top and bottom holes of the stud mount on the perpendicular center line and attach with the **long wood screws**.



2in long wood screw



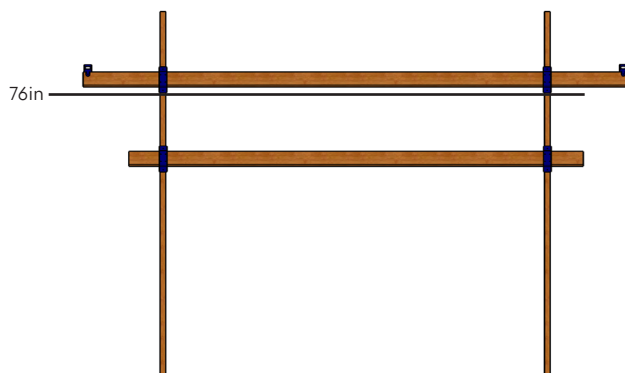
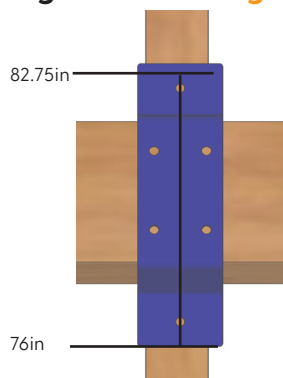
Frame legs (continued)

8. Position the top beam on the legs, with the taller side of the stud mounts flush with the 76in line.

Repeat the process of step 7, by centering the top and bottom holes of the stud mount on the perpendicular line and attaching with the **long wood screws**.



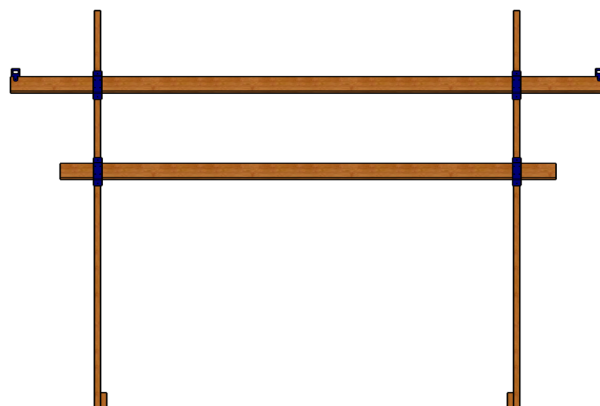
2in long wood screw



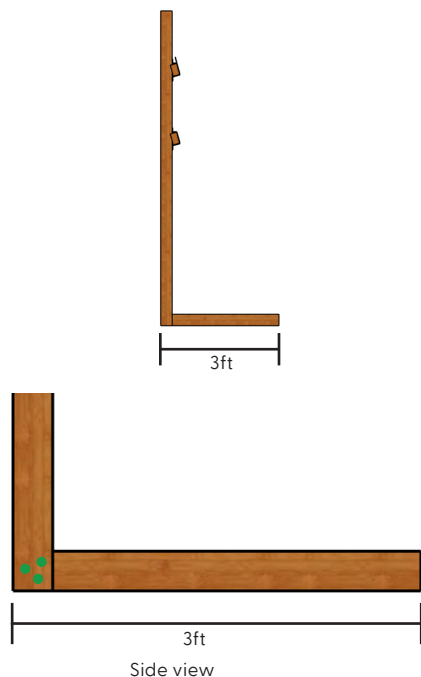
9. To attach the horizontal frame legs, write **back** on the ends of the 2in x 4in x 3ft boards. Align the back end on the inside of the vertical frame legs at a 90 degree angle to make an L shape. Use the speed square to ensure the 90 angle is square and flush with the back of the vertical frame legs. Use three **long wood screws** in a triangle to attach each leg together.



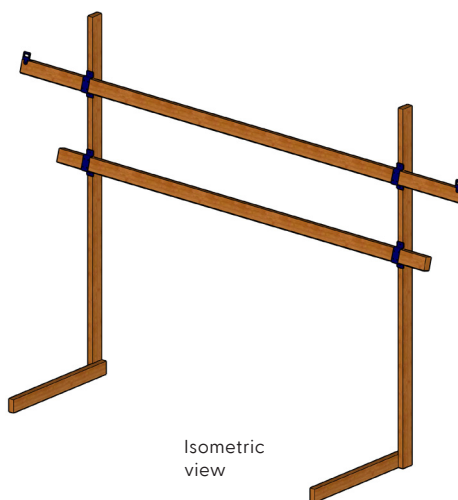
2in long wood screw



Front view

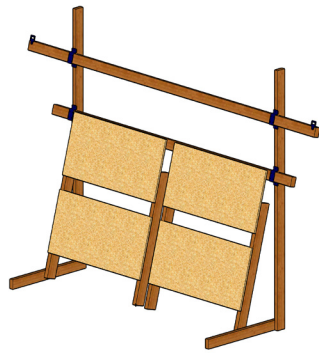


Side view



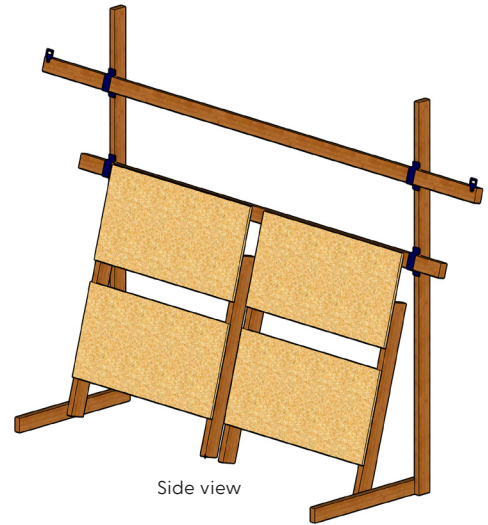
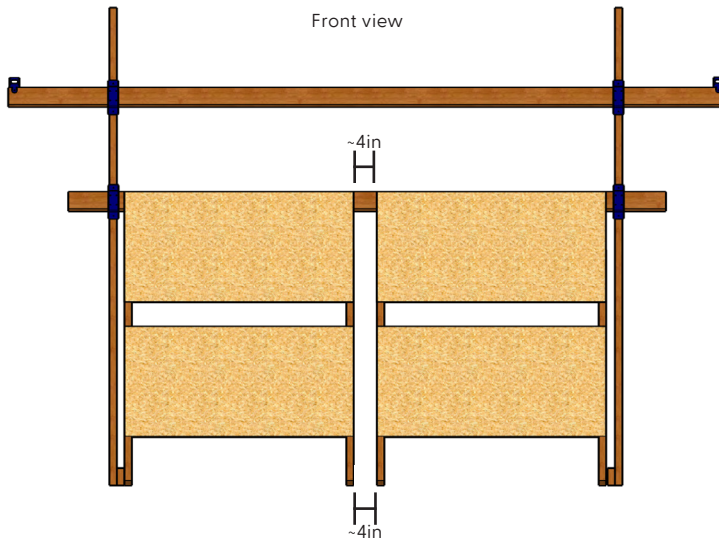
Isometric view

Attaching the canvas



Drew's Note: WARNING: This frame is designed to lean against a wall for safety. If it is not against a wall, it could tip over. For added safety, you can toenail one of the vertical frame legs into a stud or use an L-bracket (not-included), similar to what you would for an oven safety bracket. Look for a stand-alone update coming soon.

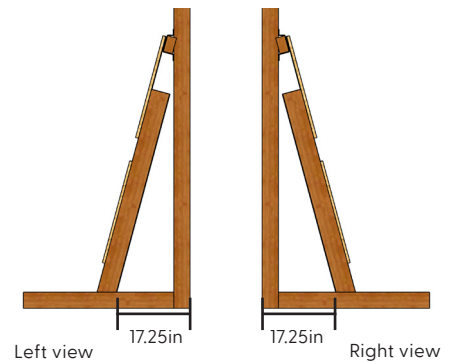
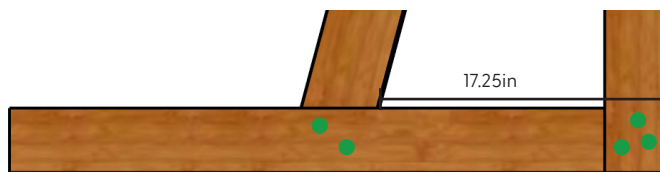
10. **(A)** Stand up your frame and push it against a wall. Lean your particle board canvases from Part One inside of the frame legs. They should be pressed against the support legs on each side, with about a 4in gap between them.



(B) From the back end of the horizontal frame legs, measure and mark 17.25in (43.81cm) out on each. Angle the canvases, so that the inside of the angle is on the 17.25in line and the top of the canvas is flat against the bottom beam. Attach to the canvases to the horizontal frame legs with two **long wood screws** on each side.



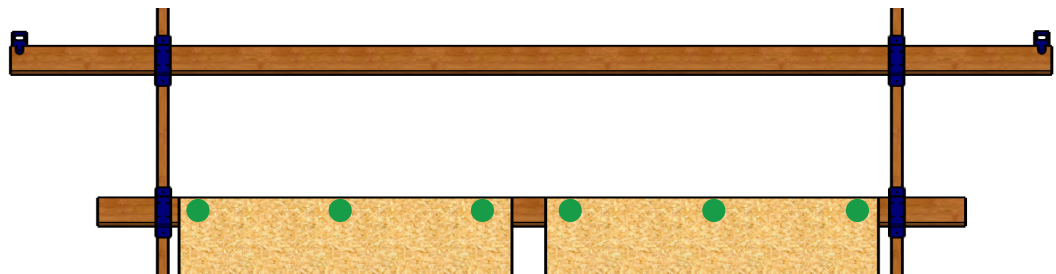
2in long wood screw



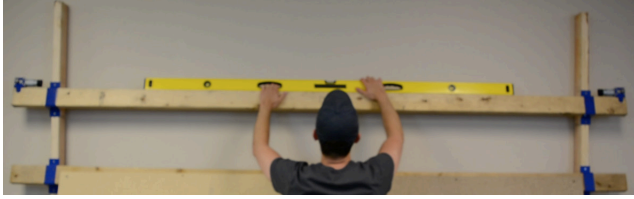
(C) Attach the top of the canvases to the bottom beam using three evenly spaced **short wood screws** on each.



1.5in short wood screw



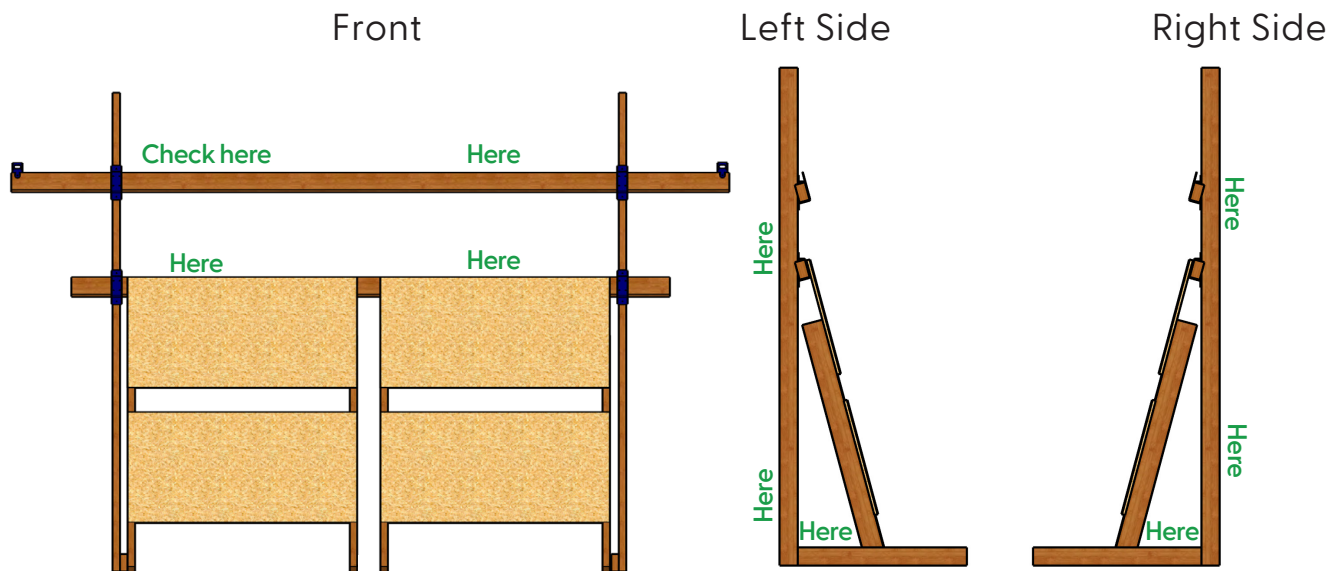
Leveling your frame



Drew's Note: It's very important that your frame is square and level! All of the M2 calibrations are based on a well built frame. If the frame isn't level and square, the M2 will slant when it cuts and have all kinds of other small problems.

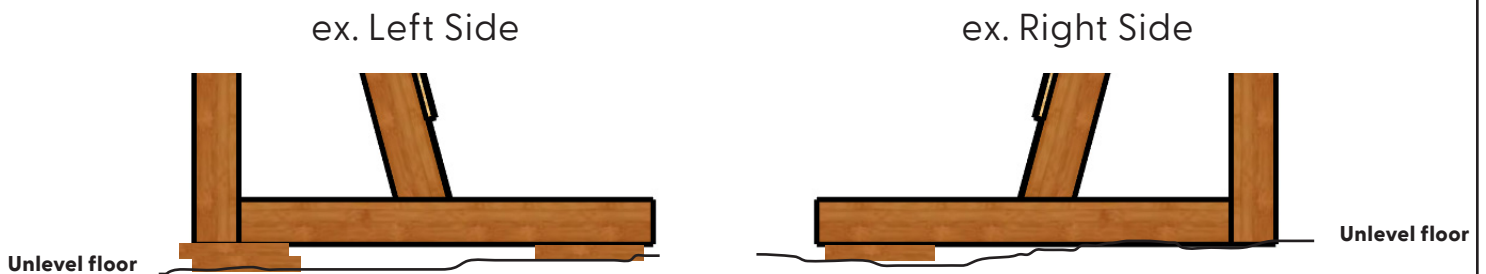
It will be very difficult, if not impossible to calibrate properly.

11. (A) Check that your top and bottom beams are level. If they are not, they should be off by the same amount, since your frame is square. Verify that the frame is level in the following places:



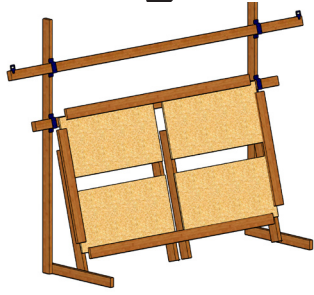
If your frame is level, you're good to go!

(B) OPTIONAL If it isn't level, first check your measurements from the previous steps to ensure that your frame is square. Once your measurements are confirmed for squareness, use a few shims (small pieces of wood or scrap material) under the back and front of the frame legs, on one or both sides, until your frame is level. This is especially useful in locations that don't have level floors.



Drew's Note: Once you've verified your frame is level in the locations in step A, you can toenail the top and bottom of the vertical frame legs to the wall to keep the frame from shifting over time.

Attaching the skirts



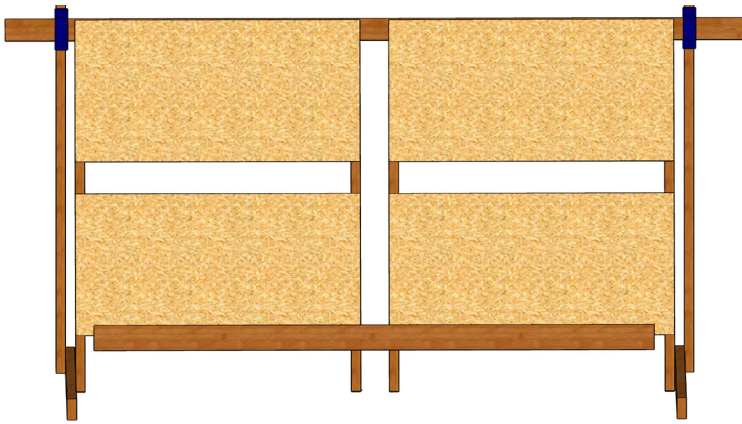
Drew's Note: A skirt's purpose is to act as a stabilizer for your M2 when it gets near the edge while cutting and the sled edge extends beyond your canvas. The bottom skirt makes it easier to mount your material to cut, because it acts as a support. As long as you're within 1/4in (6mm) on your skirt measure measurements and they are level, you're fine. It's optional, so don't sweat getting the skirt perfect.

12. (A) Measure and mark the actual center of the 1in x 6in x 8ft bottom skirt.

(B) On the left canvas, measure and mark 1.5in (3.8cm) up from the bottom. Align one of the 8ft skirts with the center line and attach it to the particle board, on that line, with one **short wood screw. Place the level on the skirt and rotate it up or down on the screw until it is level. When level, attach it to the other canvas with another short wood screw. Add three more screws per canvas to fully attach the bottom skirt.**



1.5in short wood screw

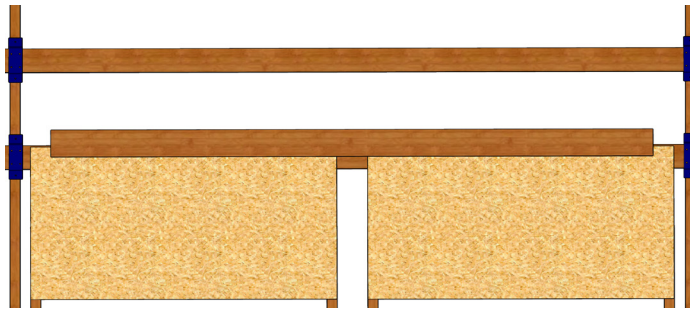


Drew's Note: Just like your frame, it's very important that the bottom skirt is level and parallel with the top beam! Your material will rest on it and if your frame isn't square and level then your cuts will be off!

(C) OPTIONAL: Similar to the bottom skirt, measure the actual length of the top skirt and mark the center. Then, measure and mark 1.5in (3.8cm) down from the top of the left canvas. Align the 8ft skirt with the center line and attach it to the particle board on that line with one short wood screw. Place the level on the skirt and rotate it on the screw until it is level. When level, attach it to the other canvas with another **short wood screw. Add two more screws per canvas to fully attach the top skirt.**



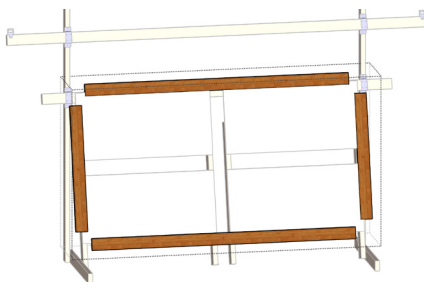
1.5in short wood screw



(D) OPTIONAL: For the side skirts, measure and mark 1.5in (3.8cm) in on each side of the canvases, closest to the stud mounts. Attach a 4ft side skirt to each side using 4 **short wood screws.**



1.5in short wood screw



Drew's Note: Your skirts can be under 1in thick, so you can use scrap material for them! It's just important that they are all the same thickness. This is because if the material you're cutting is less than their thickness, you will need to elevate your material. Otherwise, your sled will bump into the skirt when it gets close to the edge.

Attaching the 15ft chains

Drew's Note: We recommend a friend help you connect the spring and each person wear safety goggles during stretching. The chain can snap back, causing damage to people, pets, and surroundings!

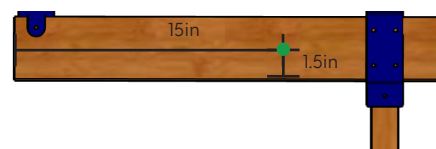
12. (A) To attach the **chains** on the front of the top beam, measure and mark 1.5in (4cm) from the bottom and 15in (38cm) toward the center, from the end of the top beam. Insert the small **nail** through **loop** in the last chain link on one chain, and hammer it into that spot. Repeat on the other side of the motor mounting brackets.



Chain Mounting Hardware Bag A



15ft chains
(purchased separately)



(B) From the nail, measure about 25.5in (65cm) toward the center of the top beam and loop the chain around your thumb, back toward the motor and above the nail. Drape the top of the chain over the motor sprocket so it locks in place. Repeat on the other side.



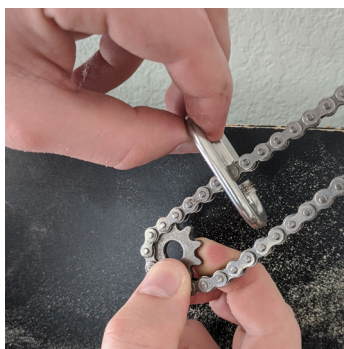
(C) On the right side, place the **sprocket** in the chain loop and attach the **quick link** through the hole in the sprocket, with its opening facing away from beam. Don't tighten the link. On the left side, attach the spring and tighten the quick link, ensuring the link nut is facing away from the beam.



Chain Mounting Hardware Bag A



Spring Hardware Bag B



(D) Carefully stretch out the spring from the left side to attach it to the other end to the open quick link on the right side. Tighten the right quick link to lock the chains together.



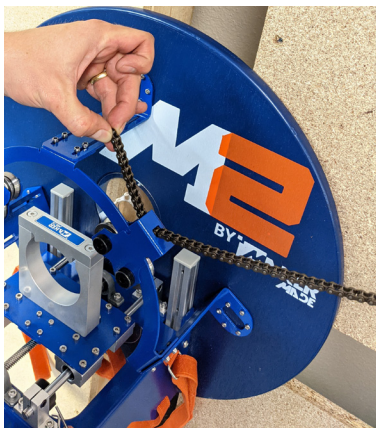
Drew's Note: You can adjust the spring tension on your frame by moving the nails toward or away from center. The most important part is that the spring keeps the tension on the chains. We use nails to connect the chain to the frame, so if something goes awry, only the nails will be removed without damaging your frame.

Mounting the M2 to the frame

Drew's Note: We recommend wearing safety goggles and having a friend help mount the sled to the frame. The chain can slip off the sprockets, causing the spring to snap and hurt people, pets, and surroundings. It's also important to insert the cotter pin into the second to last link, for extra safety of the chain attachment, as shown below.



1. Hold the M2 sled against the wasteboard near the right chain. Hold it against the frame with your body weight or have a friend help by holding it for you. Take the loose end of one chain and thread up through the hole in the roller bearing carriage.



2. Insert the **cotter pin**, with the flat side on the right, into the second to last chain link to attach.

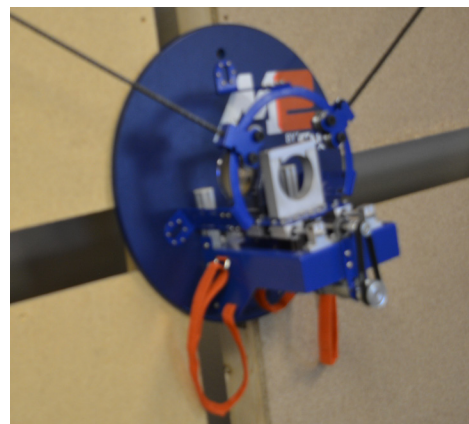


Chain Mounting Hardware Bag A

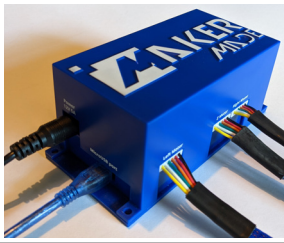


3. Manually move the M2 to the center of the Wasteboard and have a friend pull the tension on the opposite chain to around 20in from the nail to the spring. You can pull the chain away from the motor sprocket, pull for more length, and set it back for the tension to hold, and beware of it snapping. When you have enough slack in the chain, thread through the opposite roller bearing carriage and attach with the other cotter pin into the second to last chain link. Let go of the sled and it will rest against the canvas.

Drew's Note: Your M2 is ready to calibrate! (Also, don't forget to securely attach your bricks with the Velcro straps, if you waited until it was mounted).

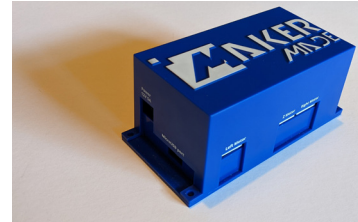


ARDUINO DUE board and shield



Drew's Note: The M2's brain is an Arduino DUE microcontroller. We recommend mounting the DUE to the wall behind your frame, but it can be mounted in any safe location where it won't be stepped on or in conflict with the M2 during operation.

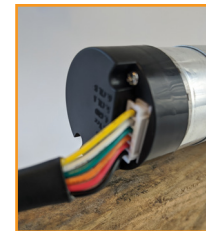
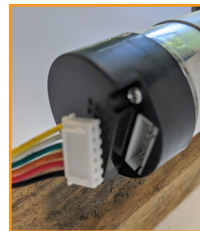
1. Mount the control board in its case to the wall above your frame or behind the canvas. It helps to mount it in the middle for the motor wires to reach everything.



2. (A) Plug in the USB, and power.



(B) The longer six-pin motor cables go to the X/Y motors, using the diagrams on the case. The connections will only fit in one direction.



Right/Left (X/Y) Motors

(C) The shorter blue cable is for the Z motor, and works best to feed under the frame to the M2 on the front before you plug it in.



Drew's Note: You can use the zip ties for cord maintenance! I also suggest putting a drop of hot glue on the connections to ensure that they don't wiggle loose over time. If one of your motors of your M2 doesn't move during operation, or the M2 generally moves in a strange direction, the first thing to check are the motor connections. If the wires connecting the X, Y, and Z motors are loose, even a tiny bit, it will cause your M2 to malfunction.

APPENDIX 1 - TIPS

[Click here to get our calibration guide and start cutting!](#)

The MakerMade M2 CNC kit is used to assemble a large format CNC machine. It is designed to use a router (or another tool) to cut 4ft by 8ft sheet materials. When used correctly, this machine is very safe. However, some safety precautions must be taken to prevent injury. These include but are not limited to:

- Always follow the safety guidelines and instructions included with the router or other tool you attach to the kit.
- Always wear ear and eye protection when running your machine.
- Use adequate dust collection or wear a respirator. Breathing material dust can be harmful.
- Use proper lifting techniques when loading/unloading materials.
- Always use caution when connecting/removing the sled. This assembly weighs around 20 lbs.
- NEVER leave your machine running unattended!
- Optionally, you can cut off the ends of the beams and the top of the vertical frame legs outside of the stud mounts, so your frame isn't as tall or long.

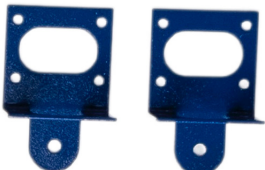
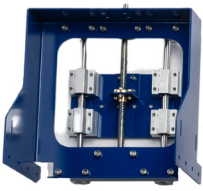
We're excited to have you in our community of makers and can't wait to see what you create.

Find us on [Facebook](#), [Instagram](#) and [YouTube](#) @makermadecnc and tag your projects!

#MakerMadeMaker

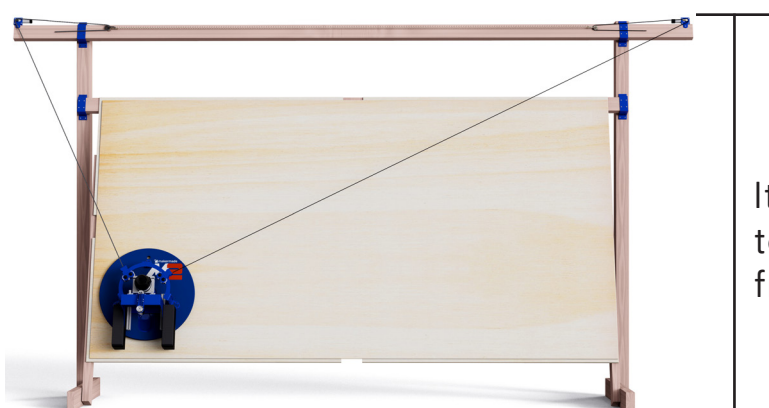
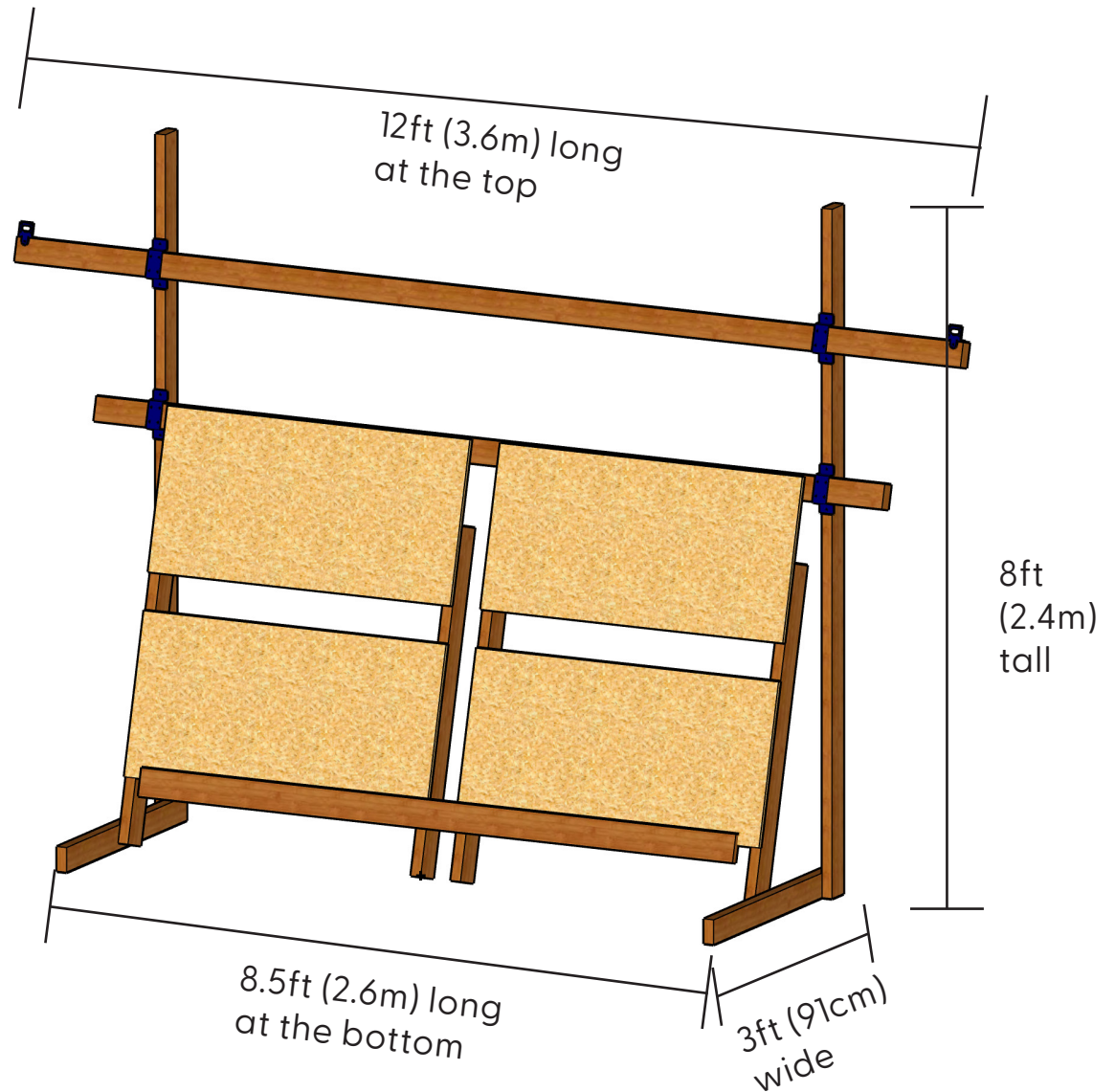


APPENDIX 2 - WHAT'S IN THE BOX?

DUE v1.2 Control Board, Shield, and case 	10ft MicroUSB to USB cord 	AC/DC Power Adapter and cord 	X, Y, and Z Axis Motors (3) 
X, Y, and Z Motor Power Cables 	Motor Mounting Brackets (2) 	Stud Mounts (4) 	Ring Carriage 
Roller Bearing Carriages (2) 	Z-Axis Mount L-Brackets (3) 	Z-Axis Assembly 	Sled 
Router Clamp 	Roller Bearings (4) 	Chains 335cm/11ft (2) 	Dust Collection Bracket 
Spring 	Maker Made Router Bit Starter Set 	Velcro Dust Collection and Brick Mounting Straps (3) 	Acrylic Dust Cover 

Maker Made USB 	Marker 	Stickers, Quick Start Guide, and Welcome Letters 	Chain Mounting Hardware Bag A Cotter pins (2) Chain sprocket (2) Small nails (2) Large nails (2) White spacers (2) 
Spring Hardware Bag B Quick links (2) Small screws (4) Zip ties 	Short/Long Frame Mounting Screws Bag C Shorter black wood screws Longer silver wood screws 	Short/Long Frame Mounting Screws Bag D Shorter black wood screws Longer silver wood screws 	X/Y Motor Hardware Bag E Motor sprocket (2) Grub Screws (2) Motor screws (8) Motor washers (8) 
Bearing Carriage Hardware Bag F Shoulder bolt (4) Large washer (8) Large locking nut (4) 	Ring and L-Bracket Hardware Bag G Tiny wood screws (20) Small black M3 bolts (12) Locking nuts (12) 	Assembly Tools Bag I 5mm hex wrench 4mm hex wrench 3mm hex wrench 	Z Axis Hardware Bag C Z Motor bracket 2.5mm and 2mm hex wrenches Flat combo wrench Belt Black M3 x 8mm bolts (6) Large gear Small gear Large set screws (2) Small set screws (2) M4 x 8mm bolts (4) M4 Locking nuts (4) M5 x 8mm bolts (8) M5 T-nuts (8) 

APPENDIX 3 - XL FRAME DIMENSIONS



It's 6ft 11in (2.1m) from the floor to the top of the x/y motors, If the 8ft vertical frame legs are cut down (optional).

APPENDIX 4 - CUSTOM FRAMES

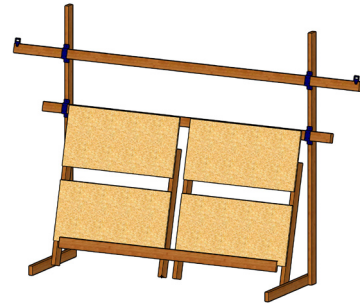
Visit our [M2 Resources page](#) for instructions over how to build the mini, standard, or XL frames by MakerMade.



Mini Frame:
6ft Top Beam
Smaller Chain
Cuts up to 4ft x 4ft



Standard Frame:
6ft Top Beam
11ft chains (included with M2)
Cuts up to 4ft x 8ft



XL Frame:
12ft Top Beam
15ft chains (purchased separately)
Cuts just over 4ft x 8ft

One of the amazing things about the M2 is the wide variety of frames that will work. From all metal frames to using a weights in place of the spring- the options are almost limitless!

However, there are four things to keep in mind when going rogue and building a unique frame:

1. The bottom of your wasteboard should be at least 10" from the floor, so the M2 has room to go across the bottom of your material.
2. For the trigonometry behind the M2's movement, the wasteboard should be clamped or screwed onto the stud mounts, to maintain a 15 degree angle.
3. The target distance of the motor offset (from where the chain leaves the motor sprockets to the top of the wasteboard) should be at least 18" for a 10ft top beam, 24" for 12ft top beam, and even higher to cut a larger area.
4. Your top beam and wasteboard must be level and equal distance from each other.
5. Makerverse Calibration may be more difficult with frames not tested by MakerMade.

Drew's Note: Interested in coming up with your own frame design? Hop on our [Facebook Owner's Group](#) or [Forum](#) and discuss with other makers about your idea if someone has made something similar!