16’ - 24’ Wide Hoophouse DIY Kit Instructions

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Backyard Hightunnels©

Designed by Growers for Growers

We designed our hightunnels with the needs of the grower and the plants in mind, as well as the problems created by extreme weather conditions. Our hightunnels have consistently held in strong winds (70+ mph) and heavy snow loads. We are confident that you will enjoy the same results if you build your hightunnel according to our instructions. Each step requires as much precision as possible, therefore, be exact with your measurements. Feel free to call with questions at 435.562.6014. We have included pictures to help you understand how to construct your hightunnel. We also reference YouTube videos for additional help. If you find that these instructions do not exactly correlate with other information which we have made available, it is because we have found a more efficient way of doing things. However, either method will work. It is strongly recommended that you have additional help when you arrive at the step of installing the canopy plastic. We recommend that you read through every step completely before executing that step.

For cold weather growing techniques, we recommend Eliot Coleman's books on Winter Harvest and Organic Gardening.

<u>All Tools Needed:</u>

- 1-2 measuring tapes (25'-100', depending on size of the hightunnel)
- 2 hand levels – one approximately 4', one approximately 12"
- skill saw
- drill
- hammer

- sledge hammer (both a long handle and short handle, if possible)
- pencil or marker
- wooden stakes
- sawzall or metal cutting saw
- string
- staple gun
- staples
- 4-5 long ropes
- 2-4 ladders
- 2 saw horses, depending on length of hightunnel
- hex-head drill bits for #14 3" tek screws
- hex-head drill bit for #10 1" metal-to-wood screws
- phillips head screw bit
- duct tape
- power cords
- nail gun
- 16 penny nails
- air compressor
- garden rake (optional)

All Materials Provided:

- 4' galvanized steel posts
- 10.5' bent arcs
- 10.5' purlin Pipe
- 10' conduit for roll-up sides
- 6 T-end clamps with nuts and bolts
- Cross connectors
- 4 end caps
- U-channel
- plastic for canopy and end walls
- wiggle wire
- plastic repair tape
- 3" Tek Screws
- 1 1/2" tek screws
- 1" tek screws
- Wood-To-Metal Screws
- fabric clips
- post pounder

- 2 hand cranks
- wind rope assembly
- Shopping List

All Materials to Purchase (see Shopping List for detailed information):

- pressure-treated wood
- pine 2x4x8
- pine 2x4x10
- pine 2x4x12
- pine 1x4x8
- pine 1x4x10
- pine 1x4x12
- 1x1.5x8 Furring Strips
- 12" Simpson Steel Strap
- 2” x 4” Mend Plates (Simpson Strong-Tie)
- 3” grabber screws
- 1 5/8” grabber screws
- screen door
- stakes
- Black Screening for vent (Optional)

Part I: Selecting Location and Setting Base Frame

When selecting the ground for your hightunnel it is best to designate and choose areas that receive a maximum amount of sunlight throughout the day, especially in the winter months. If possible, orient the ends of your hightunnel on an east/west axis, this will aid in increasing the amount of sunlight. The ground should be as level as possible. If soil is mostly clay, it may be necessary to create a slight slope to one side or to the back to allow for drainage.

It is best to clear plenty of space for construction. Try to limit the amount of possible obstructions directly beneath the future hightunnel **and within a 10-foot perimeter**. While this may seem tedious, the construction of the hightunnel will be easier if there is more than enough room to work with long, awkward pieces of metal and wood as well as ladders that need level ground near end walls.

STEP 1 – Set Base Frame

See videos titled "...."

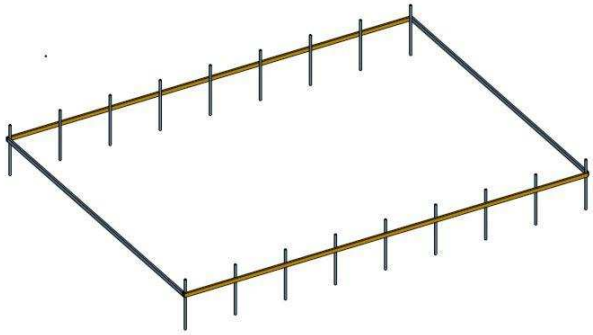

Figure 1 - Base Frame Final Product

1. Take **Pressure-Treated 2x4s** and line them up end to end until you reach the desired length for the sides of the hightunnel. If **Pressure-Treated 2x4s** were purchased according to the **Shopping List**, no cutting will be necessary.
2. Center **Mend Plates** over each joint.

3. Connect the ends of the **Pressure-Treated 2x4s** together by pounding the mend plates into the joined 2x4s.
4. Turn the complete length of 2x4 over and attach mend plates to the joints on the opposite side.
5. Use **Pressure-Treated 2x4s** to create front and back base frame in the same manner described above.
6. Join together base frame with two 3" Grabber Screws at each corner.

It is easier to pound in mend plates if 2x4s are on a solid, flat surface. When turning over the long lengths of wood to hammer in the mending plates on the unfinished side, be careful not to bend at the joints and skew off the Mend Plates.

If the **Shopping List** is followed, there will be exactly enough pieces for the base frame without having to make any cuts. Some lengths may require a combination of 8', 10', or 12' **Pressure-Treated 2x4s**, per the **Shopping List**. Attach the front and back base frame to the ends of the side base frame. The inside dimension will be the exact length of hightunnel. The width will be slightly narrower.

STEP 2 – Square Frame

See video titled "…"

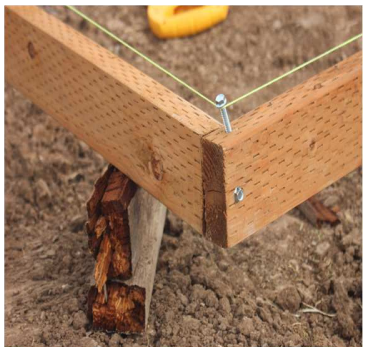

Figure 3 – String to Square the Frame

1. Mark all **4' Galvanized Steel Posts** at 12".
2. Drill a **3" Grabber Screw** 2" into the top of each corner of the base frame, leaving 1" of the screw exposed.
3. Tie the **String** very tightly from one screw to the other along each side of the hightunnel base-frame.

Pull the **String** as tight as possible as it will help ensure that the wood is straight as the frame is squared and that the base frame is as level as possible.

Choose a side that will run parallel with a wall, path, property line, or house. Position the hightunnel along that line.

Begin by pounding 2 posts into the corners along the side that is parallel with a wall, path, property line, or house. Use **4' Galvanized Steel Posts** and **Post Pounder** to pound posts into the ground. Do this until 12" mark is 6" inches above the top of the frame. This is meant to fix the hightunnel in a specific position relative to the house, fence, or property line. These will be driven further into place once the frame is level.

Figure 4 – 12" Marking on posts

4. With a long **Measuring Tape**, measure from the inside of one corner to the inside of the diagonal corner. Repeat on the opposite diagonal corners, shifting the frame as necessary until both corner measurements are within 1" of each other.

Figure 5 – Measuring diagonal corners

5. Use **Wooden Stakes** to pin the frame centered underneath the string around the entire base frame.
6. With the **Post Pounder**, drive **4' Galvanized Steel Post** into the remaining 2 corners of the frame until the 12" mark is 6" inches above the top of the frame.

Figure 6 – Pounding Posts

7. Mark the base frame at 4’ increments starting from the corner posts already driven into the ground. These marks determine where the remaining posts will be driven.

Figure 7 – Mark base frame at 4’ increments for remaining posts

STEP 3 – Level Frame and Set Posts

Use the long level or a string for this step. Use stakes, stones, soil, or anything that is handy to hold the frame level. Some places may need to be dug out. Because our hightunnels aren’t designed to be permanent structures, the plot does not need to be perfectly level and may have a gentle grade. Due to this flexibility, it is only necessary that the end walls of the hightunnel are plumb with room for deviation on the sides.

1. Level End walls.
2. Finish driving **4’ Galvanized Steel Posts** in until the 12” mark lines up with the top of the frame.
3. Secure base frame to the corner posts using two **3” Tek Screws** and **Washers** for each post. Attach base frame along the side (length) and not from front (end wall).

Figure 8 – Screwing stake to frame

4. Using the string that goes around the top of the base frame. Make sure that there is a 1” gap between the **base frame** and the **String** down the length of the hightunnel, with the **end walls** of the base frame being perfectly level.

Figure 9 – Leveling base with the string

5. Secure the frame to each post with two **3” Tek Screws** and **Washers.** Drive screws from outside of base frame into wood then into post. Space screws 2” apart vertically.
6. Remove stakes along the sides of the hightunnel.

Drive the remaining **4' Galvanized Steel Posts** into the ground at each 4' interval until the 12" mark aligns with the top of the baseboard. As posts are pounded in, use a small **Level** to periodically check that each post is plumb. The placement of the posts should be such that the base frame will be centered beneath the string when the base frame is screwed to the post. Having each post aligned and plumb is extremely important during later phases of construction.

The importance of pounding in the posts as plumb as possible cannot be overstated. Additionally, the alignment of the posts to each other is critical. **These factors will affect the overall integrity and alignment of the rest of the hightunnel**. Depending on the type of soil, it may be extremely difficult to drive the posts a complete 30" into the ground. If such is the case, posts will need to be cemented into the ground, taking care not to bump or throw off the alignment of the frame in the process.

After each post is pounded in and secured to the frame, it is possible that the tops of the posts will be somewhat deformed due to tough soil conditions. With a **Sawzall**, cut off the minimum amount from each pipe so that they are all the same height. We recommend cutting them all to 10" to 12" above the top of the base frame.

Figure 10 – Cutting off smashed post

Part II: Setting Ribs and Purlins

Ribs are the arched galvanized Pipe that create the shape of the hightunnel. Purlins run the length of the hightunnel and secure the ribs together; together the arches and purlins serve as the skeleton of the hightunnel.

Tools Needed:

- pencil or marker
- measuring tape
- sawzall or hacksaw
- drill
- hex-head drill bit for #14 1" Tek Screws
- 1-2 ladders

Materials Needed:

- straight purlin Pipe
- bent rib Pipe
- T-end clamps
- nuts and bolts
- hose clamps
- 1" Tek Screws

STEP 1 – Assembling Purlins

See video titled "…"

1. Take the **Purlin Pipe** and lay them out inside the hightunnel. Connect the joints together until there are three purlins that extend beyond the length of the hightunnel.
2. Screw purlins together with **1" Tek Screws**. Ensure all screws are on the same side of the purlin for the full length.
3. Cut **Purlin Pipe** 5 ¼" shorter than the length of the base frame (use inside dimensions). Cut off the swedged end. Both ends of the **Purlin Pipe** must be open ended.
4. Place **Purlin Pipe** next to the posts on the inside of the hightunnel and center it between the two ends. The **Purlin Pipe** should sit about 1" shorter than the rib posts on each end.
5. Using the **4' Galvanized Steel Posts** as a guide, mark the purlins at 4' increments. A marker works well on the Pipe. By setting the purlin up against the posts it is easy to mark 4' increments needed. **Purlin Pipe** are now ready for installation.

STEP 2 – Assembling Ribs

See video titled "…"

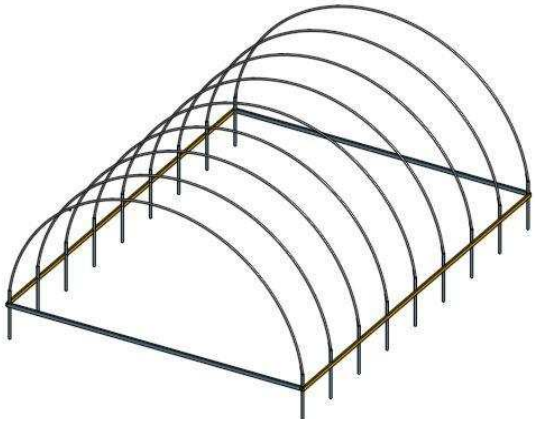

Figure 11 – Assembled Ribs

Bent Pipe are the ribs which will be assembled into arches. One 10.5' **Bent Pipe** will have a 6" black line on the end, while all the 3' **Bent Pipe** will have the other 6" black line. Depending on the width of the hightunnel, The **Bent Pipe** will have colored marks; green, blue, and yellow.

1. Lay out the **Bent Pipe** and join them together into an arch according to colored marks.
2. Slide the black end into the **4' Galvanized Steel Posts** until 6" mark is flush with the top of the post.
3. There will be a segment of the **Bent Pipe** sticking out from opposite sides of the hightunnel. It should look like a rib cage, with the tops of the ribs hanging free.

Figure 12 – Insert Ribs into frame Posts

Notice that the ribs are open. Depending on width, there could be a long segment and a short segment opposite each other.

Figure 13 - Ribs hanging free waiting for joining

4. Check the base of both sides of the rib to ensure that the 6" mark is flush with the top of the **4' Galvanized Steel Posts**.
5. Using ladder(s), pull the tops of the open ribs down and grab each end and sliding them together.

Figure 14 – Connecting Ribs on ladder

This step can be difficult. A metal rake can sometimes be helpful to reach the open ribs and pull them down. Be sure to keep steady, consistent pressure. Continue down the length of the hightunnel pulling the

ribs together. If the rib does not hold together on its own, drive a **1" Tek Screw** into the joint on the underside of the structure. Ensure ribs don't slide down into posts while making this connection.

6. About 2" from the top of the steel posts, screw the ribs into the **4' Galvanized Steel Posts** using **1" Tek Screws**. Be sure to screw them together on the <u>inside</u> so the screw head won't tear the plastic cover.

Figure 15 – Securing rib into post

STEP 3 – Attaching Purlins to Ribs

It is helpful to have people hold the Pipe in place until enough hose clamps can be attached to hold the Pipe up. The **Ribs** come pre-marked with a center line and two side purlin lines. If assembled correctly, the marks should align with each other and extend the length of the hightunnel.

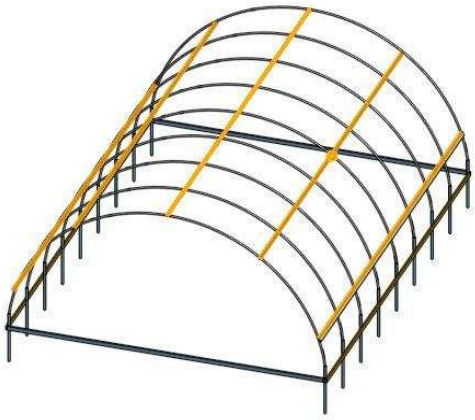

Figure 16 – Assembled Purlins and Pipe

1. Lift the **Purlin Pipe** up to marks made on the **Ribs** and ensure that the **1" Tek Screws** on the **Purlin Pipe** are facing down towards inside of hightunnel. Slide the **Purlin Pipe** into the **T-end Clamps** until the **Purlin Pipe** touches the end arch.
2. With **Nut** and **Bolt** attach **T-end Clamps** to end ribs. <u>Ensure that the **Bolt** stem directs itself downward.</u>
3. Insert **1" Tek Screw** through the **T-End Clamp** into **Purlin**, make sure that the screw is inserted on the inside of the structure..
4. Attach the purlin to the arches at each intersection of the **Purlin and arch** with cross connectors. Be sure to align the mark on the **Purlin Pipe** and the mark on the **Rib**.

Figure 19 – Hightunnel with Purlins & Pipe finished

Part III: Framing End Walls

Tools Needed:

- hammer
- drill
- 18” Level
- pencil or marker
- phillips head drill bit
- skill saw or hand saw
- saw horses
- nail gun and compressor (optional)

Materials Needed: Note – materials are dependent on width see shopping list

- pine 2x4x12s
- pine 2x4x10s
- pine 2x4x8s
- 1-2 ladders
- metal straps
- duct tape
- 2” grabber screws or #16 penny nails (recommended)
- 1 1/2” grabbers screws
- #14 3” tek screws
- Black Screening for vent (Optional)

STEP 1 – Choosing a Plan

This kit comes with an end wall framing diagram, which you can use or choose to use your own design. Some customers opt for variations to accommodate bay doors or additional storm doors. The vent should be installed as high as possible to vent the hottest air during the summer. Cover the vent with screening mesh and use left-over plastic or plywood to seal vent during

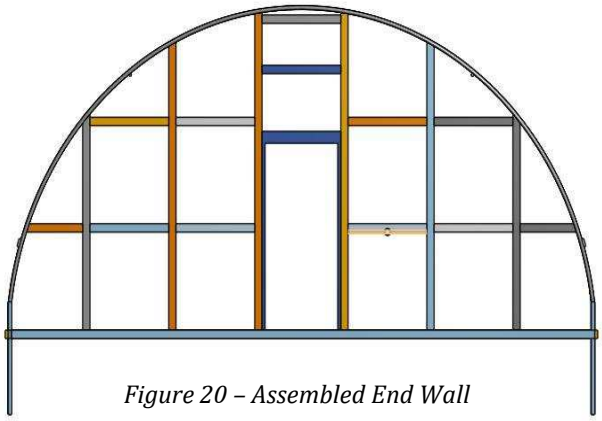

Figure 20 – Assembled End Wall

the winter. The height of hightunnel is approximately 12'.

The plan provided is for one storm door to be framed in the center. It can be framed off center if preferred. Be prudent in cutting framing pieces so as to limit waste.

STEP 2 – Framing End Walls and Door

1. Mark the base frame where the vertical 2x4's will go.
2. Place the appropriate length 2x4 on the mark at the bottom and with the help of a level, scribe a line at the top where the 2x4 is plumb.
3. Cut on the scribed line.
4. Attach the wood framing to the metal **Ribs** using **Metal Straps** and **1 ½" Grabber Screws**.

Figure 21 – Framing ends of hightunnel (Metal straps looking from the inside, on far left).

Secure as tightly as possible. Always start on the outside, keeping the screws flush with the board, then come to the inside, angling the screws to tighten the straps. Keep all outside materials as flush as possible. Use duct tape to cover screws and metal straps on the outside. This step is done before the U-channel is attached to the rib.

5. Frame in cross pieces.

6. Mark the rough opening for the door according to the directions provided on door box.

7. Add a 4' piece of pressure treated wood to the inside of the base frame where the door will be located. This will create a double plating at the door opening.

8. Frame in the rough opening of the door. Turn the 2x4s used to frame the door sideways so they face each other and are perpendicular to the base frame, as shown in picture. Keep the outside edge flush. 2x4s are only turned this direction to frame in the door. All other 2x4 pieces sit flush with base frame.

Figure 22 – Metal straps as seen from the inside of the hightunnel.

A rough opening for the door is being created with the 2x4's turned sideways so there will be more material to attach the door. It also makes the doorway more stable. The double plate base frame gives something to which the bottom of the 2x4 can be attached.

Frame in the header according to the door manufacturer's rough opening dimensions.

Circulation vents are framed in at the top centered over the door and covered with screening instead of plastic. If you have a screen, this is usually the best time to put in the screen for the vent.

Figure 23 – Hightunnel with framing. Note opening for a bay door on back side (Right)

STEP 3 – Attaching End Walls to Grounded Posts

Four extra posts are provided in the kit. These are used to support the endwalls and firmly attach them to the ground. Pick two studs on the front-end wall that are equal distance from the center to attach a 4' post to. Repeat for the opposite end wall.

1. Pound in four **4' Galvanized Steel Posts** along the inside of the studs. Ensure posts remain plumb as they are driven in.
2. Use **3" Tek Screws** for each post to secure them to the end wall. Attach from the outside of the hightunnel, drilling through the frame first then into the post. We recommend that one screw go through the base board and the other go through a vertical stud.

Figure 24 – Posts on inside

It is recommended that screws be countersunk into the wood.

Part IV: Attaching Roll-Up Board and U-channel

The wiggle board is the point in which the canopy is attached along the length of the hightunnel. It is also referred to as the Roll-Up Board. All the plastic below the Roll-Up Board is attached to a **Roll-Up Bar Pipe**. The placement of this board can vary between the purlin and the base plate. Most Roll-Up Boards are about 2 ½ to 3 ½ feet from the top of the base frame.

Tools Needed:

- drill
- hammer
- sawzall or hacksaw
- washers

Materials Needed:

- mend plates
- U-channel
- pine 1x4x12's
- 1-1/2" Tek Screws
- 1" Tek Screws
- metal-to-wood screws

STEP 1 – Create Roll-Up Board

1. Mend together lengths of **1x4s** in the same manner as previously done with the **Pressure-Treated 2x4s** used to create the base frame**.** The length of the **Pine 1x4s** needs to be from outside of end rib to outside of end rib. It can extend beyond and then be trimmed with a **Sawzall** later.
2. Make a mark on every rib where the board is to be installed. This height is subject to variation and preference of builder. Between 2'-3' from base frame is recommended.

Be extra cautious in handling the long, full-length boards, as the **Pine 1x4x12s** can crack and break if not installed with plenty of helping hands.

STEP 2 – Mount U-Channel to Roll Up Board, Mount Roll Up Board to Hightunnel

This step usually takes a team of 4 or more to do if hightunnel is 40' or longer. One good method is to set **1 ½" Tek Screws** in the ribs where the board is mounted. **Tek Screws** should be drilled in just enough to provide a shelf for the board to rest on. They will be removed once the board is fastened.

1. With Roll Up board on the ground, attach U-Channel to Roll Up board with 1" metal to wood screws every 1.5 ft.

Figure 25 – Mounted Roll-Up Boards

2. Start and end the channel 1.5” from ends of the Roll Up boards. This allows space for the channel that will be installed on end arches.
3. Three screws are no longer required as shown in figure 26.
4. Use **1-1/2” Tek Screws** and **Washers** to fasten the **Roll-Up Board** to the ribs. Put 2 screws in each following the directions below.

   a. Put 1 screw through **Roll-Up Board** below the **U-Channel** into the rib.

   b. On the same rib, put another screw through the **U-Channel** and **Roll-Up-Board**. Be sure to drive a **1-1/2” Tek Screw** through the **U-channel** and into every **Rib, except for the two end wall ribs (front and back)**.

   c. Repeat steps A and B for every rib.

5. Cut off excess Roll-Up Board flush with the outside face of rib.

When attaching the board, it is best to drill in and out of the wood a few times, and then drill into the rib and then through the U-Channel. drill the first screw in only partially, then drill the second screw in all the way. Go back and drill the first screw in all the way. This method helps prevent cracking in the board.

STEP 3 – Mounting U-Channel to Ribs

U-channel will be mounted to first and last ribs only. Keep the **U-channel** level, butting them up end to end and plumb with the **Roll-Up Board**. Attach **U-channel** to end ribs using **1” Tek Screws**.

Figure 26 – Attaching U-Channel

1. Pre-drill **2** holes **1”** apart vertically, and **1”** from the end of the **U-channel.**
2. Using two 1 5/8” **Wood Screws**, attach **U-channel** with pre-drilled holes onto baseboard so that the end of **U-channel** is

flush with the bottom of the base board and the side of the **U-channel** is flush with the face.

3. Place **U-channel** over **Roll Up Board** so that **U-channel** is flush with the end of **Roll Up Board** and the pipe is flush with **Roll Up Board** as well. This may require two people to bend the **U-channel** and to push the end wall in so that everything is flush with the **Roll Up board**.
4. Using a **1 ½" Tek Screw** attach **U-channel** and **Roll Up Board** to the rib going through the center of the **U-channel** and the **Roll Up Board.** Be sure that **Roll Up Board** is still hitting the line marked previously.
5. Once you are ¾ of the way over the rib, start from the base board on opposite side. Repeat the process above.

Figure 27 –U-Channel End Wall Attachment

Be sure to stay on top of the **Rib** as you move across and over the **Rib** with the **U-channel.** Keep each segment flush and plumb against its adjoining segments.

A cut will need to be made with a piece of **U-channel** to fit the empty space on the arc.

Be sure to stay centered on top of the **ribs** as you move across and over the **arch** with the **U-channel**.

Part V: Attaching Plastic

The plastic is shipped in two rolls, one for the canopy and the other for BOTH ends. Canopy and End-Wall rolls will be marked. The End-Wall plastic will arrive in one long piece that will need to be folded in half and cut. BE SURE plastic is cut it in the right direction. Based on the dimensions of your hightunnel, cut the end wall plastic in the right direction so that it covers both the front and back of your hightunnel.

When dealing with plastic at any step, be sure that there is little to NO WIND. Any wind at all may cause the plastic to catch on sharp objects and tear.

Tools Needed:

- staple gun
- exacto-knife or scissors
- 4-5 long ropes
- drill
- hex-head drill bit for #14 1" tek screws
- 1-2 Ladders
- hammer (*Optional*)

Materials Needed:

- plastic
- wiggle wire
- ¾" EMT pipe with conduit sleeves
- plastic tape
- 1" tek screws
- staples
- fabric clips
- sawhorses (*Optional)*

STEP 1 – Cut and Attach Plastic to End Walls

We recommend attaching the End-Wall plastic first. We attach the ends first because the plastic lasts much longer on the ends. The canopy will need to be replaced sooner, so for ease of canopy replacement, attach the canopy after End- Wall plastic. It usually takes two people to wiggle wire the plastic into the channel; one to hold the plastic tight and in the proper place, the other to wiggle wire in.

1. Roll out the **End-Wall** plastic sheet and fold it in half longways. The fold that is made is where you will cut your plastic in half. However, sometimes the rolls come in different sizes**. Be sure plastic is cut so there is 1' extra on all sides.** Stretch each piece over the end walls of the hightunnel, making it as tight as possible and eliminating bubbles and wrinkles.

Figure 28 – Plastic on End-Wall

2. Secure the plastic to the **U-channel** on the rib using the **Wiggle Wire**. Begin at the center and work down the sides maintaining a very taut sheet. Stretch plastic over **Roll-Up Board** and continue in **U-channel** below the **Roll-Up Board** to the ground.

3. As the plastic is fastened into the **Rib**, another team follows along and while holding plastic even on both sides and level to the ground, tacks the plastic into the 2x4 framing pieces and the wooden base frame using the **Staple Gun** and **Staples.** Aim for the center of 2x4 as you are tacking.

4. Trim off excess plastic with **Scissors** or **Exacto Knife**, leaving a 4-6" of excess plastic.

Figure 29 – Stapling the plastic to the frame

STEP 2 – Attach Furring Strips

Materials Needed:

- furring strips
- 1" tek screws
- 1 5/8" grabber screws

1. Cut **Furring Strips** to the approximate lengths of the outside of the end frames.
2. Attach the **Furring Strips** using 1 ½" **Grabber Screws**.
3. Install storm door according to instructions inside the box.
4. Using an **Exacto Knife**, trim plastic from door opening cutting plastic even with 2 x 4 door frame on the inside of the frame. Make sure there are plenty of Staples holding it in place.

The cuts do not have to be exact, simply cover the staples used to attach the plastic. Be sure to attach **Furring Strips** to the base frame on the end walls as well. Furring strips secure the plastic to the end wall framing, preventing wind damage.

Figure 30 – Furring Strips on End Walls

Notice that furring strips do not have to be the exact lengths of the frame beams they are following. The main objective is to cover staples and give extra support to the plastic.

STEP 3 – Attach Canopy

Figure 31 – Plastic laid out

This step is the most hazardous. There must be NO WIND when installing the canopy. It is recommended that this step be carried out with a team of at least 6 people, more if the structure is long. PLEASE READ THROUGH THIS SECTION COMPLETELY BEFORE MOVING FORWARD.

1. Lay out and connect lengths of the **EMT Conduit Pipe** until there are two Pipe that are 2ft-4ft longer than the total length of the hightunnel. These will form the **Roll-Up Bars**.
2. Secure the joints of the Pipe lengths using the **1" Tek Screws**. Cover the screws with **Duct Tape**. There should now be two lengths of roll up bar**.**
3. Once both **Roll-Up Bars** are ready, open the plastic and roll it out on a smooth, soft surface, preferably grass if available. Do not completely unfold the plastic.
4. Lay the **Roll-Up Bars** along the middle of the length of the plastic. Center the **Roll-Up Bars** lengthwise on the plastic. Both edges of the plastic will be in the middle. Find them. Fold the edge of the plastic over the **Roll-Up Bar** till it wraps once around the bar.
5. Attach **Fabric Clips** every 2'-4'**. If they are loose, screw them in.**

6. Once both bars are attached to the plastic, fold one side of the plastic under itself so the bars are together.
7. Gather the plastic and walk over to the hightunnel. Set entire length on sawhorses or on 2x4's that lay perpendicular to the side baseframe with one end laying on the baseframe and the other on the ground. See video in playlist for this example.

The **Roll-Up Bars** need to be on the outer edge and on top of the plastic.

Figure 32 – Plastic gathered and carried to hightunnel

8. Tie middle of rope onto one bar inside plastic sleeve at gaps between the fabric clips. Tie in a way that it can be easily undone.
9. Throw one of the rope lengths over the top of the hightunnel. There should be ½ of the rope over the top and ½ remaining. . This allows those in the **second** position to help control the speed of **Roll-Up Bar** as it moves across the ribs. This will also help in case of a wind hazard where the ropes can be pulled to the Hightunnel and tied to the baseframe or arch in order to keep the plastic from billowing.

Tie as many ropes as needed to lift the length of the canopy. All lengths require two ropes, while a 90-foot hightunnel requires 5 ropes.

Figure 33 – Roll-Up Bars on the side of hightunnel

STEP 4 – Pull Canopy

There are two teams for the next step. These are detailed below:

The **first team** is pulling back with the rope on the side where the folds of plastic are, causing the bar to lift up over the roll up

board. This position will also be guiding the plastic as it unfolds making sure that it does not catch on anything. and will help regulate the speed of the pull. It will also help against wind hazards by pulling the rope down into the hightunnel.

The **second team** is where the rope ends are; those in this position will be pulling slowly and in unison on the ropes to pull the plastic over the top of the hightunnel.

Once both teams are ready, start pulling the plastic over the arch slowly and communicate so that the plastic isn't torn. It is very easy for the plastic to tear during this step! All positions need to be watching out for any possible snags as the plastic is pulled into place.

1. As soon as the plastic is over the ribs, ensure it is even on all sides. <u>The roll up bar should extend 12-18" beyond the end of the hightunnel that will have the **Hand Cranks** and 4-8" beyond the opposite end.</u>
2. Begin securing the plastic to one end of the hightunnel using the **Wiggle Wire**. Start at the top middle of the end rib. Two teams of two will be required for this.
3. Starting at the center of the two end walls, the two teams will pull the hightunnel canopy against each other. Once the canopy is as tight as possible, the two teams will work in the same direction, securing the canopy to the end wall while pulling as well to keep the canopy taut using the **U-Channel** and **Wiggle Wire System**.
4. A foot of plastic needs to be extended past the front and back of the hightunnel (this may vary).
5. People along the side of the Roll Up bar will be pulling down on ropes or on bar to help prevent it from being picked up by wind gusts.
6. Finally, secure the sides of the plastic into the **Roll-Up Board**, maintaining even pressure. It is easy to pull too hard in the middle causing the roll up bar to be uneven. Keep an eye on the fold lines of the plastic and make sure they stay even during the installation of wiggle wire along the sides.

The best way to do this is to roll the **Roll-Up Bars** up a few rotations and use the weight of the bars as an even pressure. Remove any wrinkles or bubbles that may form in the plastic. It is best to work in teams of two or three for this step. It is also recommended that you attach a 2x4 or a long piece of wood to the end of the roll up bar when it is rolled up. This will allow the **Roll-Up Bar** to apply weight to the canopy without being unrolled. Extra pressure can also be applied to the **Roll-Up Bar** to increase canopy tightness if desired.

It is not unusual to have to re-pull one of the ends or a portion of the side in order to get the plastic tight. Note: 2 layers of plastic and 2 sets of wiggle wire are in the same U- channel on the front and back arch once canopy and end walls are finished.

Part VI: Roll Up Bars, Hand Cranks, and Wind Rope

Part VI: Roll Up Bars, Hand Cranks, and Wind Rope *see video* Jiggly Greenhouse® MRUP300 Sidewall Ventilation Hand Crank Installation

Tools Needed:

- drill
- hex-head drill bit for #14 1" Self Tapping screws

STEP 1 – Finish Roll-Up Bar

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- On the end of the roll bars that extend 2" beyond the hightunnel, attach an **end cap**, and on the other end attach a **hand**

  crank. For help with the installation,

  watch the video demonstration.

- Drive a **5' long 3/4" conduit pipe** into the ground so the hand crank casing can ride up and down on the conduit as the sides are rolled up and down. Attach handle. Drill hole in conduit pipe and attach bar to hand crank.

STEP 2 – Wind Rope

Materials Needed

- Power drill
- 1” size socket
- 5/16 metal drill bit
- Socket head attachment for drill
- Small eye bolts
- Large eye bolts
- Wind Rope
- Crescent wrench (Optional)

The **Wind Rope** is used to prevent your **Roll Up Bar** from being blow away from your hightunnel by the wind.

1. Pre-drill holes through **U-Channel** along the **Roll Up Board** with 5/16 metal drill bit 1” away from rib on the front and back wall. The hole will be going through the plastic and through the **U-Channel**, do not pre-drill the **Roll Up Board**.
2. Continue pre-drilling holes through the **U-Channel** along the **Roll Up Board** every other rib 1” away from rib.
3. Using the **small eye bolts**, attach where pre-drilled holes are located. This can be done with a 1” size socket in your drill or with a crescent wrench.
4. With a drill and the 1” socket head, attach the big eye bolts to the baseboard alternating from where the small eye bolts are attached. A big eye bolt will go on the bottom of all four corners of the baseboard in line with the length of the hightunnel.
5. String Wind Rope through both the large and small eye bolts making a V pattern along the hightunnel.

Notice figure 37, the Wind Rope goes vertically down or up at the first rib, this needs to be done at each corner.

Your hightunnel is finished! The easy work is done! Enjoy seasons of fruits and veggies as you harvest year-round from your own backyard.

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Operations and Maintenance Manual

While your hightunnel is guaranteed to withstand winds up to 70 mph and 30 psf of snow, without proper care and maintenance standard wear and tear through use and rough conditions can threaten the integrity of the structure. In this manual we include recommended practices and additions to your hightunnel to help it last as long as possible and continue to extend your growing season. These recommendations become more important as the length of the hightunnel increases.

General Tips on Preventing Wind Damage

The plastic canopy is in the most vulnerable position when the roll-up bar is completely rolled down should high winds kick up. High winds can lift the plastic and tear it off the roll-up bar. As such, in high winds the hightunnel sides will be more stable with a bit of tension on the roll bar – especially for longer hightunnels. In warmer months roll up the sides halfway or more to give the roll-up bar weight. In cooler months completely unroll the sides and wiggle them into place along the end ribs.

General Tips on Preventing Snow Damage

While our hightunnels are strong under heavy snow loads, they will not hold more than 2' of snow on the top. Clear snow from the sides of the hightunnel in order to allow the snow to continue to shed as more snow falls. In heavy storms, use a long rope with towels tied to the middle. Throw one end of the rope over the hightunnel and with a sea saw action walk the length of the hightunnel clearing the snow from the top. Our hightunnels are engineered to withstand 30 psf; they are not engineered to withstand more. 30 psf is close to 2 feet on top of the hightunnel.

Although our hightunnels will withstand strong winds and heavy snow loads, they will experience wear and tear during severe weather events. It is important to repair, replace, and regularly maintain the hightunnel in order to ensure long life of the structure.

Optional Add-Ons

Given here is a list of possible additions and modifications that can be made to your hightunnel to provide increased strength and support. Note that any damage made to the structure during the installation of the following items may nullify the warranty

agreement. At the owner's expense, Roberts Ranch and Gardens is able to perform the installation of any of the following items.

Interior Bracing
Interior bracing can be applied to the inside to stabilize the structure against strong bursts of wind. Interior braces are meant to be installed cross-sectionally from one purlin to the other. T-clamps or sockets are typically used.

Cables
Cables are typically installed at opposite corners of the hightunnel at the junction of the purlin and the end rib. This ties the structure together in such a way that when one end of the hightunnel is being affected by a large force, the other end will be able to support and distribute that force down the length of the hightunnel.

Anchors
When anchors are used they are usually driven down at each corner and intermittently along the sides. We recommend every 20ft. Anchors help hold the structure down in the event of extremely violent gusts of wind the threaten to lift the entire hightunnel. Once the anchor receives a significant tug it uses a mechanism to lock into the ground and hold the structure in place. Recommended for regions that experience unusually high winds.

Figure 37 –Duckbill Anchor

Reinforcement Posts
Reinforcement posts are often used – even with smaller hightunnels – to help strengthen the end walls. Reinforcement posts are driven down at each end wall in alignment with the framing studs. They are secured to the end wall from the exterior. Because the end walls are the least aerodynamic part of the structure, they have the most risk of being damaged in high winds.

Simpson Braces
The simpson braces serve a similar purpose as the reinforcement posts: strengthen the end walls. They are placed on the inside of the end walls where the vertical studs meet the horizontal pieces. End walls are often damaged at these joint spots in high winds.

2x4 Bracing

Hoophouses get much of their stability from the strength of the end walls. As such, as the hightunnel becomes larger it is more vulnerable due to an increase in surface without internal supports. 2x4 bracing is used to create a simple support in the middle of the hightunnel to reinforce it against high snow loads. These supports can be attached to one or many arcs. We recommend they be situated along the center purlin where the rib and purlin intersect.

Figure 38 – 2X4 Bracing