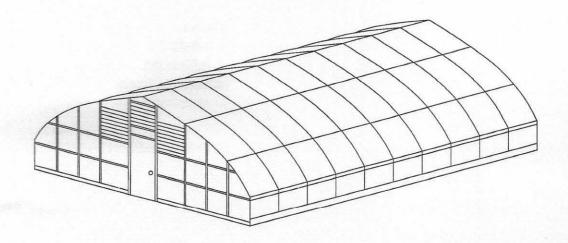
Greenhouse Construction Manual



30' Greenhouse Unit

Manufactured By:

CVS SUPPLY

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GETTING STARTED

THANK YOU

Thank you for purchasing a CVS Supply Greenhouse Kit!

This manual includes recommendations for the most efficient construction of your greenhouse. We do recognize that individual circumstances may vary and that occasional customization may be necessary. However, by following these simple step-by-step set up and assembly instructions, CVS is confident that your greenhouse will be solid, well-built and capable of withstanding normal weather conditions year after year.

MATERIALS AND PACKING

A complete list of materials, based on the model and size of your greenhouse, has been included with your kit. This list will include a description of the parts required to construct your greenhouse, the quantity of parts needed (including the quantities shipped and on backorder), and the amount of lumber that will be required. Please verify that all components marked "shipped" have been included in your shipment. We will inform you upon pickup of your kit when any backordered materials will be available.

You will need to obtain your framing materials from your building supply retailer, as CVS does not include lumber in your greenhouse kit.

While additional tools may be needed, we recommend that you locate the following tools and keep each conveniently on hand prior to starting your construction project:

Hammer Vise Grips Staple Gun Screwdrivers Adjustable Wrench Sledge or Post Driver Hammer Air or Cordless Drill w/ Bits Circular Saw Transit String

Shovel Post Level 6' Step Ladder 10' Step Ladder Post Hole Digger

Although optional, a scaffold wagon may be more maneuverable as you move along the length of the structure.

Please note that the following fasteners are commonly used for greenhouse construction and have been included in your kit:

Carriage Bolt

TFK Screw

Lag Bolt

Brace Band

Purlin Clip

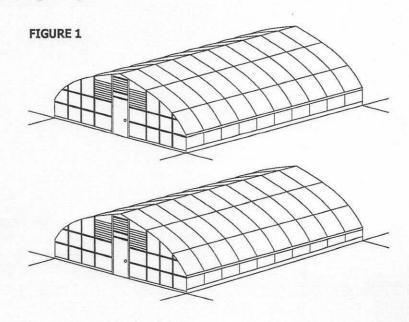
We recommend that you familiarize yourself with these fasteners, as each will be frequently referenced throughout this manual.

SITE SELECTION

For best results, the site you select for your greenhouse should be level to gently sloping. If the site does slope, you must determine whether your greenhouse will follow the slope of the ground or be built into the grade (see Figure 1).

If you choose to construct your greenhouse to follow the grade, a maximum slope of 5° is recommended. In this case, the stakes will be driven into the ground vertically while baseboards and eave supports will run parallel to the ground.

Alternatively, if you construct your greenhouse into the grade, stakes must be driven deeper into the ground at the higher end, resulting in less head room once your greenhouse is complete.

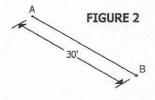


FOUNDATION LAYOUT

The most critical step in the construction process is to squarely layout the foundation of your greenhouse. While various methods may be used to successfully layout your foundation, we recommend the following steps.

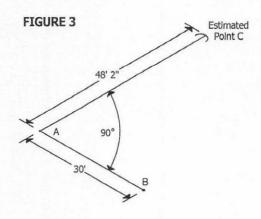
First, roughly lay out a triangle having three sides equivalent to the length, width, and diagonal of the greenhouse. Please note that throughout this construction manual, we have used a 30' x 48' unit. However, the accompanying table provides the applicable diagonals for other units. Please note the length (AC) must be two inches (2") in excess of the stated length of the greenhouse to accommodate the diameter of the end stakes.

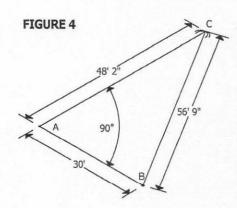
	Width (AB)	Length (AC)	Diagonal (BC)
	30'	32′ 2″	44′ 0″
1	30'	48' 2"	56′ 9″
	30'	72′ 2″	78′ 2″
	30'	96′ 2″	100′ 9″
1	30'	100' 2"	104' 6"
	30'	128′ 2″	131' 8"



Lay out the baseline by setting points A and B at 30' apart (see Figure 2), each representing the location for future corner stakes. As this baseline will ultimately represent one end of your greenhouse, establish these points with this in mind.

Originating at Point A, measure a 48′ 2″ line that is perpendicular (or 90°) to the Base Line, or Line AB (see Figure 3). Strike an arc at the 48′ 2″ location (now known as Estimated Point C).



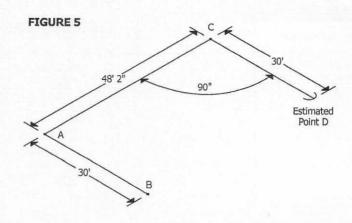


Originating at Point B, measure a 56' 9" diagonal line that angles toward Estimated Point C. Strike an arc at 56' 9" (see Figure 4). The intersection of the arcs forms Point C.

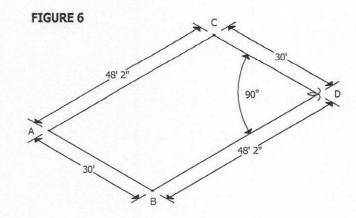
Verify the lengths of Lines AB, AC, and BC as 30', 48' 2", and 56' 9", respectively. If accurate, you may move on to the next step. If any line is not consistent with these measurements, redo the preceding steps.

Line AB represents the 30' width of your greenhouse while Line AC represents one side.

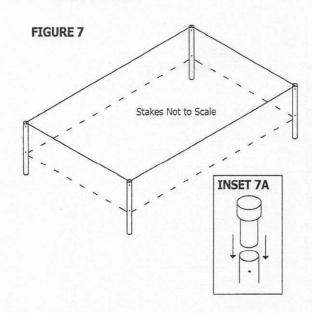
Originate a 30' line from Point C that is perpendicular (or 90°) to Line AC and strike an arc (see Figure 5). This becomes Estimated Point D.



Originate a 48′ 2″ line perpendicular (or 90°) to Line AB from Point B and strike an arc (see Figure 6). The intersection of the arcs form Point D.



SETTING STAKES

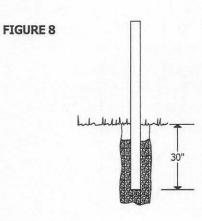


With the four corner locations now established, drive stakes to a depth of 30" (see Figure 7). To avoid damaging the stake's top surface, use a ground stake driver. Fit the ground stake driver into the top of the stake (see Inset 7A) and drive stake into the ground.

Use the post level to keep the stake vertical as you drive it into the ground.

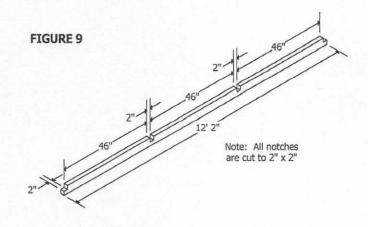
Run the string along the tops of each stake. Then, use a transit to ensure that all strings are level. Additionally, run strings along the bottom of stakes at ground level to be used for aligning subsequent stakes.

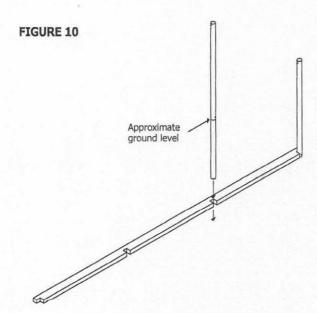
For added stability, the stakes may be cemented (see Figure 8). The hole should be three times the width of the stake. To avoid upward heaving by frost, the diameter of the hole's opening should not be larger than its base.



SETTING STAKES

With the foundation squarely laid out, set the remaining stakes at 4' increments. Use a template to ensure accuracy in setting the subsequent stakes (see Figure 9). Form the template by first cutting a 2" square notch at one end of the two-by-four. On 4' centers (beginning at the back side of the first notch), cut three additional notches. At the fourth and final notch, cut off the excess two-by-four, resulting in a total length of 12' 8".





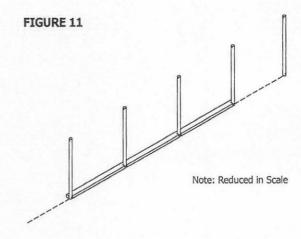
Note! Prior to driving, rotate stakes to ensure the bottom holes are perpendicular to the side of the greenhouse.

Place the template along the foundation so that the corner stake fits securely in the first notch. Align the template with the side of the greenhouse (using the string previously laid on the ground) and set the second stake (see Figure 10).

After the second stake is driven, ensure the template is tight against both stakes and then drive the third stake.

With the template tight against the preceding stakes, continue along the length of the greenhouse until all stakes have been set (see Figure 11). Repeat on the opposite side of the greenhouse.

Ensure that all stakes are level using the string and transit.

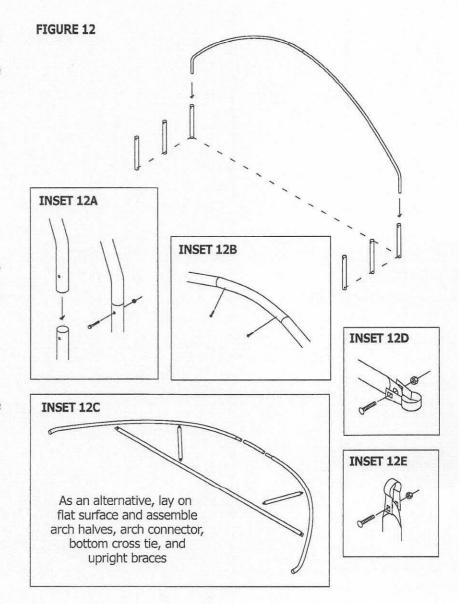


INSTALLING ARCH HALVES

After all stakes are driven into the ground, insert the ends of the arch halves into the stakes (see Figure 12) and connect using 5/16" x 2½" bolts (see Inset 12A). Please note that a 10' step ladder (or scaffold wagon) is recommended for completing this step.

Connect the arches at the peak using an arch connector (see Inset 12B). Once in place, fasten the connector to the arches using two (2) 1" TEK screws.

During the installation process, one person should walk along the side of the greenhouse and sight the arch unit to ensure proper alignment. If not aligned, use a pipe wrench to twist to proper alignment. Once the arch is at the desired location, tighten all bolts and screws.



As an alternative, lay arch

halves, arch connector, bottom cross tie, and upright braces on a flat surface and in a manner consistent with the anticipated assembly (see Inset 12C). Connect arch halves together using the arch connector (see Inset 12B). Next, slide brace bands into position along arch and bottom cross tie, as applicable, and tighten (see Insets 12D and 12E). With adequate assistance, lift assembly upright and slide arch bottoms into stakes. Then secure as indicated above. (Note: If assembling arch halves in this manner, you may disregard page 10, "Bottom Cross Tie Installation" and "Upright Brace Installation.")

<u>CAUTION!</u> TO AVOID PERSONAL INJURY, USE EXTREME CAUTION WHEN CLIMBING ON THE STEP LADDER OR SCAFFOLD WAGON.

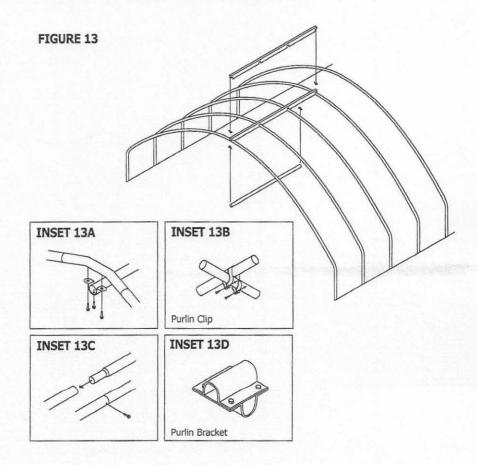
PURLIN INSTALLATION

With all arch halves in place, the purlins are installed next.

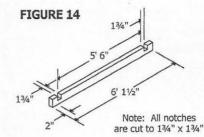
Starting at the peak of the first arch, align the first purlin segment with the mid-point of the arch connector using the same template used for setting the side stakes (see Figure 13). The first purlin must be straight, as it is used to align all subsequent purlins.

Use a 1" pipe strap to attach the purlin to the end arch (see Inset 13A). A purlin clip (see Inset 13B) is used to secure the purlin to the second and subsequent arches. Purlin clips should be assembled using 1/4" x 1" carriage bolts while purlins are connected using 1" TEK screws as illustrated in Inset 13C.

As an alternative, purlin brackets may be used (see Inset 13D).



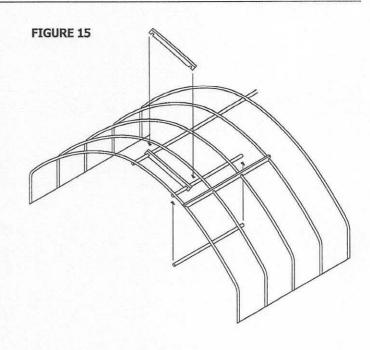
Once the center purlin has been installed along the length of the greenhouse, create a second template to be used to properly space the second and third purlins along the arches. Cut the template from an 8' two-by-four (see Figure 14) with $1\frac{3}{4}$ " x $1\frac{3}{4}$ " notches. A 5' 6" length should be included between notches.



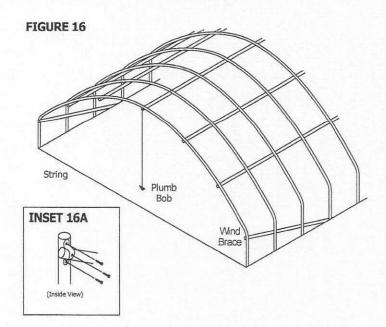
Using the template, install the next purlin.

Lodge the center (ridge) purlin inside the notch of the template and hold parallel along the arch to establish the location for the next purlin (see Figure 15). Use the template created in Figure 9 to ensure arches remain at the proper spacing.

Once in the desired location, attach the purlin to the arch with a pipe strap. Connect the next section of purlin (refer back to Inset 13C, if necessary) and attach to the arch. Continue installing purlins as you move along the length of the greenhouse. Repeat along the opposite side of the greenhouse.



WIND BRACE INSTALLATION



The wind braces are added next.

Using a plumb bob, ensure the first arch unit is properly aligned and held firmly in place. Start at the top of the first corner stake (see Figure 16) and fasten the wind brace to the corresponding stakes using 1" Pipe Straps and 1" TEK screws (see Inset 16A).

Repeat along the opposite side of the greenhouse.

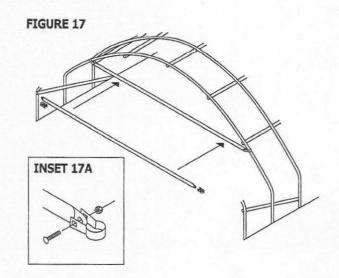
Note! The length of wind braces will vary based on the length of your greenhouse.

BOTTOM CROSS TIE INSTALLATION

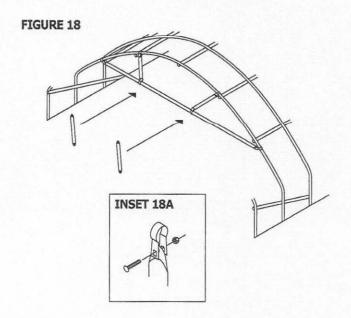
Note! End arches do not require bottom cross ties.

Bottom cross ties are attached to the arch using a 15/8" brace band and 11/2" x 5/16" carriage bolts. Strap the brace band over the arch and hold the end of the cross tie in place (see Figure 17). Pinch the open ends of the band together using vise grips to allow the carriage bolt to be easily started (see Inset 17A). Repeat on the opposite end of the bottom cross tie. Tighten both carriage bolts.

With a second person on the opposite side of greenhouse sight leveling the cross ties, install bottom cross ties to remaining arches.



UPRIGHT BRACE INSTALLATION



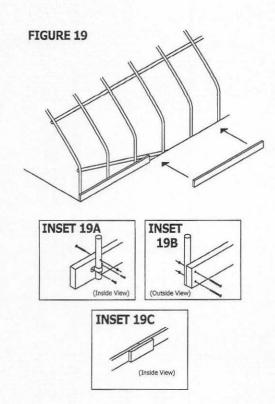
Then, install the upright braces in the same manner as the bottom cross ties (see Figure 18 and Inset 18A). However, use a 13%" brace band to fasten the upright brace to the bottom cross tie.

BASEBOARD INSTALLATION

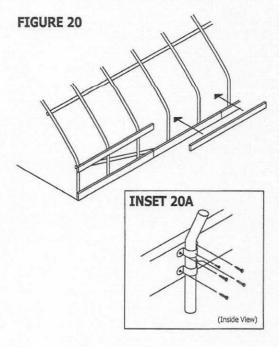
Baseboards consist of two-by-tens attached end-toend along the foundation of the greenhouse structure (see Figure 19). To install, begin at the end of the greenhouse and attach the boards to each stake using $1\frac{1}{2}$ " pipe straps and lag bolts. Baseboards are attached to the end stakes using two (2) 5/16" x 4" carriage bolts (see Inset 19B). Note that you will need to drill these holes. Then, fasten the inner stakes to the baseboards using one (1) 5/16" x 4" carriage bolt (see Inset 19A).

For added support, baseboards must be joined (end-to-end). Cut an 18" section of the two-by-ten and nail it along the inside of the baseboards (see Inset 19C). If preferred, connector units available at any building supply center may be used. However, joints must be placed between stakes.

Once complete, install baseboards on the opposite side.



EAVE SUPPORT INSTALLATION



Note! While adding stability to your structure, eave supports are only necessary when you plan to install roll up side curtains. *If using double wire lock rather than standard eave supports, refer to the Supplement for installation guidelines.*

When used, eave supports consist of two-by-six boards that are placed as high as possible on the stakes before the bend in the arch (see Figure 20).

As with the baseboards, begin at the end of the greenhouse and use two (2) 5/16" x 4" carriage bolts to attach the eave supports to the end stakes. However, use two (2) 11/4" pipe straps with lags to attach the eave supports to the inner stakes. Then, drill a 1" TEK screw through one strap and into the stake (see Inset 20A) to lock the pipe strap in place. As with baseboards, eave supports must also be joined for added support. Refer back to Inset 19C.

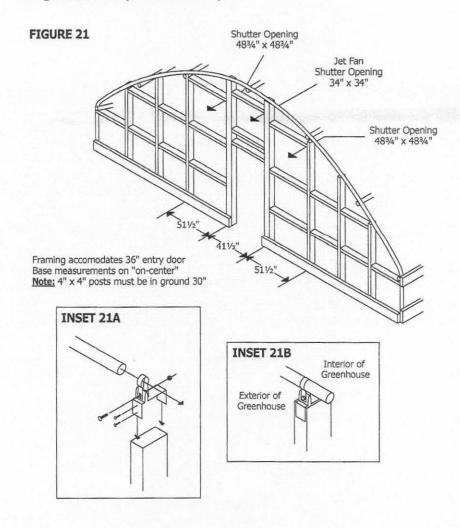
Once complete, install eave supports on the opposite side of the greenhouse.

END WALL CONSTRUCTION

Although end wall construction may vary depending on your site location, we recommend that you frame your end walls consistent with the following guidelines (see Figure 21). While some variation is acceptable, both $48\frac{3}{4}$ " x $48\frac{3}{4}$ " shutter openings as well as the smaller 34" x 34" jet fan shutter opening <u>must</u> be framed to the <u>exact size</u> to allow for the proper installation of equipment. Additionally, the end wall should be framed to accommodate a 36" entry door.

Dig two 30" holes in the ground (using the post hole digger) and set four-by-four posts. Frame the remainder of the end wall, taking note that all other framing remains above the ground.

Referring to Inset 21A, attach the end arch to the upright two-by-fours and four-by-fours using end wall brackets. Note that each end wall bracket consists of one (1) 15/8" brace band, one (1) 5/16" x 11/2" carriage bolt and nut, and one (1) 2" x 4" bracket. Affix the bracket to the framing (using 1" galvanized roofing nails or similar) so that the bracket loop is located toward the exterior of the greenhouse (see Inset 21B).



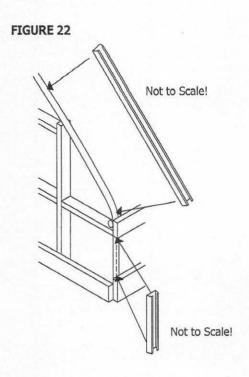
WIRE LOCK BASE INSTALLATION

Once the end walls have been framed, attach the wire lock base to the outside surface of the end stakes and arches (see Figure 22) using 1" TEK screws.

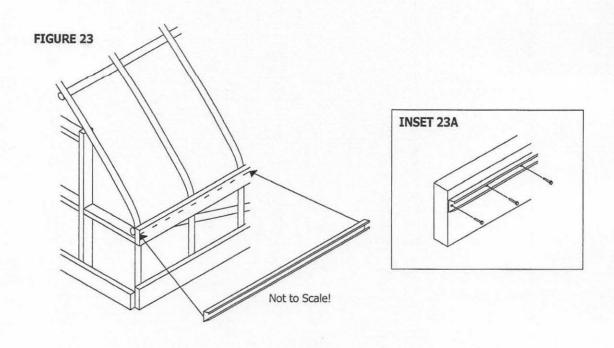
As the wire lock base will run the perimeter of the arch, it must be gently bent to fit the curve. This can be accomplished by starting at either end of the arch and gently forming the base to fit the arch. 1" TEK screws should be used at 18" increments to secure the wire base.

Once the wire lock base has been attached to the arch and stakes, it must be added along the length of the eave supports (see Figure 23). Attach the base to the eave supports using $1\frac{1}{2}$ " TEK screws set at 18" increments (see Inset 23A).

If you opt to construct your greenhouse without side curtains, wire lock should also be installed along the length of the baseboards to secure the side covering.



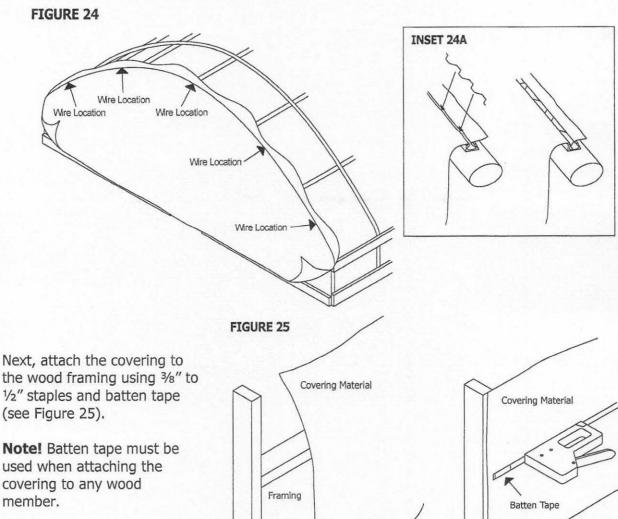
Note! Always use 11/2" TEK screws when fastening to wood framing.



ATTACHING THE END COVERING

Once all wire lock base units are in place, install the end wall covering. Hold the end covering in place and begin at the peak of the arch. Secure the covering at five locations using 2' zig-zag wire sections inserted at equal increments along the length of the arch (See Figure 24). While not necessary, you may secure the covering along the entire length of the arch, however, only do so after all batten tape (see below) has been fastened.

Zig-zag wiring may be inserted into the wire lock base by first aligning the wire parallel with the wire base (see Inset 24A). Then, insert one end of the wire into the channel and gently weave the remaining portion of the wire into the base.



used when attaching the covering to any wood member.

When complete, carefully cut out openings for doorways and ventilation fans.

ATTACHING THE MAIN COVERING

For best results, choose a calm day and have plenty of help when installing the main covering. Specifically, we recommend that you have up to two or three helpers for a 48' greenhouse and as many as four to five for a 100' unit.

Unroll the covering along the side of and parallel to the greenhouse. In 15' to 25' increments (depending on the length of your greenhouse), attach a rope to the covering. The rope may be attached by first wrapping the covering around a tennis ball or wadded paper and tying if off with one end of a rope. Ropes must be at least 50' in length.

Throw the opposite ends of the ropes over the top of the greenhouse. With a helper on the end of each rope, simultaneously pull each rope and bring the cover up and over the top of the greenhouse. Care should be used to avoid tearing the covering on the heads of any exposed nails, TEK screws, or other sharp surfaces.

Once the covering is at a point it can be reached, remove the tennis balls or wadded paper and pull the cover the remainder of the way down along the side of the structure until it reaches the ground.

Immediately place the second cover layer in position using the same procedure. While more difficult for longer structures, both layers may be pulled at the same time.

Pull tight enough to remove most wrinkles, but avoid over tightening the outer layer as it must be loose enough to allow proper inflation. The remaining wrinkles will be removed when inflated. If you do not plan to inflate, tighten both layers as much as possible.

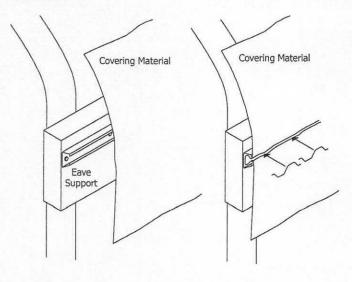
ATTACHING THE SIDE COVERING

Gently push the covering into the wire lock base (along the eave supports) and insert wire lock to hold the covering in place (see Figure 26). Do not insert covering into the wire lock base along the end stakes, as the lower portion of the covering will form the side curtains.

If you have chosen not to include side curtains on your greenhouse, insert and secure the covering into the wire lock base along the end stakes and baseboard.

Repeat on the opposite side.

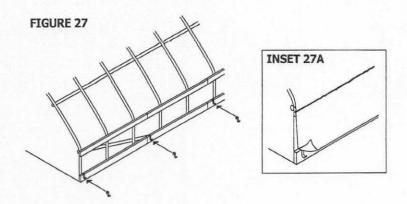




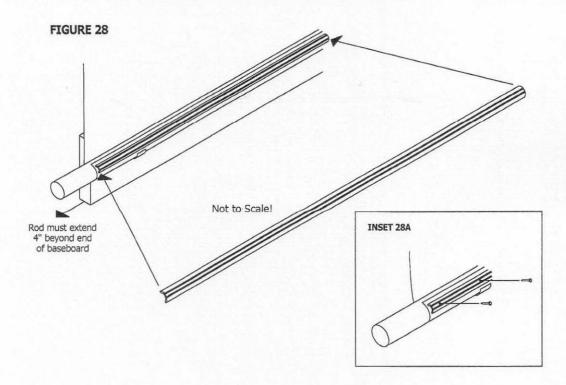
CURTAIN ROD INSTALLATION

Note! If only one curtain is used, it should be located on the south or west side of the structure.

Place the curtain rod installation brackets along the baseboard in approximate 10' increments (see Figure 27). Allow the covering to extend over the brackets (see Inset 27A).



Place the curtain rods in the brackets, "pinching" the covering between the curtain rod and the installation bracket (see Figure 28). Please note that the curtain rod must extend 4" beyond the end of the greenhouse to allow the hand crank to function properly.



The covering is held in place on the curtain rod by attaching the roll bar cap along the length of the rod with 1" TEK screws set at 18" increments (see Inset 28A). Once secure, trim any excess covering that extends beyond the roll bar cap.

Open and close your curtain several times to ensure that it rolls evenly. If not, refer to the Supplement at the end of this manual for further instructions.

IMPORTANT!

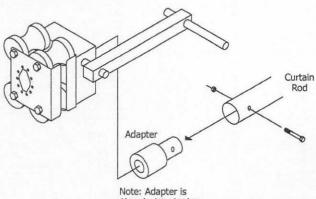
CVS Supply offers two alternative cranking mechanisms for raising and lowering your side curtains. If you purchased the Posi-ClaspTM Curtain System with your greenhouse kit, proceed to Figure 29. If you opted for the swivel lock hand crank, skip to page 18 and Figure 32.

POSI-CLASP™ HAND CRANK

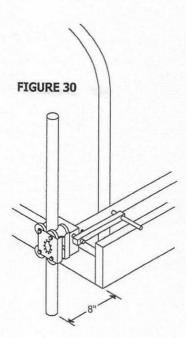
The hand crank must first be prepared and installed (see Figure 29). Insert the adapter (affixed to the crank mechanism) into the curtain rod and drill a $\frac{1}{4}$ " hole through. Secure the adapter to the curtain rod using a $\frac{1}{4}$ " x $\frac{1}{2}$ " bolt.

Once attached to the curtain rod, you must determine if you will use a stationary or a swivel guide post.



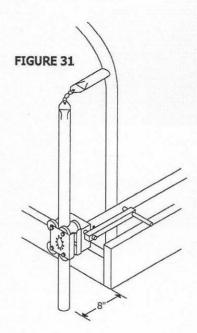


Note: Adapter is Already Attached to Output Shaft on Mechanism



If a stationary post is used, set the post in a vertical (90°) position located approximately 8" from the end of the structure (see Figure 30). Drive the post firmly into the ground.

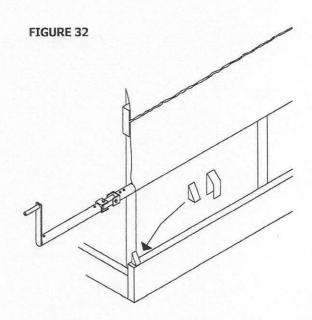
Alternatively, connect the swivel attachment to the top of the guide post (see Figure 31). Drill a hole in the end arch just above the beginning of its curve. Slide the bolt through the hole and tighten the nut. Like the stationary post, it should be set approximately 8" from the end of the structure.

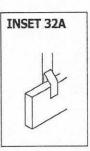


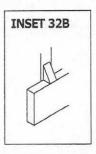
Posi-Clasp is a registered trademark of Advancing Alternatives, Inc.

CURTAIN ROD BASEBOARD DEFLECTOR

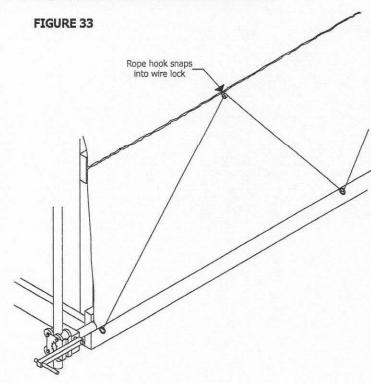
A baseboard deflector should be installed to allow the curtain to unroll evenly along the side of the greenhouse (see Figure 32). If included in your kit, a Roll Bar Baseboard Deflector should be secured to the baseboard at approximately every third stake (see Inset 32A). Alternatively, cut a deflector from spare baseboard or framing materials as illustrated in Inset 32B.







SIDE CURTAIN ROPE INSTALLATION



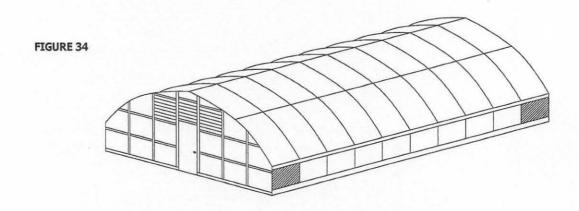
With the curtain rod and crank mechanism installation complete, install lag eye bolts and rope hooks in a zig-zag pattern along the sides of the greenhouse consistent with the side stakes (see Figure 33). Rope hooks snap into the wire lock base at the top. Eye lags screwed into the baseboards should be evenly set 2" below the top of the baseboard to provide a rest for the curtain rod when closed.

Work the rope through the eye bolts in the zig-zag pattern and knot at the opposite end of the greenhouse. Once tight, the rope will act to hold the curtain against the structure.

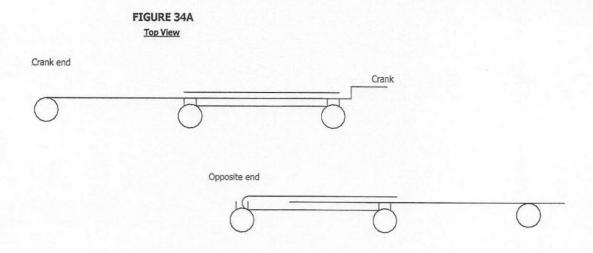
The wire lock base previously

attached along the end stakes (per Figure 22) should be used to seal off the curtain when it is not in use.

The solid fabric wind panel installs between the first and second arc sections (see figure 34 for example). Fasten around perimeter with wire lock. At the end opposite from the crank; cut roll up rod off so the end is halfway between the first and second arch. Now attach the wind panel to second arch (inside curtain) then to the first arch (end). Now bring the wind panel back to the second arch over the outside of the curtain. Attach the top and bottom.



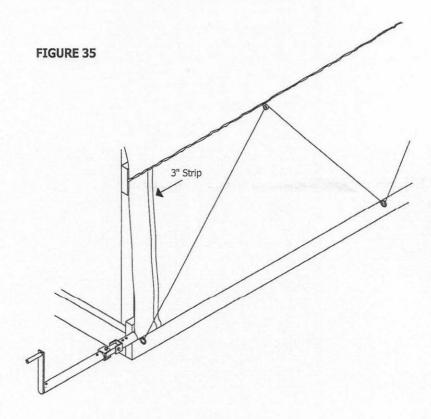
(The end at the second arch is not fastened.) Do not tighten too much along the bottom so the roll rod can move up and down freely. This forms a pocket around the curtain end to keep out the wind. The crank end is similar, however, the roll up rod must stick out so there is one panel on the inside of the curtain and one on the outside fastened top and bottom only.



ADJUSTING THE CURTAIN

Should your curtains roll or unroll in an uneven or unequal manner, we recommend that you add poly strips cut from excess covering material (see Figure 35). While the width and exact locations of your strips will vary pending individual circumstances, initially cut two (2) 3" strips to the length of the side curtain. Place the strips approximately 6" from the ends of the curtain. Secure the top of the strip with the wire lock bracket and zig-zag wire located on the eave support. The bottom of the strip should be secured with the roll bar cap used to attach the curtain to the rod.

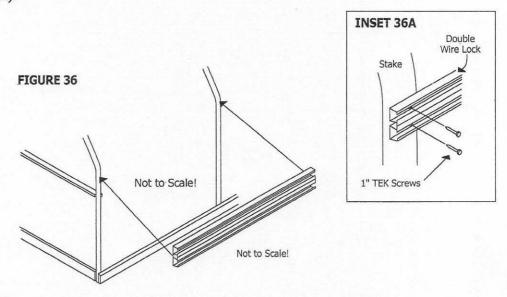
Again open and close your curtain several times to ensure that is rolls evenly. If not, adjust the width and/or location of the strips until the curtain rolls properly.



Note! Curtain must be rolled as illustrated above to allow water to run off its surface.

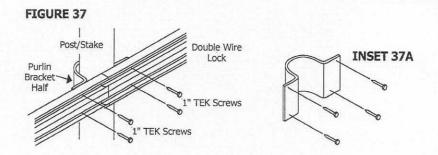
OPTIONAL DOUBLE WIRE LOCK

Rather than standard eave supports, you may consider using double wire lock. If so, secure the double wire lock directly to the stake using two (2) 1" TEK screws (see Figure 36 and Inset 36A).



OPTIONAL SLIDE CLAMP

To make a sturdier connection at stake, an optional slide clamp may be used. Drive four (4) TEK screws through double wire lock and into the slide clamp (see Figure 37). It is helpful to clamp the two pieces together with a vise grip to get the first screws started.



After assembling double wire lock and slide clamp, attach main cover. Tighten main cover by driving slide clamp down another $\frac{3}{4}$ " or so. Finally, drive a TEK screw through the slide clamp into the stake to lock it in place.

OPTIONAL HAT PURLIN BASEBOARD

Consider using this rather than the wood baseboards described on page 11. The hat purlin baseboard option forms a pocket for curtain to roll down into. Use TEK screws to fasten top and bottom. Drill a 5/16 hole every other arch for eye bolt. Assemble with nut on each side of hat purlin. Overlap to join the next piece.

