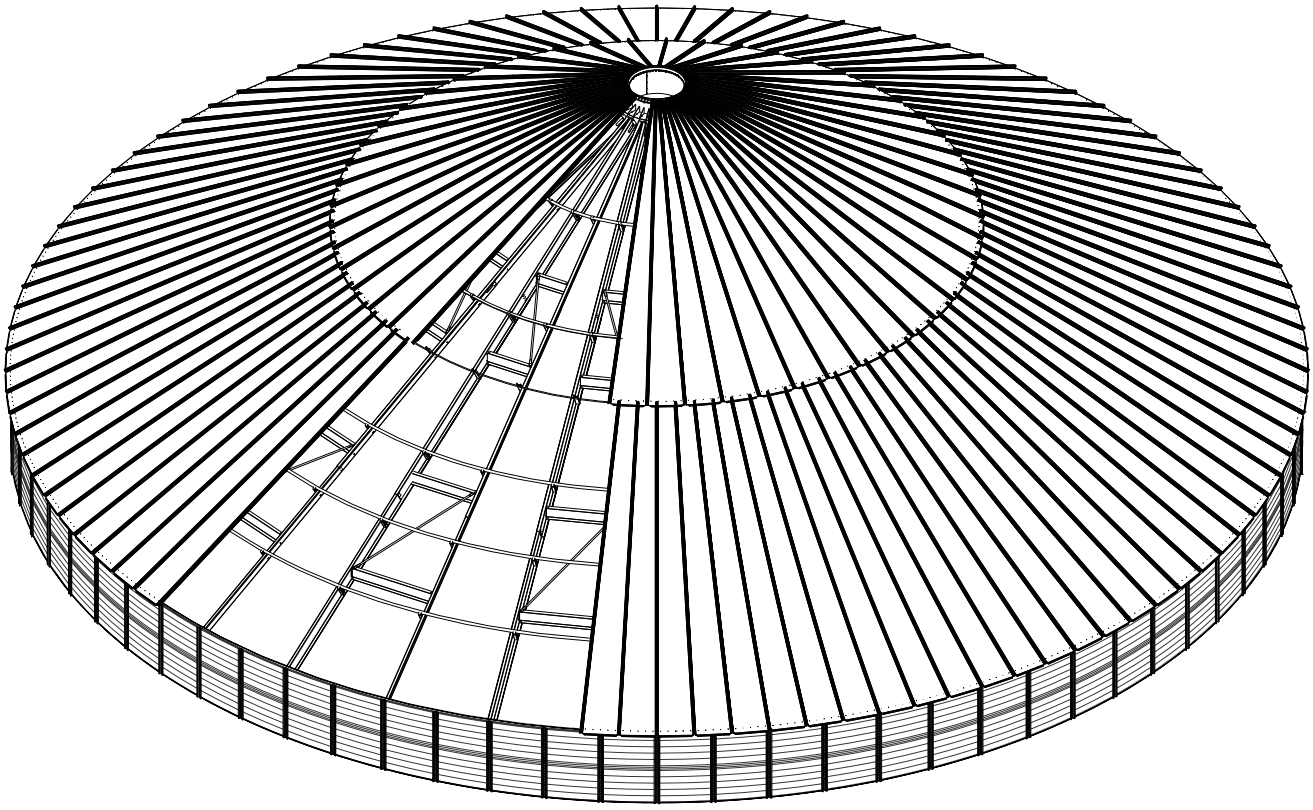
AGI WESTEEL

Structured Roof

Wide-Corr® Centurion® Grain Bin
Installation and Storage Instructions



Read this manual before using product. Failure to follow instructions and safety precautions can result in serious injury, death, or property damage. Keep manual for future reference.

Part Number: 212453 R16
Revised: January 2022
Original Instructions

New in this Manual

The following changes have been made in this revision of the manual:

Description	Section
Update instructions	Section 5.6.12 – Remote Roof Cap Opener System for 60' Bins on page 54
Updated remote roof cap material list table	Section – Remote Roof Cap Material List on page 68
Updated RCO parts identification	Section 6.3 – RCO Parts Box Part Identification on page 99

CONTENTS

1. Introduction

Before assembling, please read this manual. Familiarize yourself with the process and the necessary precautions for efficient and safe assembly of this Westeel Structured Roof.

Everyone present at the assembly site is required to be familiar with all safety precautions.

Keep this manual available for frequent reference and review it with new personnel. Call your local distributor or dealer if you need assistance or additional information.

2. Safety

2.1. Safety Alert Symbol and Signal Words

This safety alert symbol indicates important safety messages in this manual. When you see this symbol, be alert to the possibility of injury or death, carefully read the message that follows, and inform others.

Signal Words: Note the use of the signal words **DANGER**, **WARNING**, **CAUTION**, and **NOTICE** with the safety messages. The appropriate signal word for each message has been selected using the definitions below as a guideline.

DANGER Indicates an imminently hazardous situation that, if not avoided, will result in serious injury or death.

WARNING Indicates a hazardous situation that, if not avoided, could result in serious injury or death.

CAUTION Indicates a hazardous situation that, if not avoided, may result in minor or moderate injury.

NOTICE Indicates a potentially hazardous situation that, if not avoided, may result in property damage.

2.2. General Safety Information

Read and understand all safety instructions, safety decals, and manuals and follow them when assembling the equipment.

- Only experienced personnel who are familiar with this type of assembly and installation should perform this work. Untrained assemblers/installers expose themselves and bystanders to possible serious injury or death.
- Do not modify the structured roof in any way or deviate from the instructions in this manual without written permission from the manufacturer. Unauthorized modification or methods may impair the function and/or safety. Any unauthorized modification will void the warranty.
- Follow a health and safety program for your worksite. Contact your local occupational health and safety organization for information.
- Contact your local representative or Westeel if you need assistance or additional information.
- Always follow applicable local codes and regulations.

2.3. Personal Protective Equipment

The following Personal Protective Equipment (PPE) should be worn when installing the equipment.

Safety Glasses

- Wear safety glasses at all times to protect eyes from debris.

Coveralls

- Wear coveralls to protect skin.

Hard Hat

- Wear a hard hat to help protect your head.

Steel-Toe Boots

- Wear steel-toe boots to protect feet from falling debris.

Work Gloves

- Wear work gloves to protect your hands from sharp and rough edges.

2.4. Safety Decals

- Keep safety decals clean and legible at all times.
- Replace safety decals that are missing or have become illegible. See decal location figures that follow.
- Replaced parts must display the same decal(s) as the original part.
- Replacement safety decals are available **free of charge** from your distributor, dealer, or factory as applicable.

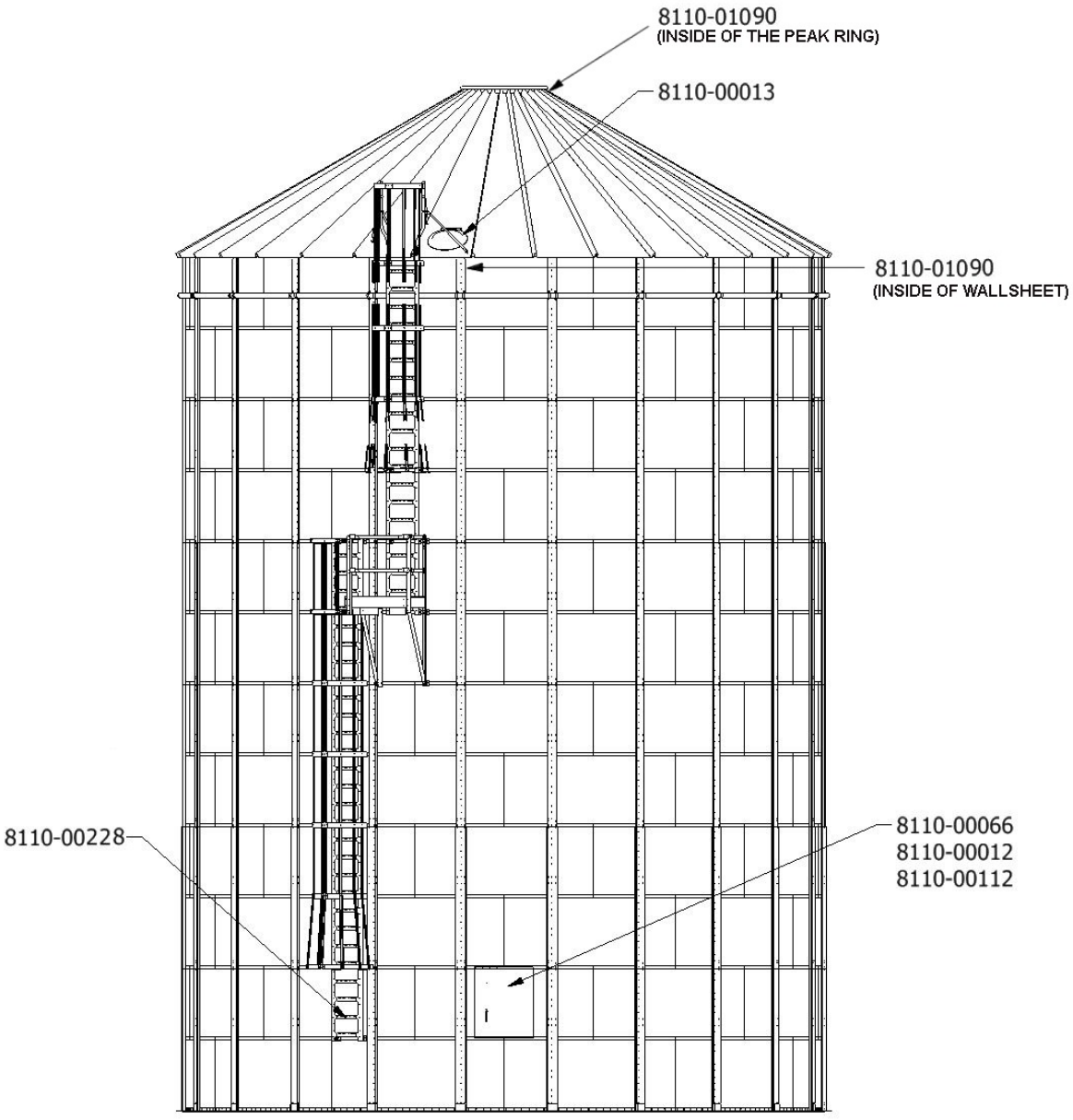
2.5. Decal Installation/Replacement

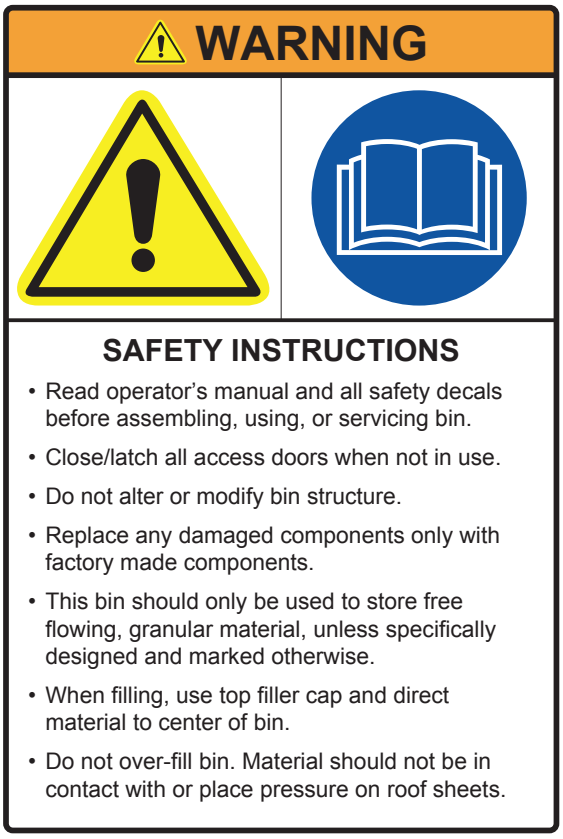
1. Decal area must be clean and dry, with a temperature above 50°F (10°C).
2. Decide on the exact position before you remove the backing paper.
3. Align the decal over the specified area and carefully press the small portion with the exposed sticky backing in place.
4. Slowly peel back the remaining paper and carefully smooth the remaining portion of the decal in place.
5. Small air pockets can be pierced with a pin and smoothed out using the decal backing paper.

2.6. Safety Decal Locations and Details

Replicas of the safety decals that are attached to the structured roof and their messages are shown in the figure (s) that follow. Safe operation and use of the structured roof requires that you familiarize yourself with the various safety decals and the areas or particular functions that the decals apply to, as well as the safety precautions that must be taken to avoid serious injury, death, or damage.

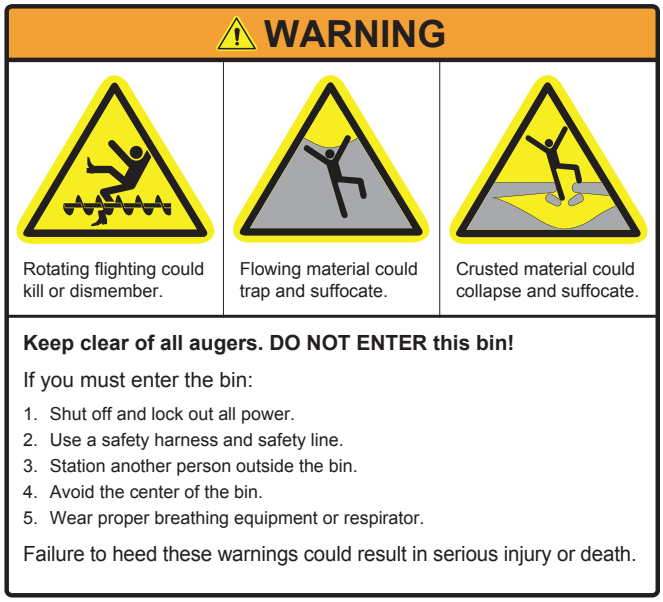
Figure 1. Safety Decals





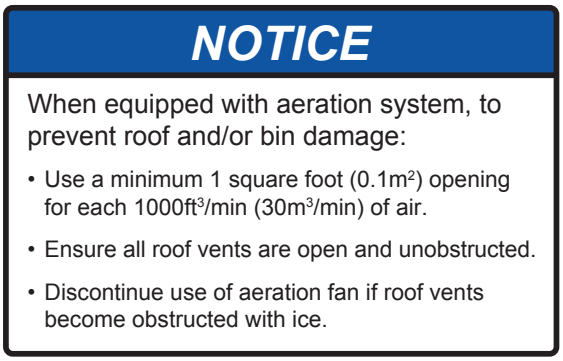
Part Number: 8110-00012

Part Number: 8110-00013



Part Number: 8110-00112

Part Number: 8110-00228



Part Number: 8110-00066

Part Number: 8110-01090

3. Before You Begin

3.1. Bin Design and Capacity

Standard Westeel Grain Bins are designed for:

1. Non-corrosive free-flowing materials up to 55 lbs/ft^3 (880 kg/m^3) average compacted bulk density.
2. Maximum horizontal wind pressure based on 94 mph (151 km/h) as per NBCC 2015 and 105 mph (169 km/h) as per ASCE 7-16.
3. Zero seismic activity.

   Note

   Seismic resistance in grain bins varies with height and diameter. Many standard designs have significant seismic capabilities. Designs can be reviewed and/or modified to reflect local seismic requirements.

4. Roof loading capabilities vary with diameter, peak load and snow load.
   a. Peak Loads – standard peak loads follow. ***Upgrades are available.***

Table 1. Peak Loads for Various Roofs

Size	Type of Roof	Load (lbs)	Load (kg)
15’ to 24’	non-structural	4000 lbs	1814 kg
27’ to 48’	non-structural	5000 lbs	2268 kg
51’ & 54’	non-structural	8000 lbs	3629 kg
48’ to 108’	structural	20,000 lbs	9072 kg

   b. Roof Snow Loads (RSL) – at the above stated standard peak loads, standard RSLs vary with diameter and range from 16 psf (78 kg/m^2) to 45 psf (220 kg/m^2). ***Upgrades are available***.

      Note

      The correlation between ground snow load (GSL) and roof snow load (RSL) for grain bin designs vary with jurisdictions. In the US GSL = 2 x RSL. In Europe GSL = 1.25 x RSL. In Canada the correlation between GSL and RSL varies and is site specific.

   c. For maximum roof snow load capacities for various sizes and types of roofs, refer to the Roof Design Capacities sections that follow.

3.1.1 Roof Design Capacities for Non-Structural Roofs

Table 2. Maximum Roof Snow Load at STANDARD Peak Load

Bin Series	Std Peak Load	Standard Roof		Plus Upgrade 1		Plus Upgrade 2	
	lbs (kN)	psf	kPa	psf	kPa	psf	kPa
15	4000 (17.8)	45	2.15	n/a		n/a	
16		45	2.15				
18		45	2.15				
21		30	1.44	49	2.35		
24		21	1.01	40	1.92		
27	5000 (22.2)	24	1.15	39	1.87		
30		20	0.96	32	1.53	40	1.92
33		23	1.10	33	1.58	44	2.11
36		24	1.15	30	1.44	38	1.82
39		22	1.05	27	1.29	36	1.72
42		19	0.91	24	1.15	34	1.63
45		16	0.77	23	1.10	32	1.53
48		21	1.01	26	1.24	33	1.58
51	8000 (35.6)	20	0.96	28	1.34	n/a	
54		17	0.81	27	1.29		

Table 3. Maximum Roof Snow Load at UPGRADED Peak Load

Bin Series	Upgraded Peak Load	Standard Roof		Plus Upgrade 1		Plus Upgrade 2	
	lbs (kN)	psf	kPa	psf	kPa	psf	kPa
15	8000 (35.6)	29	1.39	n/a		n/a	
16		29	1.39				
18		29	1.39				
21		24	1.15	40	1.92		
24		17	0.81	27	1.29		
27	10000 (44.5)	19	0.91	28	1.34		
30		15	0.72	24	1.15	33	1.58
33		18	0.86	24	1.15	36	1.72
36		18	0.86	23	1.10	31	1.48
39		16	0.77	21	1.01	30	1.44
42		14	0.67	19	0.91	27	1.29
45		13	0.62	18	0.86	25	1.20
48*		16	0.77	21	1.01	26	1.24
51*	12000 (53.4)	14	0.67	21	1.01	n/a	
54*		13	0.62	20	0.96		

Note

1. Standard roofs are adequate for many applications but additional capacity is available when optional upgrade packages are used.
2. Upgrade packages include roof stiffening rings and/or rib supports.
3. For peak load between standard and upgrade limits, a straight line interpolation can be used to determine maximum roof snow load.
4. *Structural roofs for 48' – 54' with rafters are available to support peak ring loads greater than loads on Table 3.
5. Higher level upgrade kits include all components from lower level kit; only one upgrade kit needs to be ordered for any given bin.

3.1.2 Roof Design Capacities for Structural Roofs

Table 4. Maximum Roof Snow Load at STANDARD Peak Loads

Bin Series	Std Peak Load	Standard Roof	
	lbs (kN)	psf	kPa
48	20000 (89.0)	39	1.87
51		39	1.87
54		39	1.87
60		39	1.87
66		38	1.82
72		38	1.82
75		37	1.77
78		37	1.77
84		37	1.77
90		37	1.77
96		37	1.77
102		32	1.53
105		32	1.53
108		32	1.53

Table 5. Maximum Roof Snow Load at UPGRADED Peak Loads

Bin Series	Upgraded Peak Load	Standard Roof	
	lbs (kN)	psf	kPa
48	60000 (266.9)	38	1.82
51		38	1.82
54		38	1.82
60		38	1.82
66		37	1.77
72		37	1.77
75		36	1.72
78		36	1.72
84		36	1.72
90		34	1.63
96		34	1.63
102		31	1.48
105		31	1.48
108		31	1.48

Note

Standard capacities are provided. Additional capacity is available with optional upgrades.

3.1.3 Roof Snow Load vs. Ground Snow Load

The Roof Design Capacity tables reflect roof snow load (RSL) values. These are design values. Often, comparisons are made to ground snow values (GSL). These are not the same. The conversion from GSL to RSL varies between jurisdictions and is governed by building codes:

- In the United States, for grain bins, GSL = RSL x 2
- In Europe, for grain bins, GSL = RSL x 1.25

- In Canada, for grain bins, the GSL/RSL conversion varies with every location across the country. However, for comparison purposes, the US conversion can be used as an approximation.

Therefore, when comparing against competitive GSL values in the US, double the above values. When comparing against competitive GSL values in Canada, double the above values for a reasonably close approximation.

3.2. Guidelines for Supporting Catwalks and other External Loads on Westeel

Frequently catwalk and related equipment loads are supported on grain bins. Such connections are commonly made into the grain bin stiffeners and across the peak. A grain bin is a thin shell structure primarily designed to withstand the internal uniformly distributed loads inherent with the stored bulk material inside of the bin. Special considerations must be given to the manner in which external loads are supported. Westeel has developed products which are compatible with these requirements and considerations. If a third party solution is provided, the provider assumes full responsibility of the structure, its load distribution, and the manner in which it is connected to the grain bin. The following guidelines must form part of the third party design considerations.

Connection to Stiffeners

1. The available catwalk support stiffeners in Westeel stiffened bins are for 10,000 lb incremental catwalk loads and 20,000 lb incremental catwalk loads per upgraded stiffener. The actual loads subjected to a single stiffener by the mating catwalk support shall not exceed these maximum capacities.
2. Westeel recommends that the vertical load transfer between the catwalk supports and the stiffener occur over a minimum distance of 66” for 10,000 lb loads and 120” for 20,000 lb loads. Adequate connection strength must be provided.
3. The catwalk support stiffener in Westeel bins are designed to provide vertical load support only. Any lateral loads subjected to the grain bin must be negligible.
4. There is a restriction of 2 upgraded catwalk support stiffeners per bin location. Therefore, the maximum supported load at the grain bin eave is 20,000 lbs (for two 10,000 lb upgrades) and 40,000 lbs (for two 20,000 lb upgrades). This can be repeated on the opposing side of the bin at a second location. Deviation from this must be approved by Westeel Engineering.

Connection to Peak Rings

1. The allowable vertical peak load to any Westeel bin roof is restricted to its published rated capacity. The load must be centered and evenly distributed into the peak ring. Any off-centre load and/or improper load distribution may cause roof failure.
2. A Westeel structural roof requires the peak support loads to be transferred directly into the compression ring/roof rafter system. This is accomplished with peak load support brackets that are included with the structural roof. They must be installed as shown in the structural roof manual, connecting the peak support structure to the compression ring. They are required even if a non-Westeel peak support structure is used. A non-Westeel peak support structure needs to be designed to be able to connect with the brackets. The required bolt pattern is shown in the structured roof manual.
3. A Westeel non-structural roof that is supporting a catwalk requires six clips to be installed in order to attach the flat cap to the peak ring. These clips are available from Westeel.

3.3. Foundation Design and Loads

The foundations for the stiffened bin models are based on 4000 lbs. per sq. ft. (192 kPa) soil bearing capacity. All foundation designs use 3000 lbs. per sq. in. (21 MPa) ultimate compressive strength (after 28 days) for concrete and 43,500 lbs. per sq. in. (300 MPa) re-bar. The foundation designs included in this manual are suggestions only, and will vary according to local soil conditions. Westeel will not assume any liability for results arising from their use.

Important

Foundation should be uniform and level. Level should not vary by more than ¼" over a span of four feet under the bottom ring angle. Any variance from level must be shimmed under upright base assembly. If being utilized to support a full floor aeration system, this levelness requirement should extend across the complete floor area.

3.4. Site and Assembly

Unless otherwise specifically provided in writing, Westeel does not take responsibility for any defects or damages to any property, or injury to any persons, arising from or related to any site or assembly considerations, including but not limited to:

- Bin location and bin siting
- Soil conditions and corresponding foundation requirements
  (Note that the examples provided in manuals are for specifically stated soil conditions.)
- Bin assembly (Westeel recommends the use of qualified bin installers).
  Contact Westeel for information on installers in your area.
- Field modifications or equipment additions that affect the bin structure
- Interconnections with neighboring structures
- Compliance with all applicable safety standards, including but not limited to fall restraint systems (ladders or other systems). Local safety authorities should be contacted as standards vary between jurisdictions.

3.5. Methods of Installation

The recommendations for assembling and installing Westeel grain bins must be closely followed to achieve the full strength of the bin and to achieve adequate weather sealing. The product warranty is void if:

1. Wall sheets and/or uprights not specified for a given tier are used.
2. Foundations are found to be inadequate or out-of-level.
3. Anchor bolts (cast-in-place, drill-in, chemical type or other) are found to be inadequate.
4. Off-center loading or unloading is used. (This does not apply to the use of approved side unloading systems).
5. Materials stored are not free-flowing or have a compacted bulk density greater than 55 lbs/ft^3 (880 kg/m^3).

If using bin jacks during assembly, always lift on an upright. Choose a hoist with an adequate capacity for the expected empty bin deadload. Make sure the rated capacity of the hoist is not exceeded.

3.6. Critical Assembly Requirements

To ensure a successful, safe and reliable outcome you must comply with the following assembly techniques and practices:

1. Comply with all local code and jurisdictional requirements applicable to your structured roof installation.
2. Design and build foundations with the necessary strength for the loads they must support, and for local soil conditions. Westeel foundation guidelines are based on specific stated conditions and may not be applicable to local conditions.
3. Your foundation must provide uniform and level support to the structure being supported. Surface imperfections causing gapping must be remedied. This may involve, but not be limited to a) grouting under the bottom ring of a non-stiffened bin or tank, and b) shimming under the uprights of a stiffened bin or tank, or under the legs of a hopper.
4. Make sure that the proper hardware is utilized for all bolted connections. If a shortage occurs, do not substitute. Take the necessary steps to obtain the proper hardware. Make sure nuts are tightened to the required torque values as specified in the appropriate assembly manual.
5. Comply with all assembly instructions provided in the appropriate assembly manual to make sure your whole structured roof is constructed safely. Important: Do not deviate from the wall sheet and upright layouts provided.
6. Before anchoring your structure to its foundation, make sure the structure is round. The maximum variation from perfect roundness is 3/4" on the radius. Locate anchor bolts toward the outside of the anchor bolt holes (away from the circle) to permit the incremental expansion that can occur with the initial filling.
7. When installing roof stiffening rings, if it is necessary to shorten the stiffening ring tubes, shorten them as little as possible. Initially the nuts on the expanders should be centered and as close together as possible. When tightening, share the amount of take-up between expanders such that the nuts remain centered, and the amount of engagement between all expanders on the same ring is equalized.
8. If extending an existing bin or tank, ensure that the foundation is adequate for the increased loads it must support.
9. If installing an existing bin on a hopper, make sure the bin is designed for a hopper application, and that the foundation is capable of withstanding the substantial point loads that the hopper legs apply. If uprights are present, make sure that they are supported.
10. Make sure that an integral end-to-end connection exists between all mating uprights. Successive uprights must not overlap.
11. Vertical tolerances between uprights and wall sheets are tight. This can be affected by “jacking” techniques, which can allow the tolerance to grow or shrink depending on the technique used. The gapping between successive uprights must be monitored to ensure that upright holes align with wall sheet holes.
12. If catwalks are being installed on the structure, upright catwalk upgrades are likely required. The upgraded stiffeners must be installed in the correct locations to support the intended catwalk loads. Also, the structure must be properly oriented to ensure the eventual correct alignment between the catwalks and the supporting uprights. Finally, the connectors that tie into the uprights and support the catwalks are best installed during assembly of the structure. See the catwalk assembly manual for additional details.

3.7. Product Storage

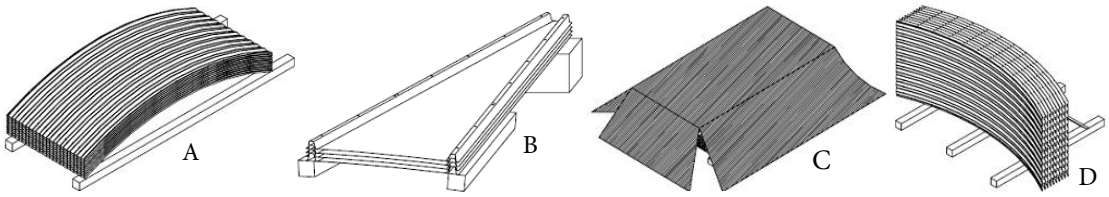
Rust on Galvanized Parts

1. White rust forms when moisture is allowed to collect on galvanized surfaces that have yet to develop the durable zinc oxide layer. This zinc oxide layer naturally occurs as the surface interacts with carbon dioxide, and is characterized over time by the dull grey appearance that weathered galvanized surfaces get.
2. Parts that are not well ventilated or well drained can collect water between surfaces and develop white rust.
3. White rust is not a structural concern if its development is stopped in the early stages. A light film or powdery residue can occur after a period of heavy rainfall or a short time of improper storage. If white rust has started to develop, separate parts and wipe off any moisture. Next, using a clean cloth, apply a thin layer of petroleum jelly or food-grade oil to the entire part.
4. If moisture is left on parts, this white rust can become more aggressive and turn into red rust. Red rust can cause degradation in the material and become a structural concern. Any parts that have red rust should be replaced immediately.

Storage Guidelines

- Keep all bundles dry before assembly of the bin.
- Start assembly as soon as possible.
- Do not lay bundles on the bare ground. Raise all bundles 6" to 8" off the ground on wood blocks or timbers. (See Detail A in Figure 2 on page 17.)
- Store curved wall sheets ‘hump-up’. (See Detail A in Figure 2 on page 17.)
- All other bundles material should be placed so they are well sloped to promote good drainage. (See Detail B in Figure 2 on page 17.)
- Roof sheets must be elevated at least 12" at the small end of the sheets. (See Detail B in Figure 2 on page 17.)
- Temporary storage can be provided by erecting a simple framework supporting a waterproof tarp. (See Detail C in Figure 2 on page 17.)
- All bin boxes, ladder boxes and hardware boxes should be stored inside. These are not waterproof, and will deteriorate in normal weather conditions, allowing moisture to contact the parts inside.

Figure 2. Product Storage



If Parts Become Wet

1. If parts become submerged or wet, the bundles should be opened as soon as possible, sheets or material separated and dried. Keep separated until assembly.

   Brace parts properly so as to avoid damage or injury from material falling when in storage. (See Detail D in Figure 2 on page 17.)
2. Any boxed parts that become wet should be dried and stored in a new box that is free of moisture.

3. In addition to wiping down wall sheets, a food-grade oil can also be applied with a clean, lint-free cloth. This will assist in preventing any further moisture from contacting the galvanizing on the steel. Due to safety concerns with installation and use, Westeel does not recommend the use of oil on other parts such as roof sheets and safety ladders.

3.8. Grain Bin Use

- Do not off-center unload a grain bin. It is imperative to unload from the center of the bin first, until as much grain as possible has been removed, and only then proceed to unload from the next closest unload gate to the center. Continue utilizing the unload gates in succession from the center towards the outside. Gate control mechanisms should be clearly marked and interconnected to prevent an external gate from being opened first.
- The only exception to center unloading is when a properly designed and installed side draw system is utilized. However, as bins tend to go out of round when employing side draws, the bin must be completely emptied before refilling.
- When unloading a bin with a mobile auger through a properly designed auger chute, the entry end of the auger should be pushed into the center of the bin before the auger is engaged. Slower rates of flow are preferable and should not exceed the capacity of an 8” auger.
- Ensure that the inner door panels of grain bin doors are completely closed and latched before filling the grain bin.
- Never enter a loaded grain bin for any reason. Grain can be a killer.

3.9. Important Notes

- Westeel does not provide a foundation design for this product, and is not liable for any damages or injuries related to inadequately designed or constructed foundations. Customers must contract professional services for all foundation design and construction work.
- In order to maintain your wall sheets in good condition separate sheets and allow air circulation between them. Store sheets in a dry place. Do not store sheets with sheet ends pointing upwards.
- To keep an even pressure on walls, the bin must always be unloaded from the center.
- Contact local power officials for minimum power line clearance.
- See Section 3.6 – Critical Assembly Requirements on page 16 for mandatory siting and assembly requirements.
- Store only non-corrosive, free-flowing materials up to 55 lbs/ft^3 (880 kg/m^3) average compacted density in Westeel .
- Tighten all bolts to the recommended torque settings.
- Do not locate grain bins close to high buildings, which might cause snow to fall onto or build up on the roof of the grain bin. Consider future expansion and allow space for loading and unloading of the bin. Your dealer and local government agricultural consultants can help you plan your storage system for maximum efficiency.

4. Preparation

4.1. Check Shipment

Unload the parts at the assembly site and compare the packing slip to the shipment. Ensure that all items have arrived and that none are damaged.

Report damaged parts or shortages immediately to your dealer. Your dealer will order replacement parts immediately to ensure that assembly will not be held up by missing parts. All parts will be charged for and credit will be issued by party at fault. No credit will be issued if freight bills are signed as received in good condition.

4.2. List of Tools and Equipment

Use quality tools and equipment. Use them safely, and correctly, for their intended use. Tools for this application should include:

Tools

- Electric or pneumatic (air) impact tools
- Power drill and drill bits
- Sockets (multiple 9/16" and 1/2" sockets recommended)
- Large-pocket carpenter pouch
- 8" (20 cm) metal punches (for aligning bolt holes)
- Step and extension ladders, construction grade
- 6-point wrenches (Imperial, box end)
- Metal-cutting saw suitable for cutting roof rings and wind rings
- Scaffolding
- Centre-post bin stand
- Crane and/or bin jacks

Minimum Recommended Safety Equipment

- A properly-stocked first-aid kit
- Eye, foot, head, and hand protection (safety glasses, steel-toed boots, hard hat, work gloves)
- Cable, chain, or rope to tie-off bin or jacks in case of wind
- Body harness and lifeline (for use where falling hazard exists)
- Ground fault interrupt protected electrical hook-ups

4.3. Order Optional Equipment

Optional equipment such as unloading augers, aeration equipment, anchor bolts, foundation sealant, external ladders, safety cage and platforms, etc., should all be on site and checked before assembly starts. Plan your installation in advance. For details, see assembly instruction supplied with optional equipment.

5. Assembly

Before continuing, ensure you have completely read and understood this manual's Safety section, in addition to the safety information in the section(s) below.

5.1. Assembly Safety

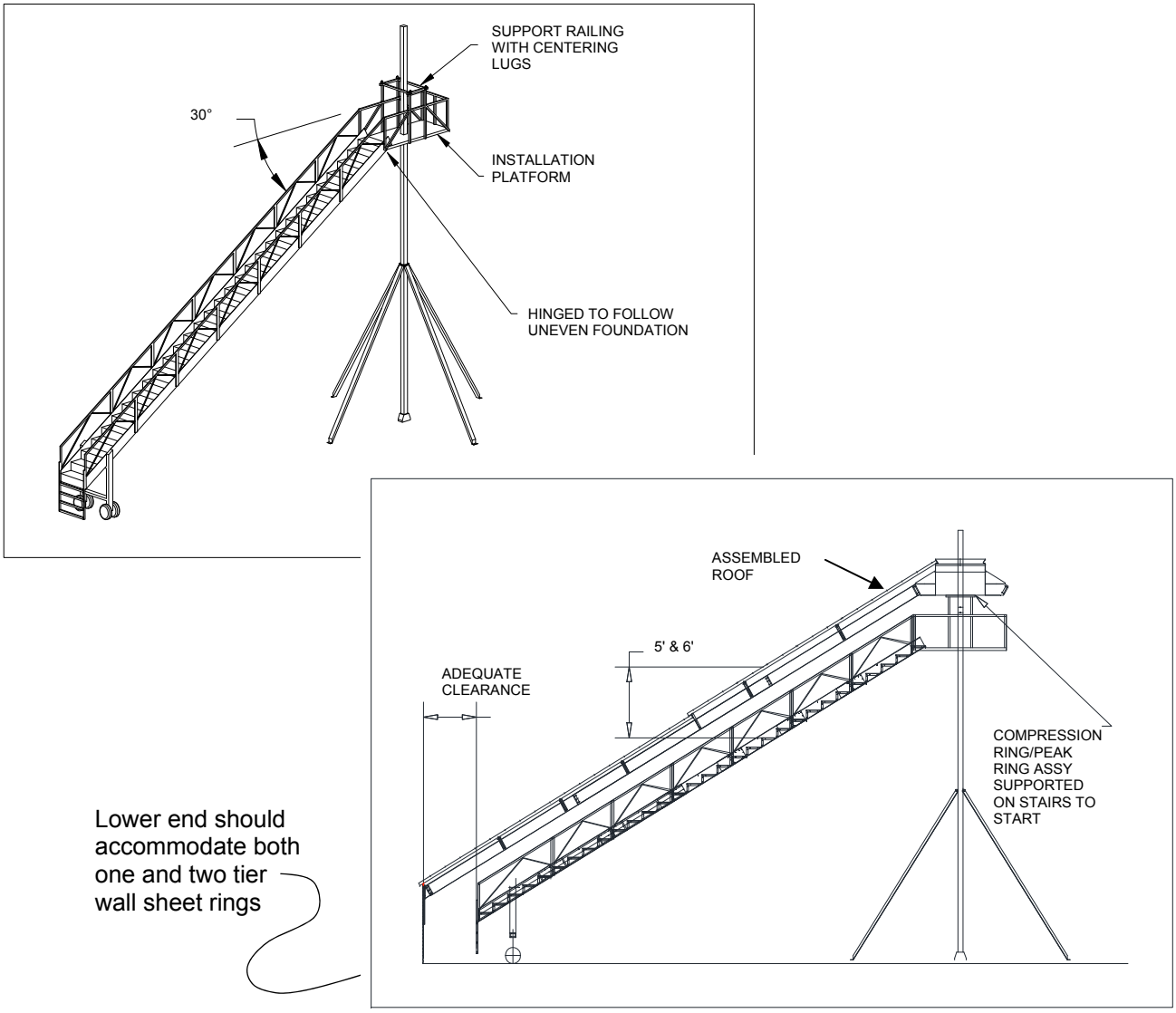
WARNING

- Do not take chances with safety. The components can be large, heavy, and hard to handle. Always use the proper tools, rated lifting equipment, and lifting points for the job.
- Carry out assembly in a large open area with a level surface.
- Always have two or more people assembling the structured roof.
- Make sure you have sufficient lighting for the work area.
- Tighten all fasteners according to their specifications. Do not replace or substitute bolts, nuts, or other hardware that is of lesser quality than the hardware supplied by the manufacturer.
- Stay away from overhead power lines and other obstructions during assembly. Contact with power lines can cause electrocution.
- Do not work in high winds.
- The equipment shall be installed in accordance with applicable local codes and regulations.

5.2. Platform and Stair Design

To ease the roof assembly process, specially designed installation stairs, a platform, and a center pole are required. This section provides specifications for the design of these components.

Figure 3. Platform and Stair Details



1. The upper end of the stair shall be hinged to the platform so that its lower end can follow the surface of the bin floor when rotating around the center post.
2. The platform shall be centered to the post and fixed to the proper height (1 tier or 2 tiers). The platform and stair shall be able to rotate around the center post.
3. The stair shall be at a 30 degree angle to horizontal, so the height from the stair to the roof is consistent.
4. Leave adequate clearance (4' suggested) between the bin wall and the lower end of the stair.
5. The platform shall be 4' wide x 9' long.
6. Vertical distance from the stair tread to roof panel shall be between 5' and 6'.

7. The lower end of the stair should be compatible with both 1 and 2 tier bottom wall-sheet rings, since a full 2 tier upright is required to be pre-installed for even tiered bins in order to attach the roof rafters.

5.3. Pre-Build and Timing Considerations

Prior to starting the erection of the roof, several decisions must be made. These include, but are not limited to:

- The location of the ladder relative to the Westeel logo,
- The location of the door,
- The location of roof sheet with inspection hatch cut out and fall restraint brackets,
- Other off-loading and site conditions.

Consideration should be given to these details well in advance of the actual bin construction. Preferably, the owner or customer should be involved in the process.

When building the roof, there are also timing considerations that come into play. These are addressed in the following sections.

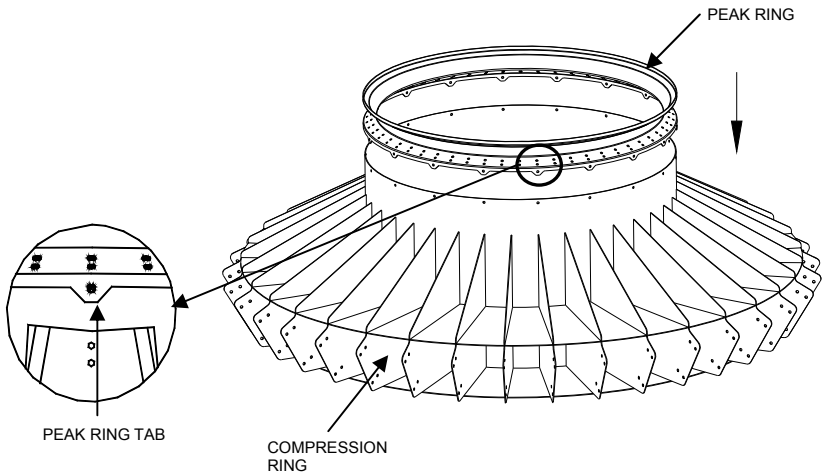
5.4. Roof Component Pre-Assembly

This section describes how to assemble some roof components on the ground, before adding them to the roof structure.

5.4.1 Prepare the Peak Ring / Compression Ring Assembly

1. Place the peak ring on top of the compression ring and bolt the two components together using 1/2" x 1" bolts.
2. Tighten the bolts evenly to ensure that the peak ring is centered on the compression ring.

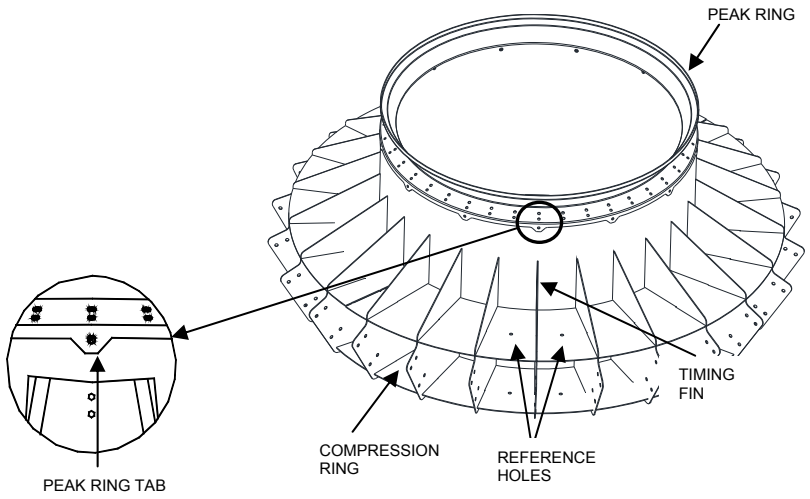
Figure 4. Peak Ring Timing Reference Point for 48’-72’, 78’-102’ and 108’ Structural Roofs



Important

TIMING ALERT: To ensure successful assembly, correct timing of the assembly process is critically important. Note the metal tab, located on the peak ring, that serves as a timing reference point.

Figure 5. Peak Ring Timing Reference Point for 75’ and 105’ Structural Roofs



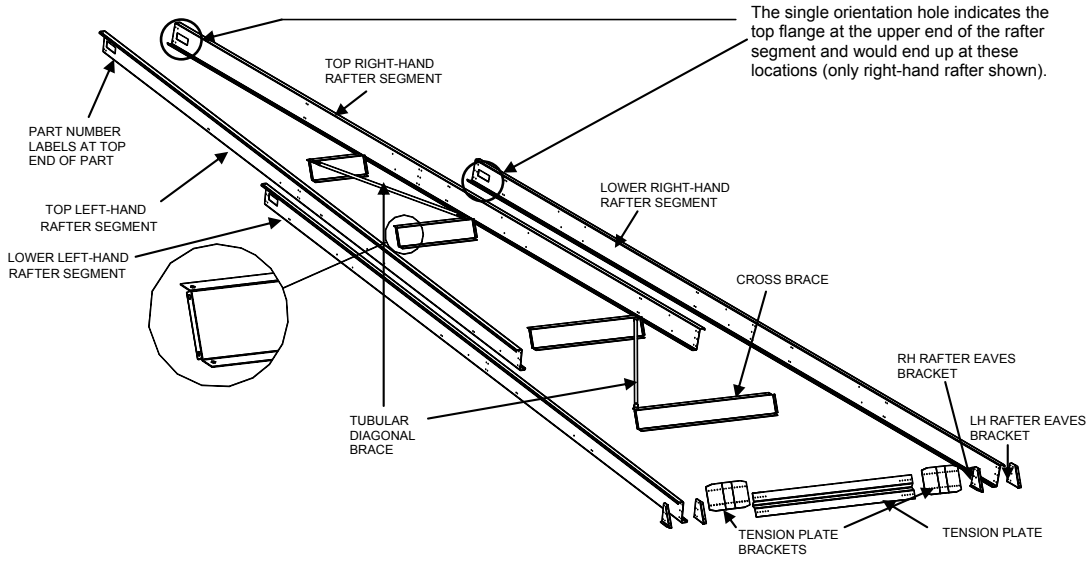
Important

TIMING ALERT: Note the timing fin, located between the reference holes on the compression ring. The timing fin is used as a timing reference point.

5.4.2 Assemble A-Frame Rafters

Rafter A-frame assemblies consist of a right-hand (RH) rafter and a left-hand (LH) rafter connected via horizontal cross braces, tubular diagonal braces, tension plates and other parts as shown. Using pre-assembled A-frames allows fewer lifts, faster construction, less labor, and a shorter crane rental time. All connections are made with ½” x 1” bolts.

Figure 6. Rafter A-Frame Assembly Detail



Best Assembly Practices:

- Sort and organize the roof structural members on the ground.
- Pre-assemble as many A-frame parts on the ground as possible prior to craning them into position.
- Choose a flat and level location to do your assembling. (This will affect how square the final A-frame is.)

1. **Assemble rafters for 51', 75' and 105' Bin Sizes**

   The roofs for 51', 75' and 105' bins have an odd number of rafters. Therefore an additional single rafter is required in addition to the A-frame pairs.

   a. Install the single rafter after all the A-frames are installed.

      Due to the lack of support from an additional rafter the single rafter is susceptible to damage due to bending and warping.

   b. Cross braces and diagonal braces connecting the single rafter to the neighboring A-frame rafters must be assembled once the single rafter is in place and connected at the compression ring, top ring angle and the Z-purlin.

      Note

      48' to 75' bins use single piece rafters. 78' to 108' bins use spliced, two-piece rafters, which must be assembled.

2. **Assemble two-piece rafters**

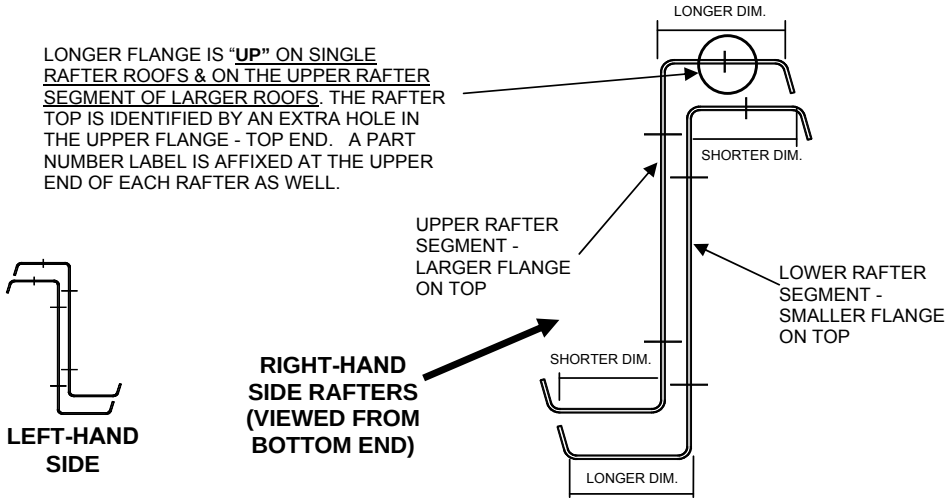
   a. Note that the flanges of the Z-channels are different in length such that the rafter segments can be nested together with a large overlap in the middle.

   b. Locate the single hole punched into one of the flanges. This is used for orientation purposes.

   c. Assemble the rafter so that this hole ends up at the upper end of the rafter segment (i.e. towards the peak) and on the upper flange (i.e. toward the roof panels).

      There is also a part number label located at the upper end of the rafter segments.

Figure 7. Assembling two-piece rafters



Note

Join mating rafter segments only at the rafter splice joints initially. Other holes will be filled as parts are added.

3. **Assemble A-frames**

Note

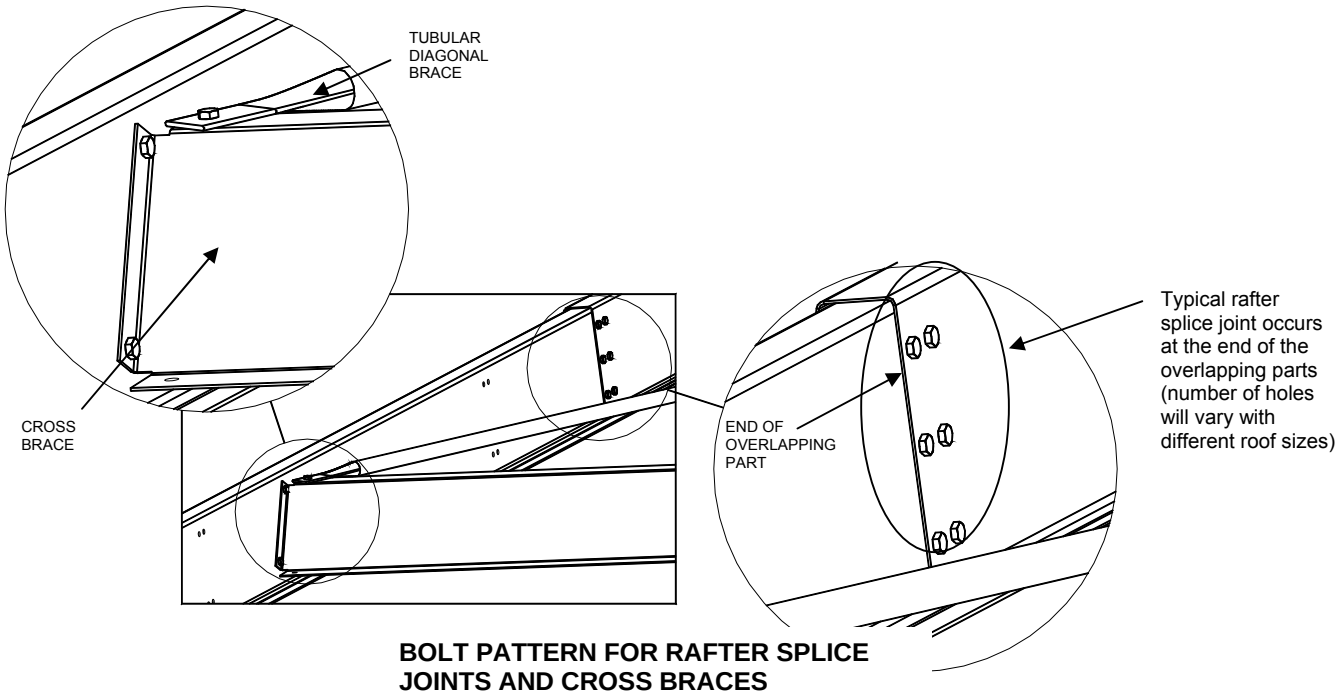
The upper flange points to the right on the right-hand rafter and to the left on the left-hand rafter (when viewed from bottom end).

a. Join the left-hand rafters to the right-hand rafters with horizontal cross braces.

The brace quantities and sizes vary with the bin diameter, but the longest is placed near the bottom and the shortest near the top.

b. Note that the braces are attached to the rafters with a two-bolt hole pattern that are angled (not vertically aligned) on the rafter.

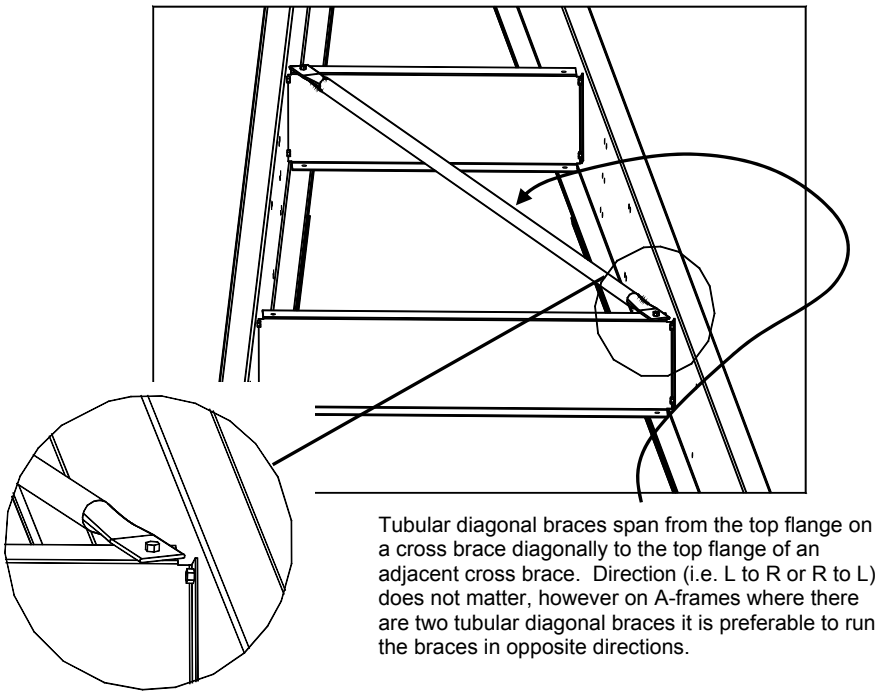
Figure 8. Bolt Pattern for Rafter Splice Joints and Cross Braces



c. Tubular diagonal braces bolt onto the top flange of one cross brace and span diagonally to the top flange on an adjacent cross brace.

On the smaller roofs there is one tubular diagonal brace and on larger roofs there are two (see information provided later for detail on specific bin diameters).

Figure 9. Tubular Diagonal Braces



Tubular diagonal braces span from the top flange on a cross brace diagonally to the top flange of an adjacent cross brace. Direction (i.e. L to R or R to L) does not matter, however on A-frames where there are two tubular diagonal braces it is preferable to run the braces in opposite directions.

d. Bolt on the rafter eave brackets (LH and RH) on either side of the bottom end on all rafters.

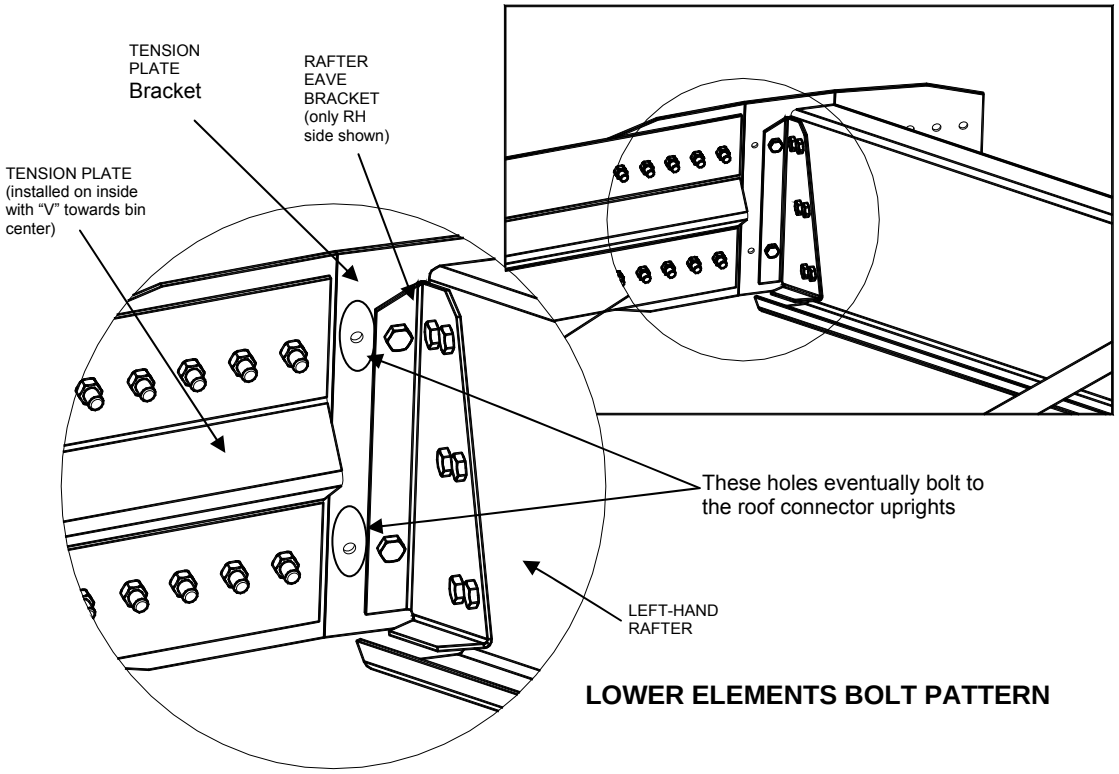
e. Bolt on the tension plate brackets.

f. Bolt on the tension plates across the bottom, between rafters.

Note

The tension plates bolt on the inside of the tension plate brackets with the center V-brake pointing inwards.

Figure 10. Lower Elements Bolt Pattern



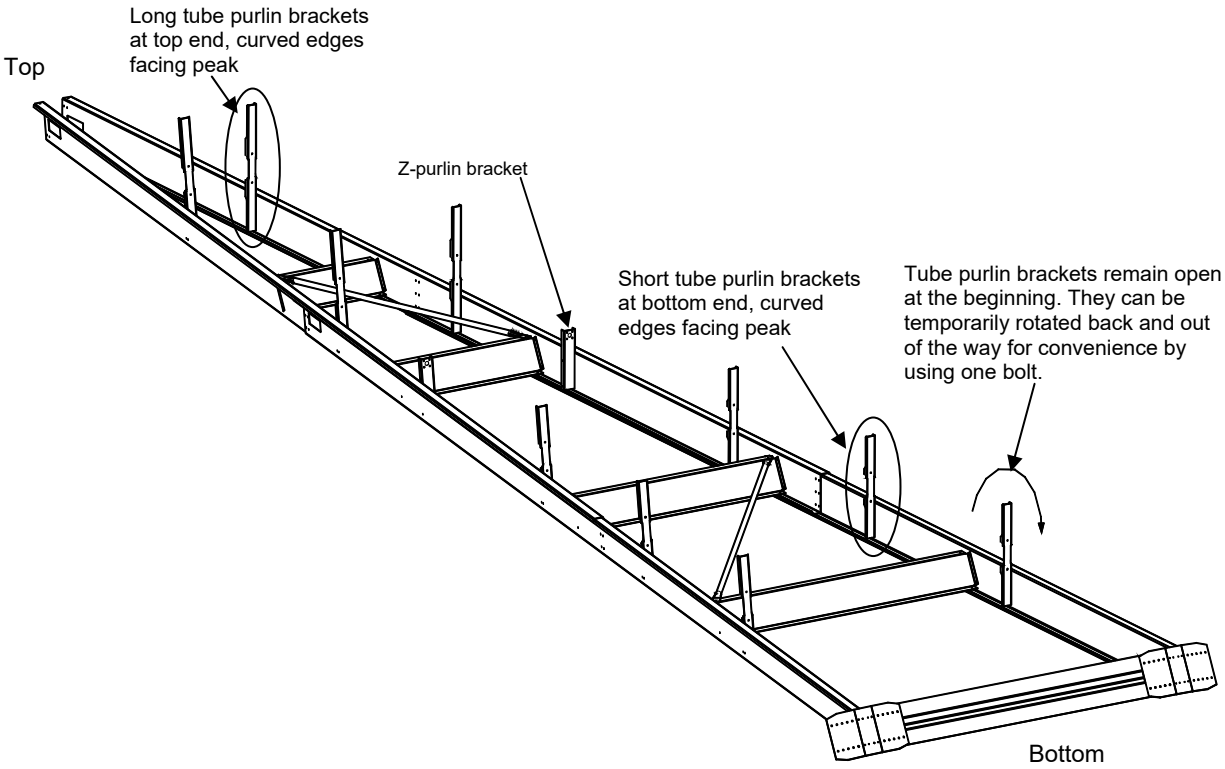
5.4.3 Bolt On Purlin Brackets

There are two types of purlin brackets that bolt onto the rafters:

- Z-purlin brackets
- Tube purlin brackets

There are two lengths of tube purlin brackets. The longer ones go toward the top above the Z-purlin bracket and the shorter ones at the bottom. One Z-purlin bracket is located at a two-hole bolt location about mid-span. The solid portion of the bracket is oriented toward the bottom, while the two flanges point toward the top.

Figure 11. Purlin Brackets on an A-frame



1. Bolt the tube purlin brackets on a four hole locations spaced along the rafters.
2. Initially, bolt them on to the lower two holes only.
3. Orient the solid portion of the bracket towards the bottom and the two flanges pointing towards the top.

Tip

There are many methods for assembling A-frames. One method is to stack the A-frames, with boards between layers. The resulting pile of A-frames acts as a table for working on subsequent sections. If stacking, it is preferable to only use one bolt on each bracket so that they can be rotated out of the way and rest in the lower flange of the rafter during stacking. Before slinging, the brackets can be rotated back to vertical position as shown in Figure 11 on page 28.

5.4.4 Using Tube Purlin Splices

There are two styles of splices used to join the tube purlins:

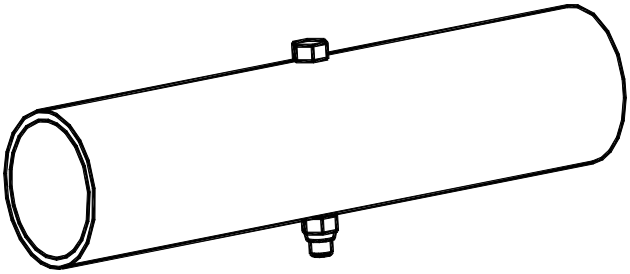
- Standard (inside) tube splices
- Final (external) tube splices

The standard connection uses short tube segments that slide inside the tube purlins.

The final connection uses a short tube segment that slides over the tube purlins.

A final pre-assembly possibility is to insert the 3/8” x 3 ¾” bolt through the tube purlin splices used for the standard connection, add a nut, and tighten.

Figure 12. A Tube Purlin Splice



5.4.5 Bin Entry Anchor System: Structured Roof

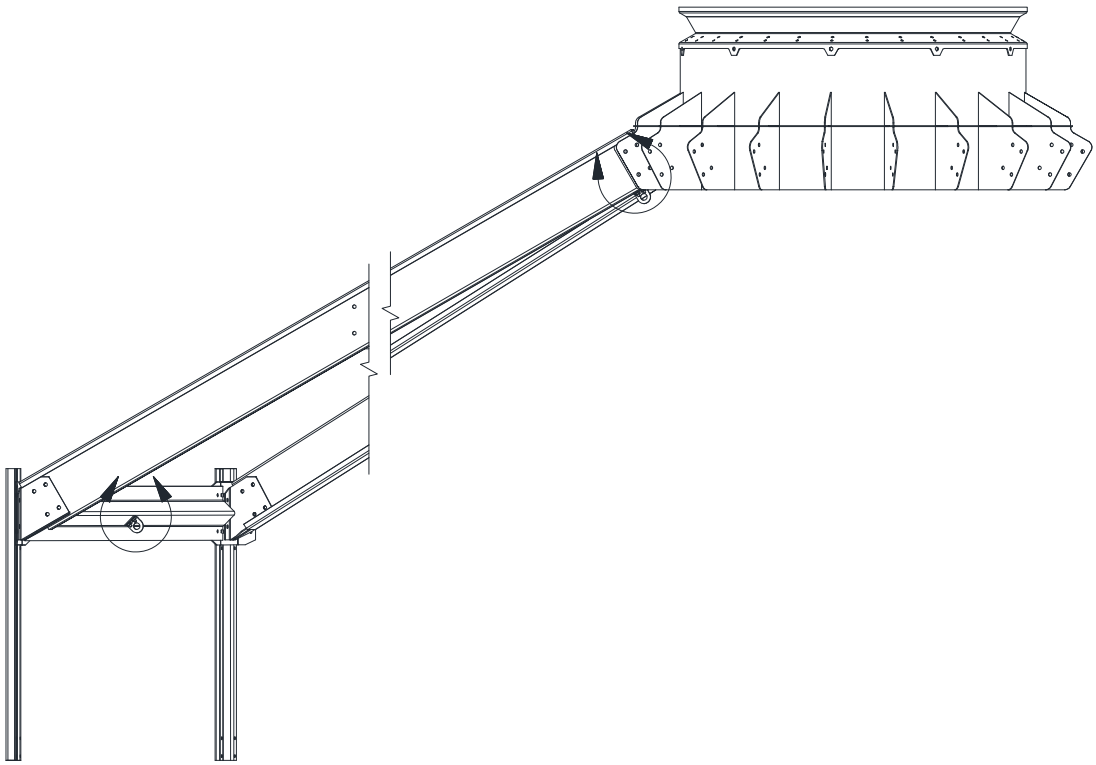
Important

The fall restraint bracket is rated for a maximum load of 2,000 lbs. The bin owner and user are responsible for correctly installing, using, and operating the Bin Entry Anchor System. The rope, pulley, and harness are not supplied by Westeel.

⚠ WARNING Failure to install correctly as instructed below may result in serious injury or death.

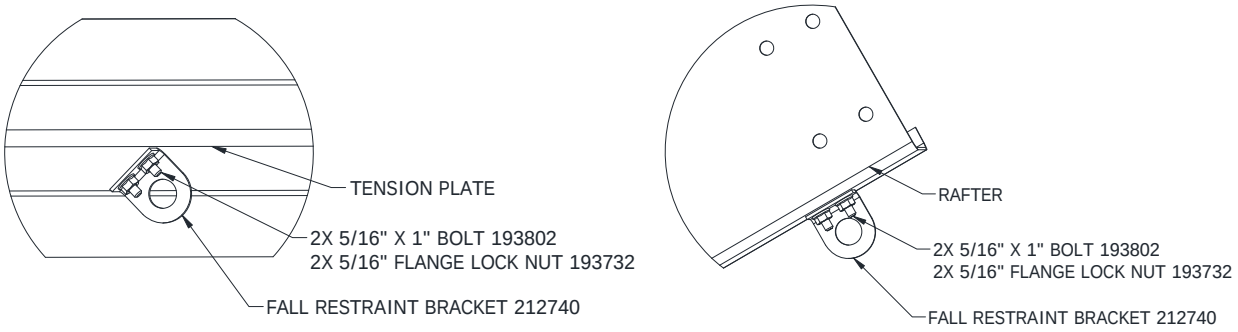
1. Determine the location of the inspection hatch prior to installing the fall restraint brackets. This will dictate where the fall restraint brackets will be installed.
2. Install fall restraint bracket under the roof rafter as shown close to the compression ring. Make sure the roof rafter selected is underneath the roof sheet with the inspection hatch cut out. Holes will need to be field drilled where the fall restraint bracket connects to the roof rafter.

Figure 13. Installing the fall restraint brackets



3. Place the Fall Restraint Anchor Point Decal (PN 8110-01090) on the bin, see Section 2.5 – Decal Installation/ Replacement on page 7 and Section 2.6 – Safety Decal Locations and Details on page 8 for installation instructions and placement.
4. Identify the tension plate below the roof sheet with inspection hatch cut out. Bolt the second fall restraint bracket to the tension plate as shown. Holes will need to be field drilled where the fall restraint bracket connects to the tension plate. The fall restraint bracket can be installed off center for better reachability from the inspection hatch.

Figure 14. Installing the fall restraint bracket to the tension plate



5.5. Bin Roundness

It is imperative that the bin be as round as possible. The following steps describe how to ensure the bin is round.

1. Verify that the foundation meets all the requirements of the installation.
2. Scribe the bin circumference onto the foundation as follows:
   a. Anchor a string to the exact center of the concrete foundation.
   b. Consult the following table to find the scribe radius for the size of the bin being assembled.
   c. Using the required string length, scribe the bin circumference onto the foundation.

      The radius values given in the chart are 3/4–inch smaller than the wall sheet radius at the bottom. This ensures that the scribed circle can be seen during assembly. A perfectly placed ring of sheets should be 3/4 inch on the outside of this scribed circle.
3. After the first ring of wall sheets has been assembled, check the position and roundness of the ring:
   a. Verify that the maximum amount that the bin is out of round is no more than 0.75" on the radius, when measured from the center of the bin.
   b. Verify that the wall sheets form a smooth circle with no flat spots or cauliflower shaped curves.
   c. Before anchoring the bin to the foundation, re-check to ensure that the bin is round and within tolerance.

      Correcting for roundness becomes much more difficult the longer you wait.
4. Locate anchor bolts towards the outside of the anchor bolt slots (away from bin) to permit the incremental expansion that can occur with the initial filling of the bin.
5. When setting jacks, make sure they are also set round and that they are anchored to the concrete.

Table 6. Scribe Radius – 48' to 108' Bins

Nominal Bin Diameter (ft)	Scribe Radius (ft in)	Nominal Bin Diameter (ft)	Scribe Radius (ft in)
48	23'9-3/4"	78	38'8-3/4"
51	25'3-5/8"	84	41'8-9/16"
54	26'9-9/16"	90	44'8-3/8"
60	29'9-5/16"	96	47'8-3/16"
66	32'9-1/8"	102	50'8"
72	35'8-15/16"	105	52'1-7/8"
75	37'2-7/8"	108	53'7-13/16"

5.6. Structural Roof Assembly

This section describes how to assemble the structural roof.

5.6.1 Install a Center Post, Assembly Stairs and Platform

1. Install a center-post at the center point of the foundation.
2. Make sure the post is vertical, braced, and anchored properly for safe installation.
3. Assemble the platform and stair to the center pole.
4. Sling in the peak ring and compression ring assembly.
5. Center, level and set the correct height (H) of the peak ring / compression ring assembly (see the table at the end of this section).
6. Provide some form of height adjustment such as a hoist or hydraulic cylinder to facilitate minor height adjustments.

Figure 15. Installing a Center Post, Assembly Stairs and Platform

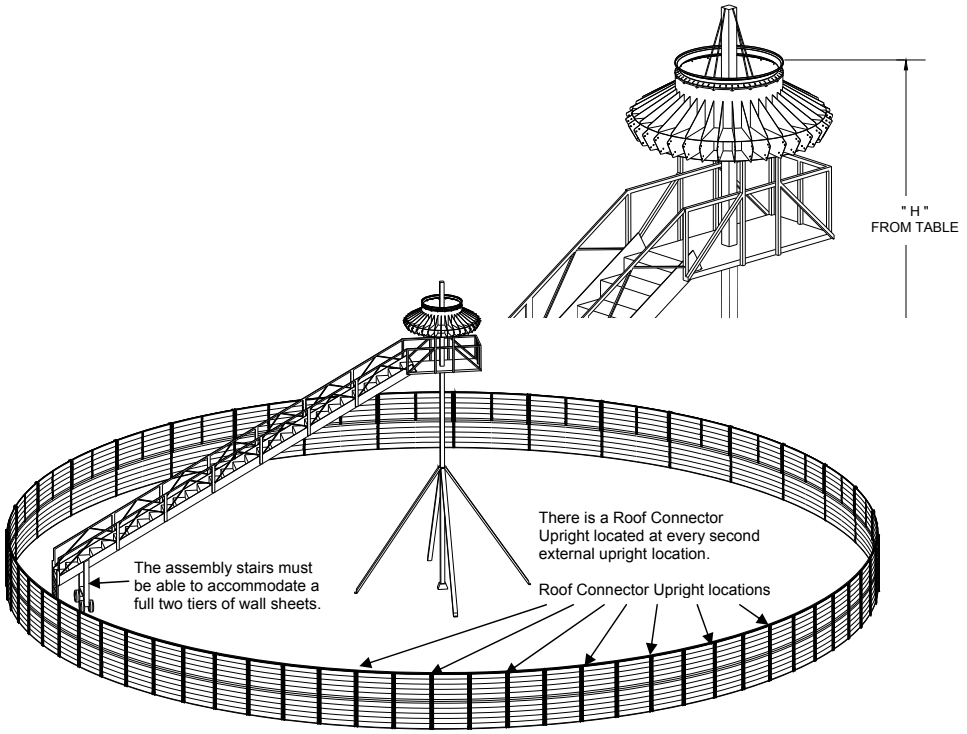


Table 7. Tier Heights — 48’ to 108’ Bins

Nominal Bin Dia.In feet	H— Height for 2 tiers	H — Height for 1 tier
48	19 ft - 11.4 in.	16 ft - 3.40 in.
51	20 ft - 6.60 in.	16 ft - 10.6 in.
54	22 ft	18 ft - 4.0 in.
60	24 ft - 3.45 in.	20 ft - 7.45 in.
66	26 ft - 0.12 in.	22 ft - 4.12 in.
72	27 ft - 8.80 in.	24 ft - 0.80 in.
75	28 ft - 7.14 in.	24 ft - 11.14 in.

Table 7 Tier Heights — 48’ to 108’ Bins (continued)

Nominal Bin Dia.In feet	H— Height for 2 tiers	H — Height for 1 tier
78	29 ft - 5.47 in.	25 ft - 9.47 in.
84	31 ft - 2.15 in.	27 ft- 6.15 in.
90	32 ft - 11.2 in.	29 ft - 3.2 in.
96	34 ft - 7.5 in.	30 ft - 11.5 in.
102	36 ft - 1.86 in.	32 ft - 5.86 in.
105	37 ft - 0.2 in.	33 ft - 4.20 in.
108	37 ft - 10.5 in.	34 ft - 2.5 in.

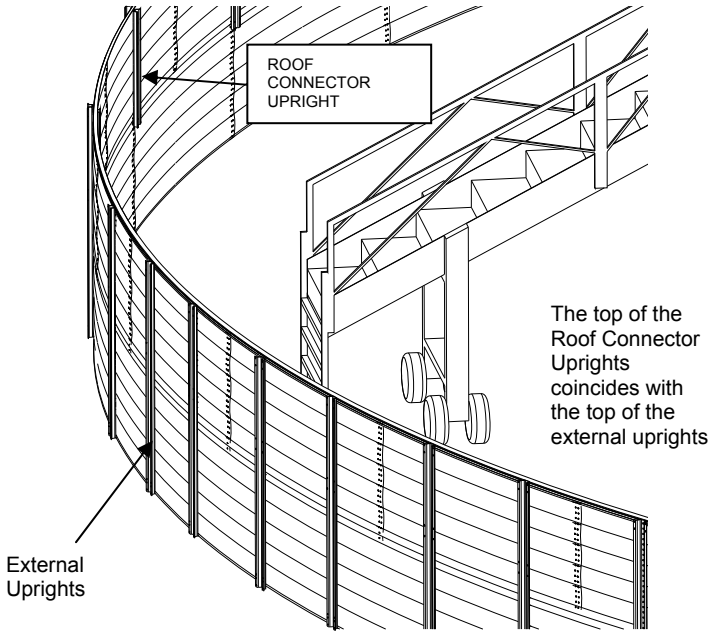
5.6.2 Layout and Assemble the Initial Wall Sheet Tiers

1. Note that two tiers are required for even tier bins since the two tier uprights are required to be bolted to the roof connector uprights (as illustrated in Figure 16 on page 33).
2. Note that only one tier is required for odd tier bins since the initial external upright is one tier high. (However, two wall sheet tiers can be assembled if desired.)
3. Consult the wall sheet section of the bin manual for wall sheet and upright layouts, and the upright assembly section for information on upright positioning relative to the wall sheets.
4. Consult the Hardware Where Used section of the manual for appropriate hardware usage.
5. Note that a roof connection upright is attached on the inside of the bin at every second external upright location.

   The height of the roof connection upright coincides with the height of the external upright.
6. Make sure the wall sheets are installed round and meet the criteria provided above.

   Misalignment can affect subsequent roof assembly.

Figure 16. Assembling the Initial Wall Sheet Tiers

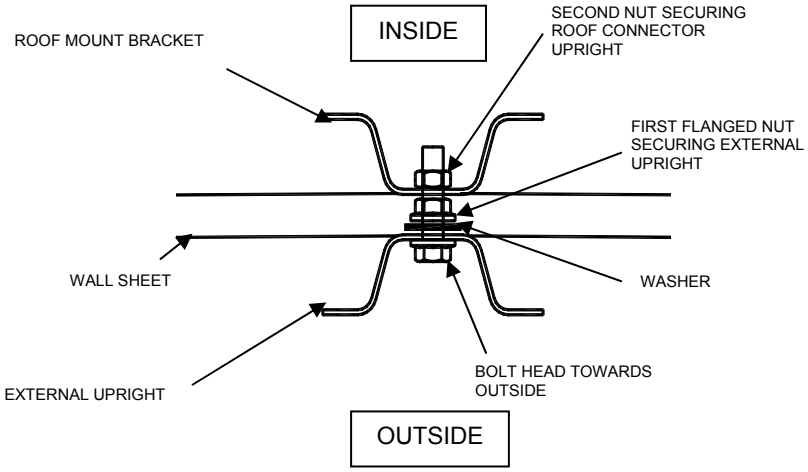


7. Use 3/8” x 1 ½” bolts at the external upright locations where the roof connector uprights are bolted on.

8. Bolt on the external upright first with the bolt head on the outside, the sealing washer sandwiched between the upright and the wall sheet, and the threaded shank protruding towards the inside.
9. Bolt on the roof connector upright on the inside using a second nut.

   Misalignment can affect subsequent roof assembly.

Figure 17. Bolting on the External and Roof Connector Uprights



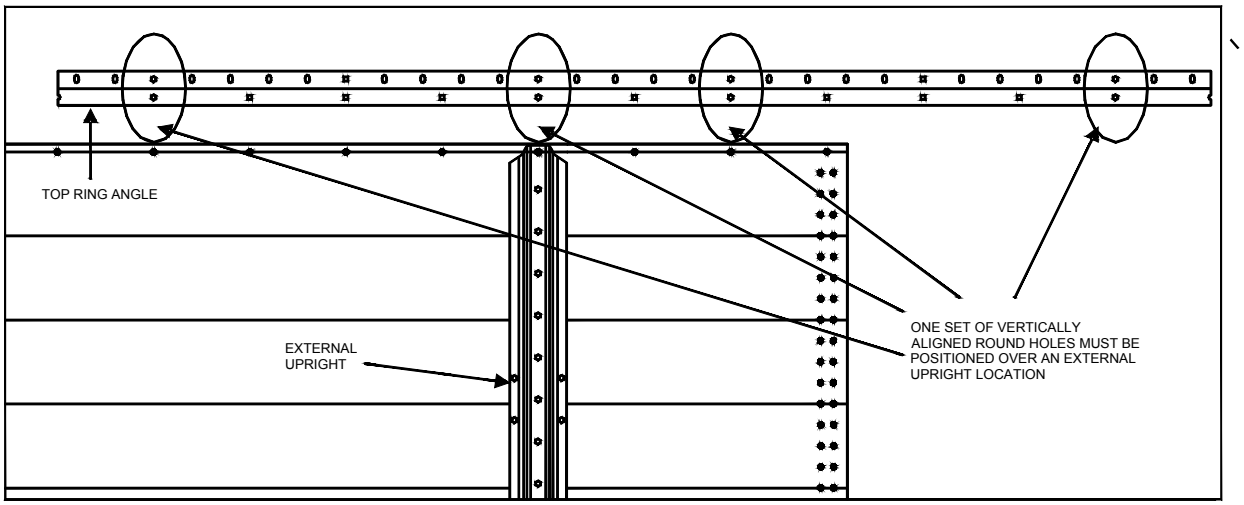
5.6.3 Bolt on the Top Ring Angles

1. Bolt on the top ring angles as per the wall sheet section of the bin manual.
2. **Use the following instructions for 48’-72’, 78’-102’ and 108’ bins:**

   a. TIMING ALERT: There is a timing requirement when attaching the top ring angle to the wall sheets. There are four pairs of vertically aligned round holes across the face of the top ring angle. Any of these vertically aligned round holes must be aligned with an external upright. Only these specified holes are acceptable. Once the first angle is bolted on the rest will align appropriately.

   Failure to do this will result in the misalignment of subsequent parts.

Figure 18. Positioning the top ring angle for 48’ to 72’, 78’ to 102’, and 108’ bins



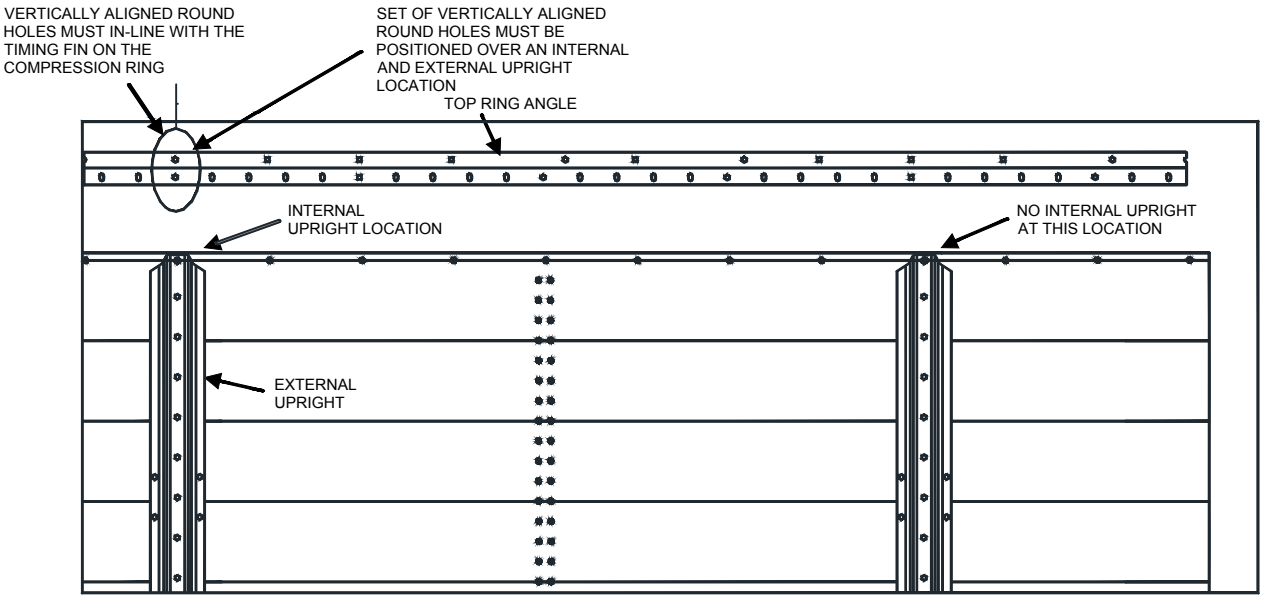
3. **Use the following instructions for 75’ bins:**

   There are six different variations of the top ring angle, which are color coded for easier identification. A total of 26 segments are used for a 75’ bin. The sequence of the top ring angle is critical for the successful assembly of the top ring angle (i.e. roof to bin).

   a. TIMING ALERT: There is a timing requirement when attaching the top ring angle to the wall sheets. The first top ring angle segment to be installed is 212267–A (black). There is one pair of vertically aligned round holes across the face of the top ring angle. These vertically aligned round holes must be aligned with an internal upright (behind the external upright in the following diagram) AND an external upright, which are aligned to the timing fin on the compression ring. This timing requirement is critical. Only this specified hole to internal and external uprights relationship is acceptable. Once the first angle is bolted on follow the sequence given in a counter-clockwise direction to align the rest of the angles appropriately.

      Failure to do this will result in the misalignment of subsequent parts.

Figure 19. Positioning the top ring angle for 75’ bins



   b. **Assembly Sequence:**

Table 8. Assembly Sequence with Part Number and Color Code (for 75’ bins)

Sequence	Part Number	Color Code
#1 & #2	212267-A	Black
#3 & #4	212267-B	Green
#5 & #6	212267-C	Red
#7 & #8	212267-D	Blue
#9 & #10	212267-E	Orange
#11 & #12	212267-F	Yellow
#13	212267-C	Red
#14 & #15	212267-A	Black
#16 & #17	212267-B	Green
#18 & #19	212267-C	Red
#20 & #21	212267-D	Blue
#22 & #23	212267-E	Orange

Table 8 Assembly Sequence with Part Number and Color Code (for 75’ bins) (continued)

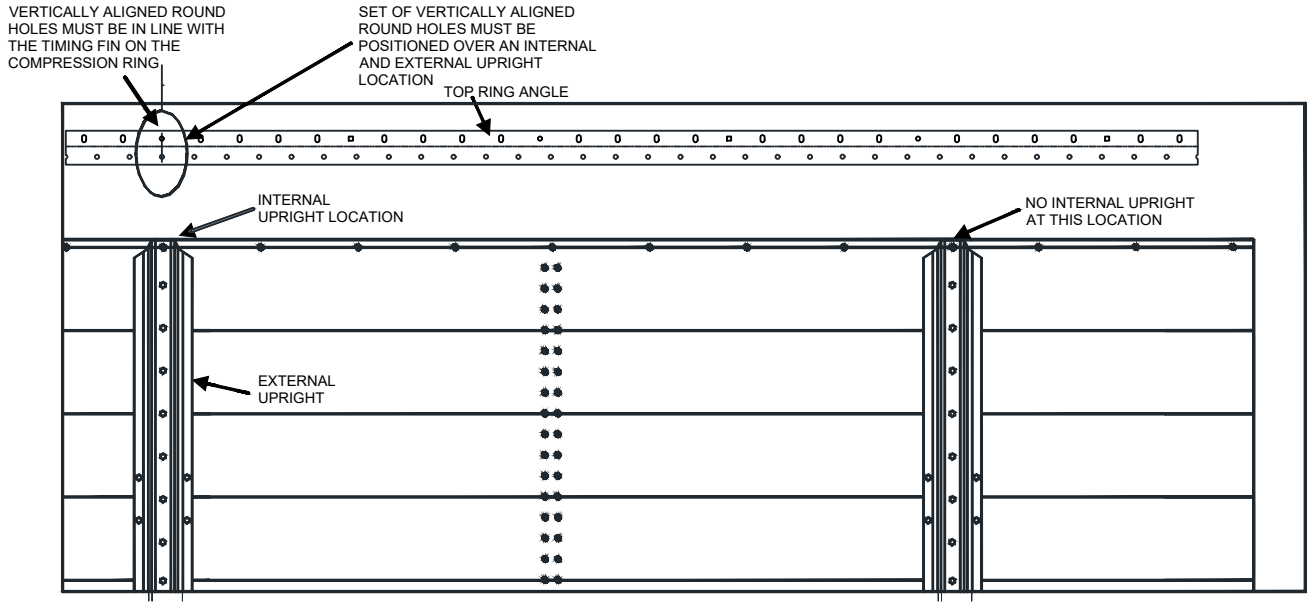
Sequence	Part Number	Color Code
#24 & #25	212267-F	Yellow
#26	212267-C	Red

4. **Use the following instructions for 105’ bins:**

   a. TIMING ALERT: There is a timing requirement when attaching the top ring angle to the wall sheets. There is only one pair of vertically aligned round holes across the face of the top ring angle. These vertically aligned round holes must be aligned with an internal and external upright. The aligned holes on the first top ring angle must be in-line with the timing fin on the compression ring. Only these specified aligned holes are acceptable. Once the first angle is bolted on the rest will align appropriately.

   Failure to do this will result in the misalignment of subsequent parts.

Figure 20. Positioning the top ring angle for 105’ bins



5.6.4 Lift the Assembled Rafter A-Frames into Position

1. Using a crane, lift the A-frames into position for bolting to the compression ring (at the top) and the roof connection upright (at the bottom).

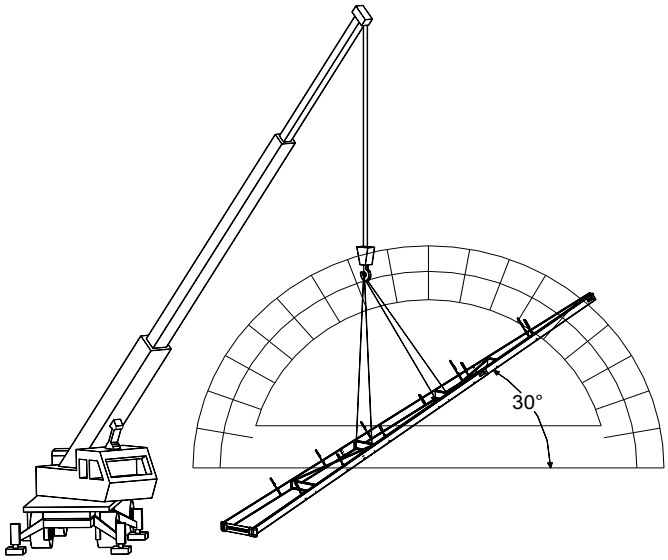
   There are no dedicated attachment points for the crane slings to attach to.

2. Recommended: For stability and adjusting versatility, wrap fabric slings (rated for the load) around two horizontal cross braces in four places

3. Adjust the slings so that the angle of the A-frames is equal to the slope of the roof.

   (This determine how closely the holes align and how easily the bolting progresses.)

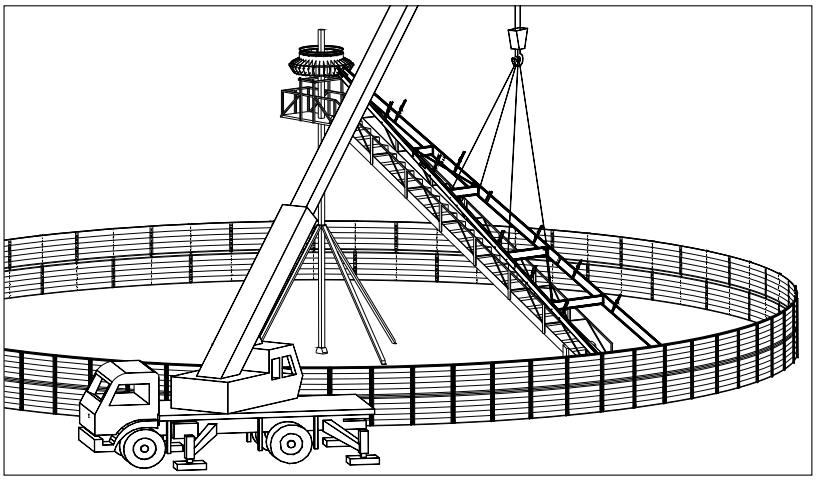
Figure 21. Slinging the A-Frame for the Correct Roof Angle



4. When ordering a crane make sure that it is rated for the load and can reach to all points on the roof so that no repositioning of the crane is required.

   (This determine how closely the holes align and how easily the bolting progresses.)

Figure 22. Positioning the Crane

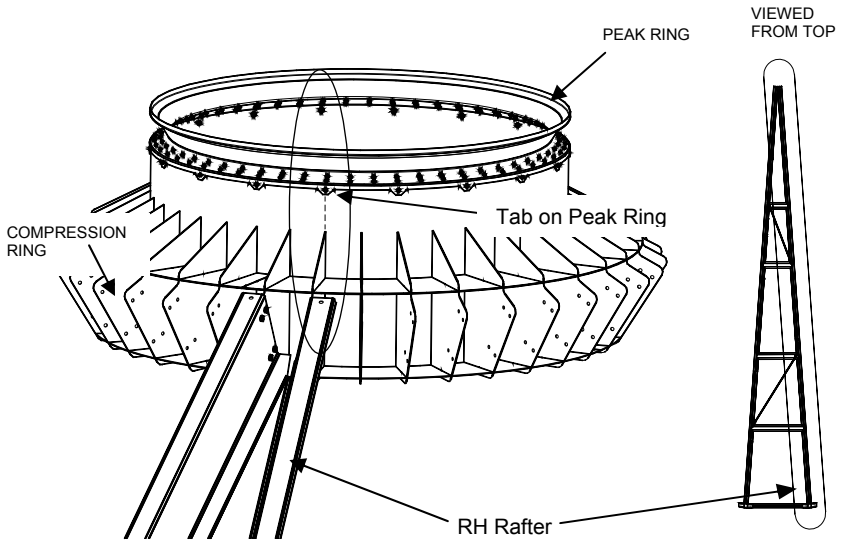


5.6.5 Align and Attach A-Frames

1. Note that the rafters fit inside adjacent fins on the compression ring.
2. **Use the following instructions for 48’-72’, 78’-102’ and 108’ bins:**
   a. TIMING ALERT: The right-hand rafter in an A-frame pair must align with the fin on the compression ring that is aligned with a tab on the peak ring.

      (This determines how closely the holes align and how easily the bolting progresses.)

Figure 23. Aligning the Right-Hand Rafter with the Correct Compression Ring Fin (48’-72’, 78’-102’ and 108’ bins)



3. **Use the following instructions for 75’ and 105’ bins:**

   a. TIMING ALERT: The first right-hand rafter in an A-frame pair must align with the timing fin on the compression ring (between two reference holes).

      (Critical to whole roof assembly timing.)

Figure 24. Aligning the Right-Hand Rafter with the Correct Compression Ring Timing Fin (75’ and 105’ bins)

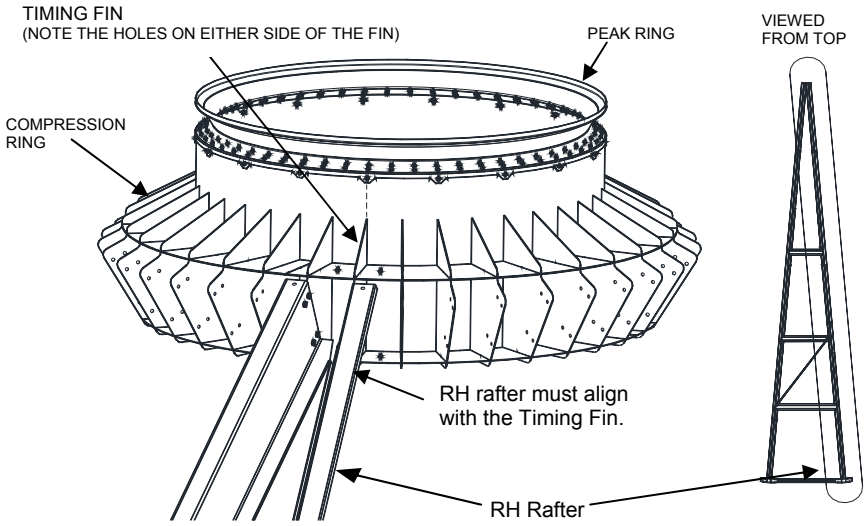
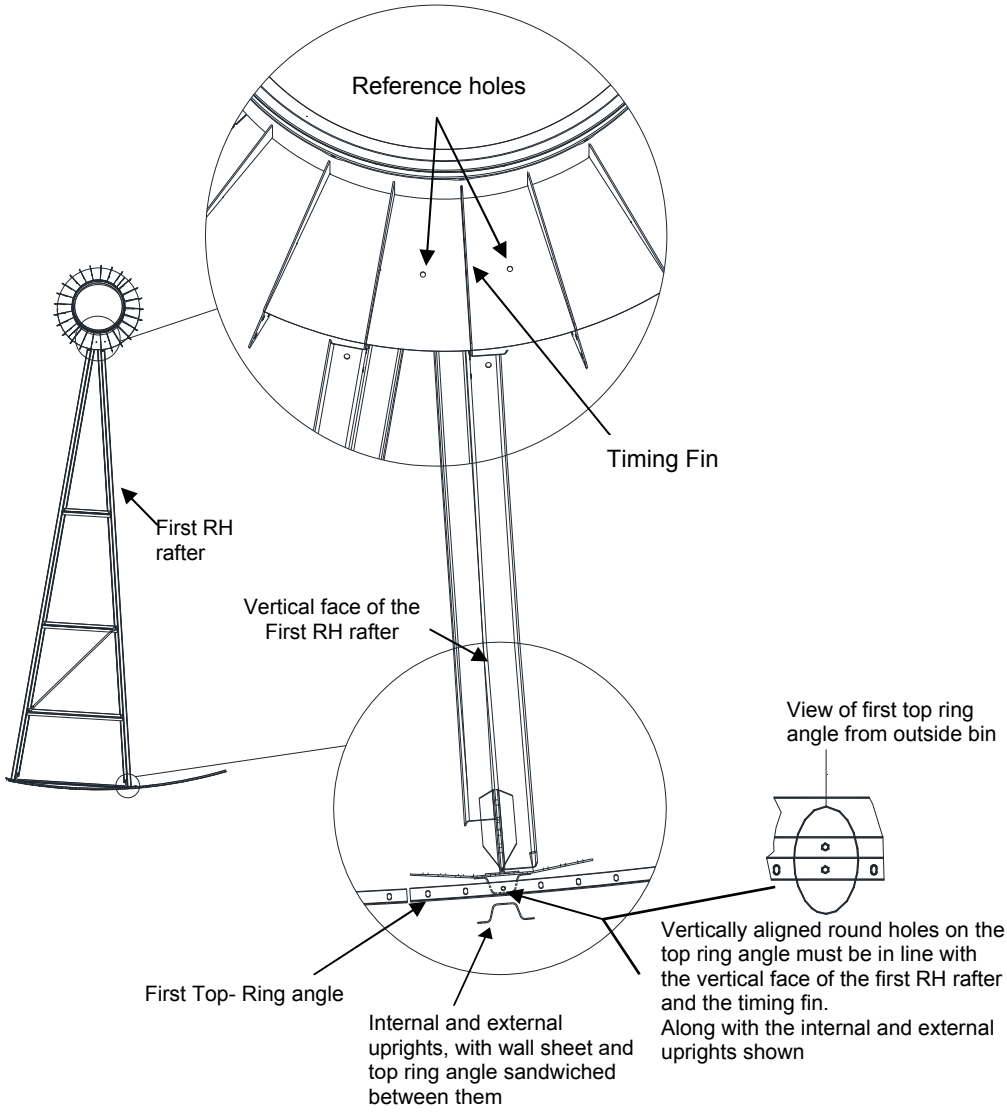


Figure 25. Aligning the Right-Hand Rafter with the Correct Compression Ring Timing Fin and Top Ring Angle



b. TIMING ALERT: The lower end of the first right-hand rafter must be in line with vertically aligned holes on the first top ring angle. This is critical for correct roof assembly timing.

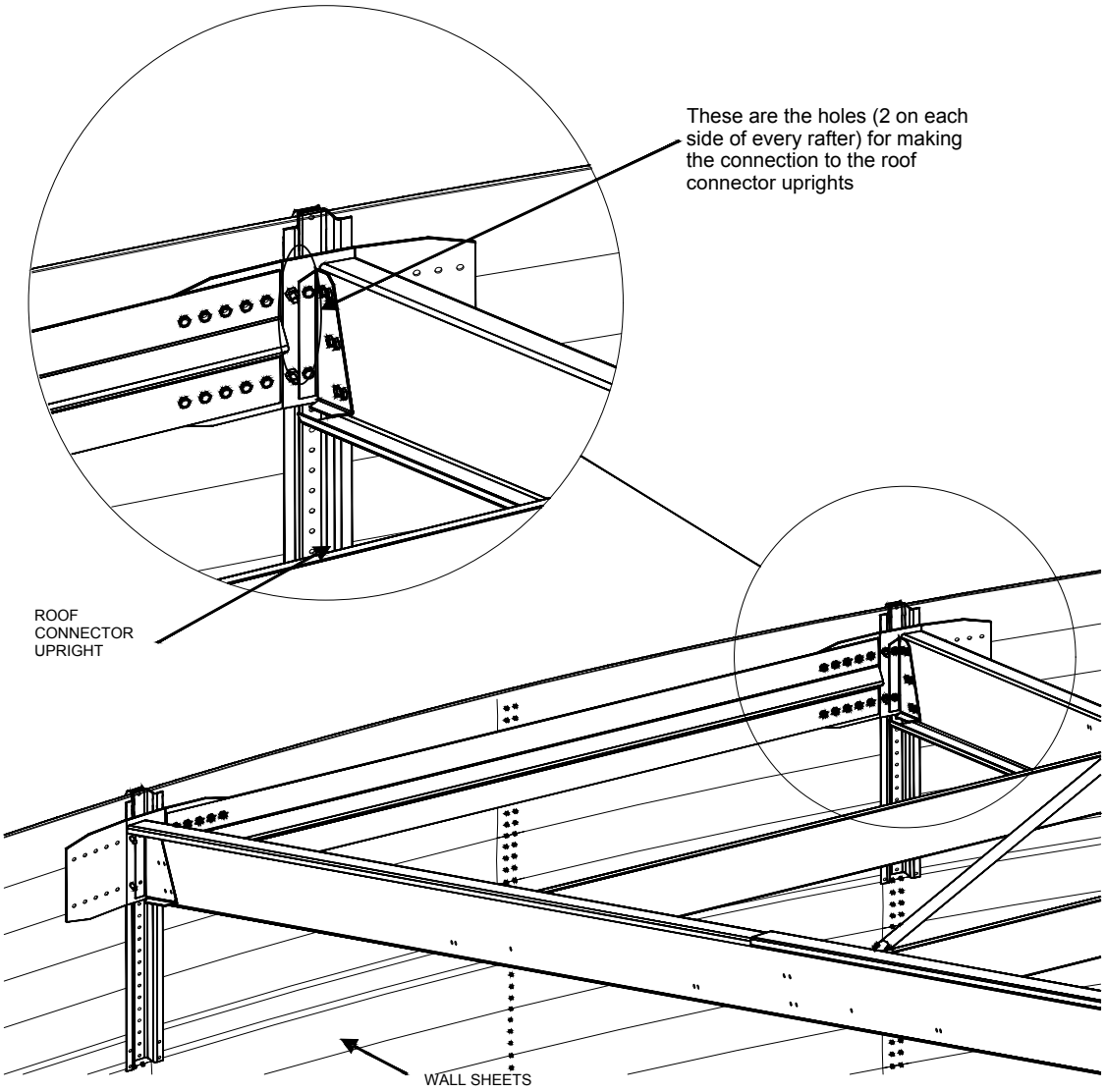
Important

For 75' bins, use 212267–A (black) for the first top ring angle. Then, follow the sequence as shown previously.

4. Attach the lower ends of the rafter A-frames to adjacent roof connector uprights as illustrated.

(Critical to whole roof assembly timing.)

Figure 26. Attaching the Lower End of an A-Frame Rafter to Roof Connector Uprights



5. Install additional rafter A-frames opposite one another around the ring such that the loads on the peak assembly remain uniformly distributed and the structure is optimally balanced.
6. Maintain the timing requirements specified earlier.
7. For each additional rafter pair assembled, install the next pair on the opposite side, to balance the weights.
8. **For 48', 54'-72', 78'-102' and 108' roofs,** make sure there are an even number of fins on the compression ring, and a matching number of roof connector uprights locations are left between adjacent A-frame pairs.

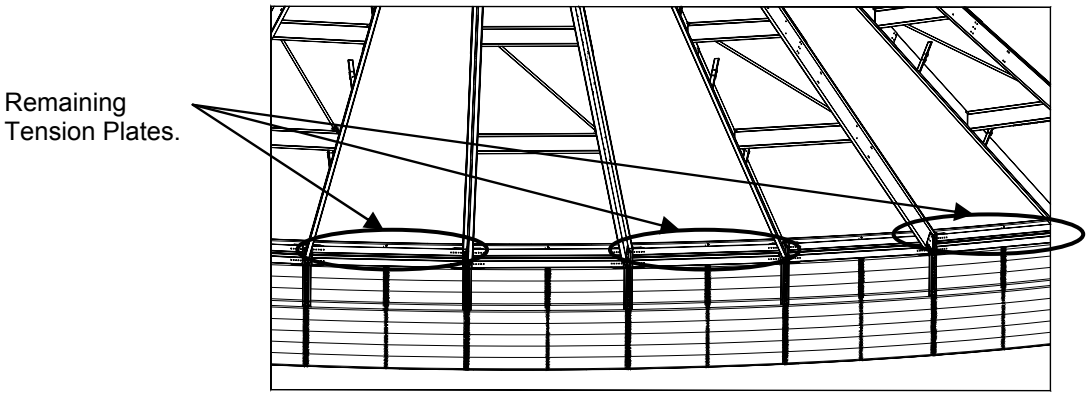
Note

The 51', 75' and 105' roofs are exceptions—they have an odd number of fins:

- The **51'** roof has 17 fins on the compression ring — eight A-frame pairs and an additional single right-rafter. Once the first A-frame is assembled as per instructions, assemble three more A-frames with right—hand rafters at the 9th, 5th and 13th fins, in that sequence on the compression ring, with the timing fin as #1 (counterclockwise).
- The **75'** roof has 25 fins on the compression ring — 12 A-frame pairs and a single rafter. Once the first A-frame is assembled as per instructions, assemble three more A-frames with right-hand rafters at the 13th, 7th and 19th fins, in that sequence on the compression ring, with the timing fin as #1 (counterclockwise).
- The **105'** roof has 35 fins on the compression ring – 17 A-frame pairs and a single rafter. Once the first A-frame is assembled as per instructions, assemble three A-frames with right-hand rafters at 17th, 9th and 27th fins, in that sequence on the compression ring, with the timing fin as #1 (counterclockwise).

9. Continue the installation process moving around the bin, bolting on the remaining tension plates between the pairs of rafter A-frames (except 51', 75', and 105' single rafter plates).

Figure 27. Bolting on the remaining tension plates



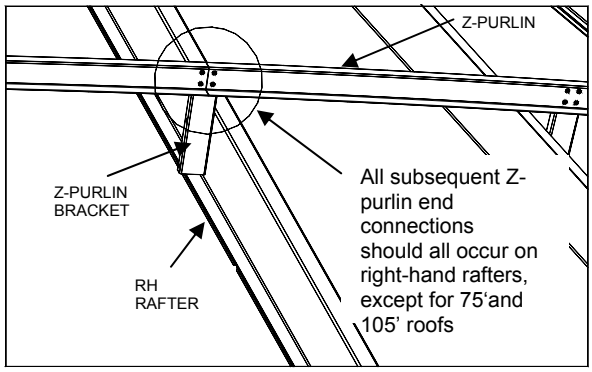
5.6.6 Bolt On Z-Purlin Brackets

1. Bolt on the Z-purlin brackets at the mid-span locations on the rafters if they have not already been pre-assembled.
   a. Bolt the Z-purlins into the Z-purlin brackets.

      All connections between adjacent Z-purlins are made at the Z-purlin brackets, **except for 75' and 105' roofs.**

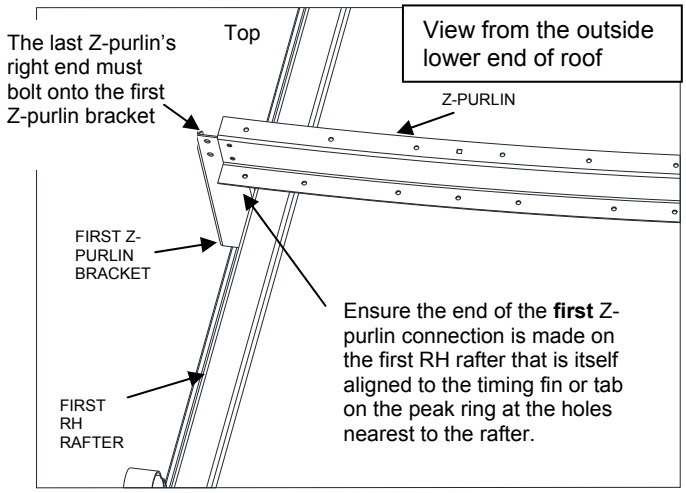
   b. Note that the top flange on the Z-purlin points toward the peak ring and the lower flange points toward the top eaves angle.

Figure 28. Bolting on Z-purlins



c. TIMING ALERT: The left end of the first Z-purlin (viewed from the outside, lower end of the roof) must be attached to the first Z-purlin bracket (at the holes nearest to the rafter) on the first right-hand rafter that is itself aligned with the timing fin or tab on the peak ring. The Z-purlins will be assembled in a counterclockwise direction (when looking from top).

Figure 29. Installing the Z-purlins



Note

For 75’ and 105’ roofs, the end-to-end connection of the Z-purlins is achieved by using splices to connect them together. The exception to this is one end of the very first and the very last purlins, which are bolted to the bracket connected to the first right—hand rafter.

For 105’ roofs, an appropriate pair of holes on the mid-section of the Z-purlin is used to bolt the Z-purlin to a rafter bracket using holes closest to the rafter.

In most cases, a purlin splice will be connected below the Z-purlin (as shown in Figure 30 on page 43), with the top flange pointing towards the peak ring. But in a few areas, there is interference from the Z-purlin bracket on the rafter. In this case, the splice can be attached above the Z-purlins (resulting in minor distortions of the roof panel). The slots on the splices are pass-through slots for the roof panel bolts (see Figure 30 on page 43).

Figure 30. Typical location of a purlin splice

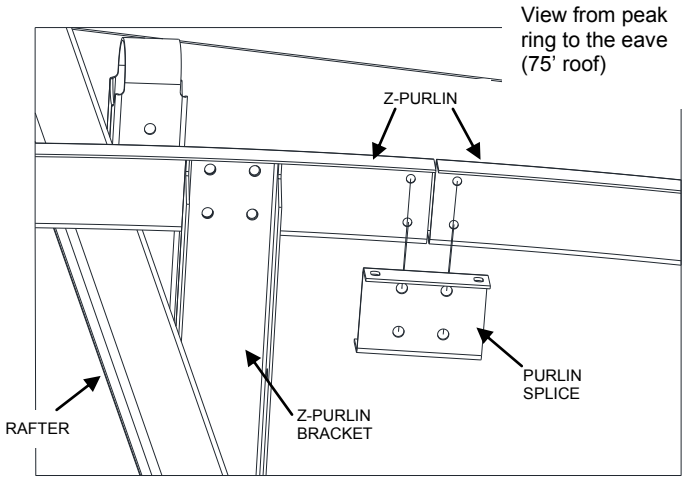
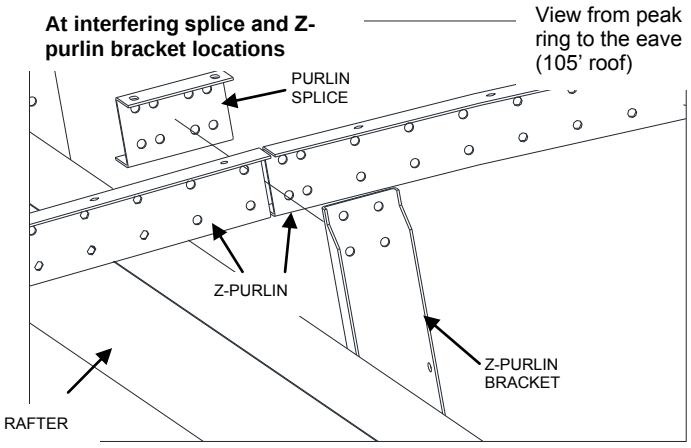


Figure 31. Purlin splice above the Z-purlin

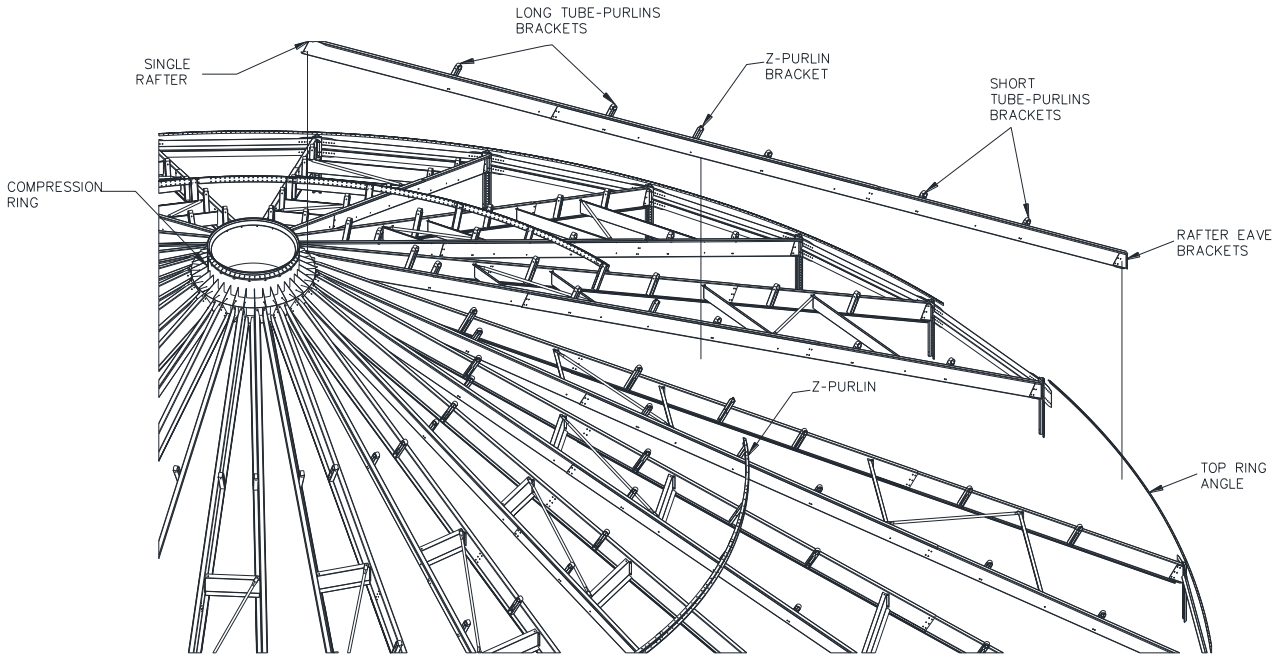


2. **For 75’ and 105’ roofs:**

   a. In order to install the single rafter, assemble the Z-purlins starting at the first right hand rafter as shown above but do not assemble the last two Z-purlins.

   b. Once the single rafter is in place connecting the compression ring and the top ring angle, bolt the last two Z-purlins to the Z-purlin brackets (or Z-purlin splices).

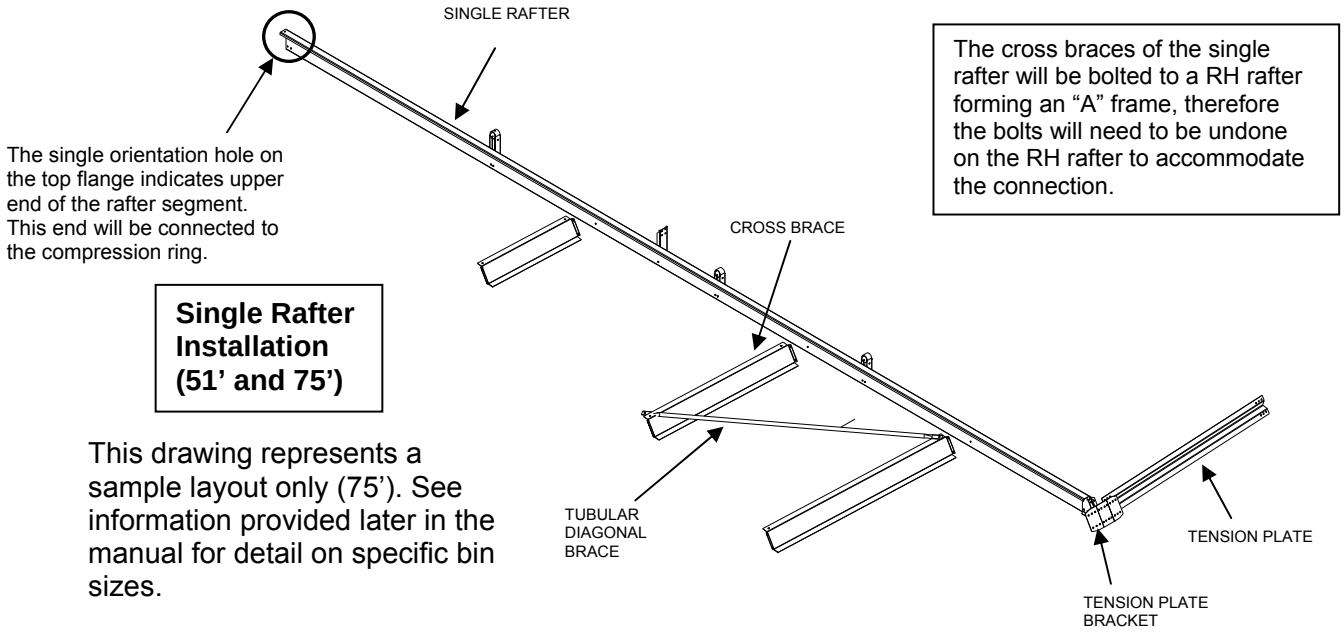
Figure 32. Installing Z-Purlins on 75’ and 105’ roofs with single rafters



c. Attach the cross braces to the single rafter and the neighboring A- frame rafter. Also attach the diagonal braces, if applicable.

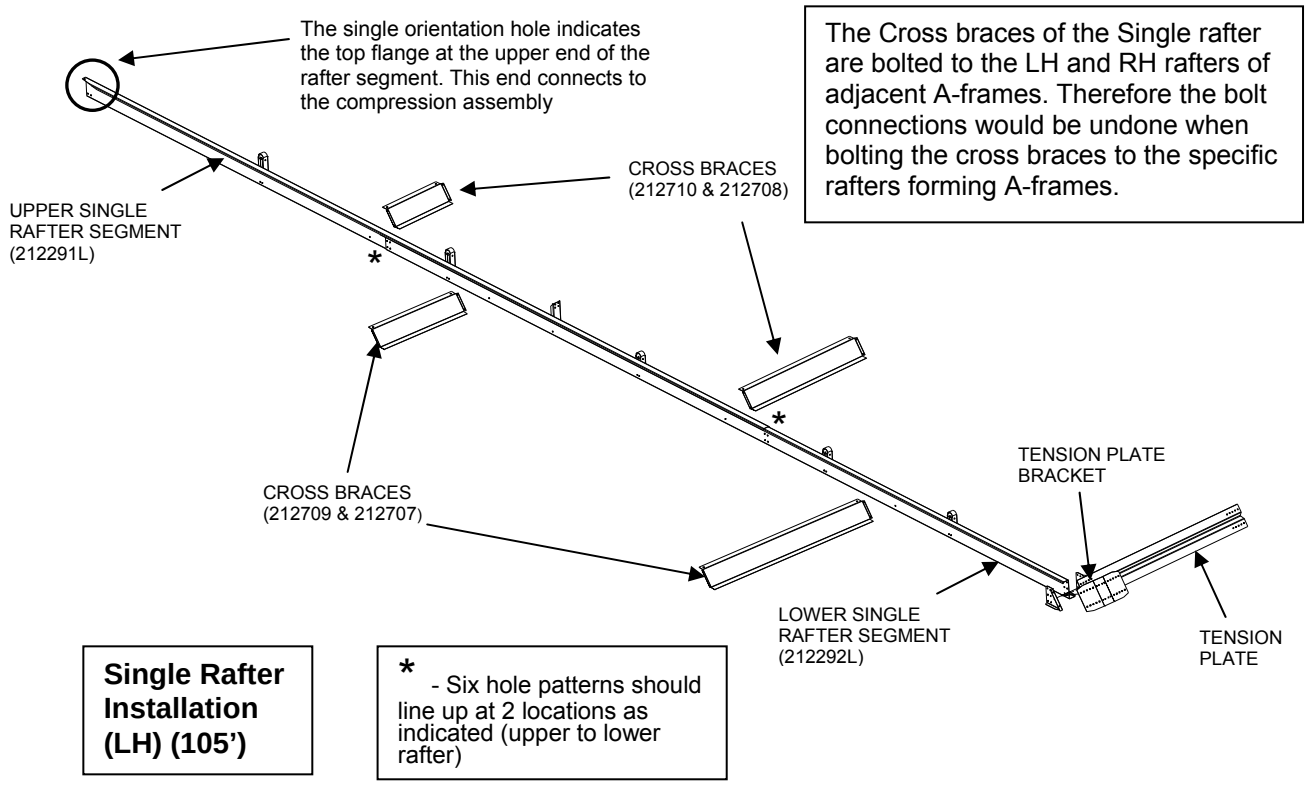
51’ and 75’ single rafters are cross braced on one side (as shown). These cross braces bolt onto the last A-Frame’s RH rafter.

Figure 33. Installing single rafters on 51’ and 75’ bins



105’ single rafter is cross braced on both sides (as shown). These cross braces bolt onto the RH and LH rafters of adjacent A-frames.

Figure 34. Installing Single Rafters on 105' Bins



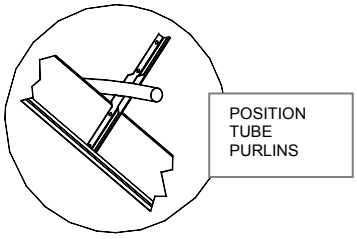
d. Ensure the tension plates between the A-frames and the single rafter are bolted.

5.6.7 Attach Tube Purlin Brackets

1. Attach tube purlin brackets (if not attached during pre-assembly — see section on Pre-Assembly):
   a. Lay the tube purlin across a number of tube purlin brackets.

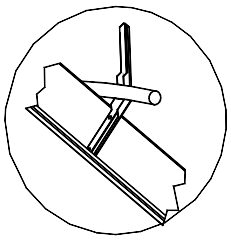
      The tube purlin bracket should have been installed such that it is open to the top as shown.

Figure 35. Position the tube purlin



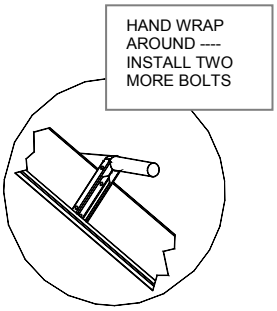
   b. Make sure all tube purlins are seated snugly into their brackets, then bend the tube purlin bracket around the tube purlin by pulling the free end down and around.

Figure 36. Position the tube purlin



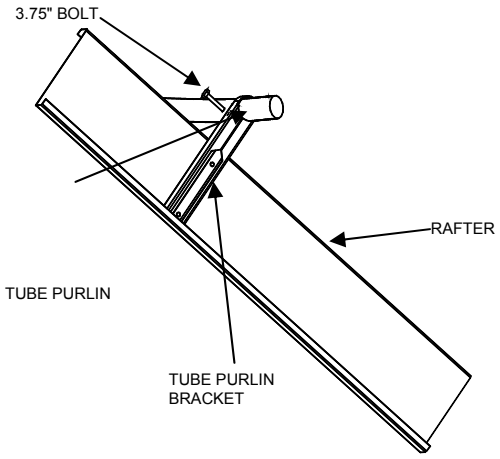
c. Insert a punch to hold and then secure with two more bolts through rafter.

Figure 37. Position the tube purlin



d. Complete the bracket closure by inserting a 3.75" bolt through the bracket just below the tube purlin and tighten.

Figure 38. Position the tube purlin



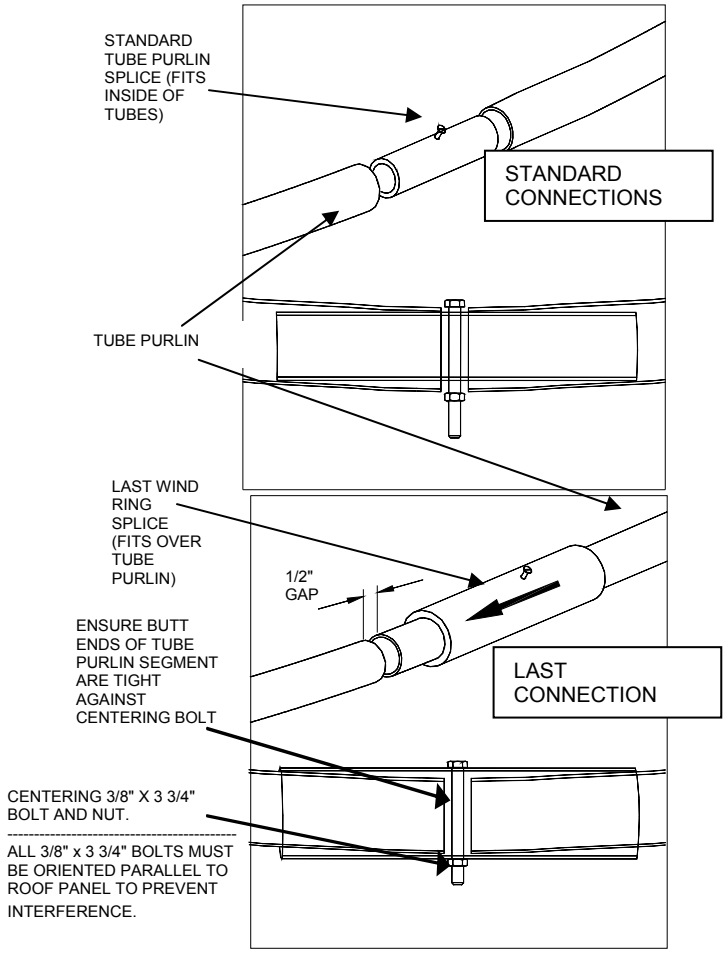
Note

On adjacent rings of tube purlins, stagger the connections so they do not all align.

2. TIMING ALERT: Position the end of the first tube purlin such that it is roughly mid-span between adjacent rafters. Then build from the other end and work your way around. This way the final connection will be made at this mid-span location and will not interfere with a tube purlin bracket location.
3. Join tube purlins together using inside tube purlin splices (standard connection) and one outside wind ring splice (last connection).
4. For all standard connections install the 3/8" x 3 3/4" center bolt as shown and insure mating tubes are pushed tight against the bolt.

5. For the final connection, the last tube purlin may need to be cut to fit. Measure and cut as required allowing for a 1/2" gap for the 3/8" center bolt.
6. Do not cut the tube too short.
7. For the last connection initially slide the outside wind ring splice completely onto one of the tube ends and then position the tube ends such that they are aligned (as shown).
8. Slide the outside tube purlin splice over the ends of both tubes and position such that the center bolt can be installed.
9. Make sure all center bolts are positioned such that they will be parallel to the roof panels to prevent damaging them.

Figure 39. Installing tube purlin splices



Note

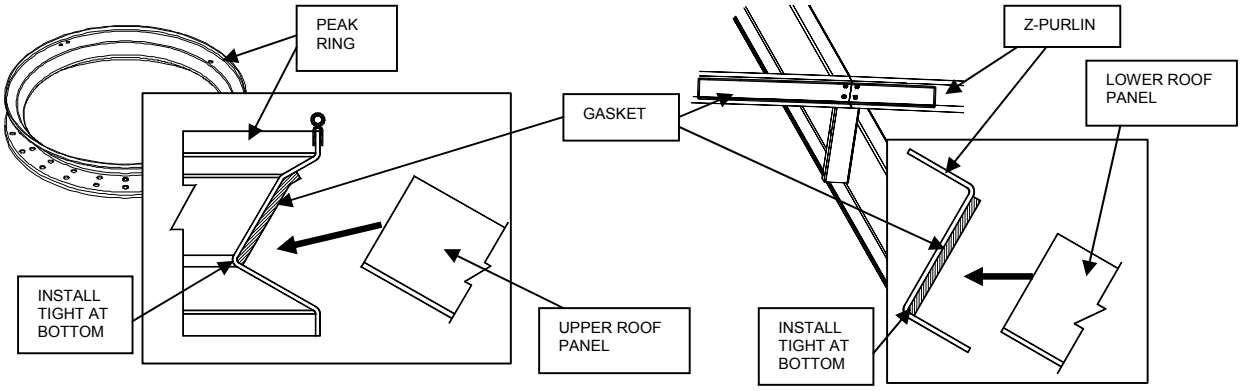
The typical standard joint has a tube purlin splice inserted into mating tube purlins while the last joint uses a larger wind ring splice that slips over the tube purlins.

5.6.8 Seal the Upper and Lower Roof to Peak Ring / Z-Purlin Spaces

The space between the upper roof panels and the peak ring, and the space between the lower roof panels and the Z-purlin, must be sealed with an adhesive backed gasket.

1. Make sure the surface of the peak ring and purlin are clean and dry for proper sealing.
2. Make sure there is no gap at the bottom of the gasket to ensure a tight seal when applying the gasket material.
3. Install the gaskets.

Figure 40. Sealing Roof to Peak Ring and Roof to Z-Purlin Spaces

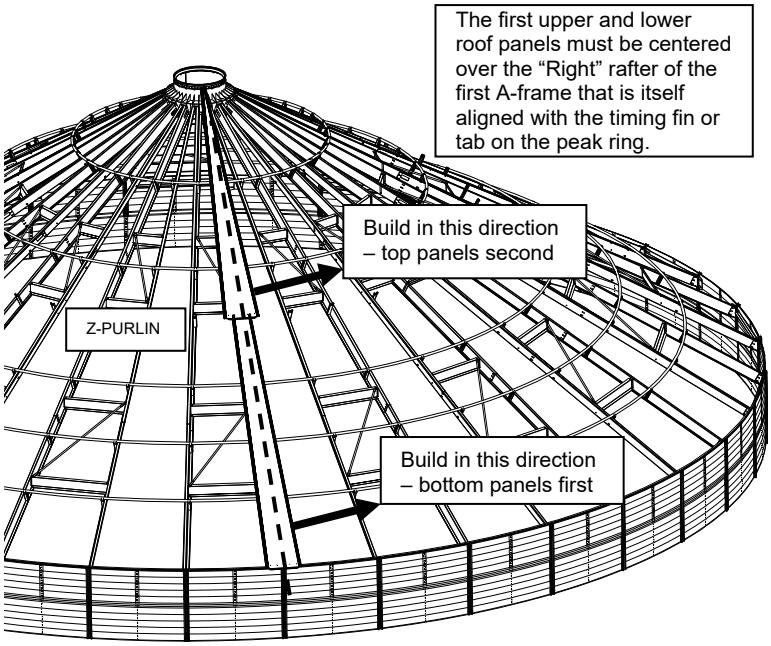


5.6.9 Attach the Roof Panels

The top roof panels span from the peak ring to the top flange of the Z-purlin. The lower roof panels span from the lower flange of the Z-purlin to the top ring angle. If all of the timing alerts provided earlier were followed the holes in the roof panels should align.

1. The lower roof panels should be installed first to avoid interference with the overhang of the top roof panel.
2. Successive roof panels should be installed in a counterclockwise rotation such that the left rib of the next panel (when viewed from the eaves) covers the right rib of the previous panel.

Figure 41. Attaching Roof Panels



3. TIMING ALERT: When bolting on roof panels, the first upper panel and the first lower roof panel must be centered on the right—hand rafter of the first A-frame that is itself aligned with the timing fin or tab on the peak ring.

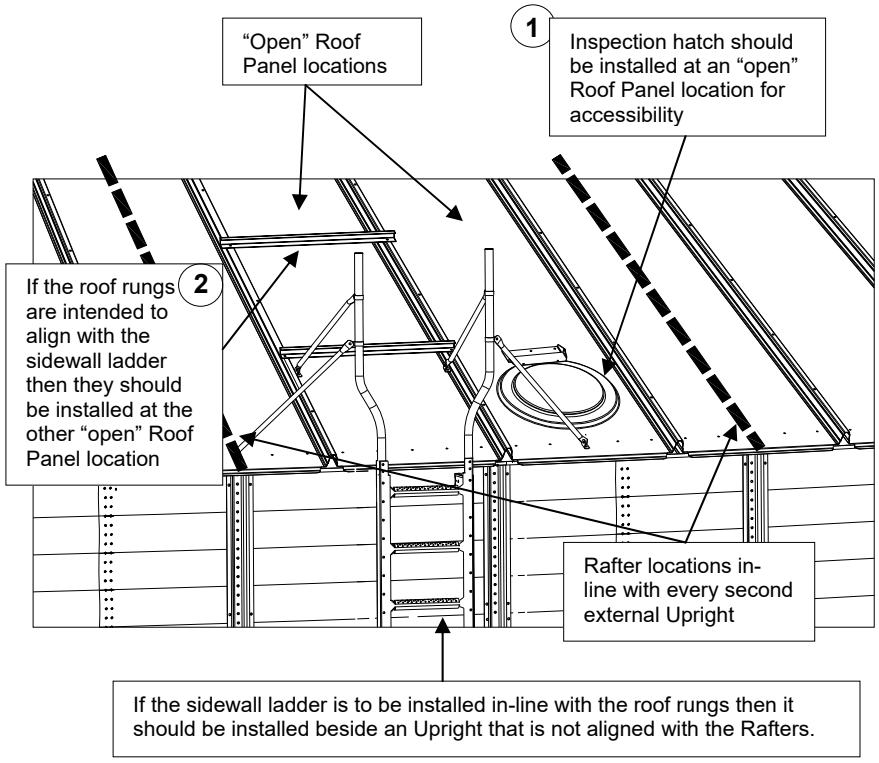
   Remember

   Evenly distribute vent roof panels around the roof as you build.

   ⚠ WARNING Do not walk on roof panels or severe damage or injury can occur. Roof panels are designed for a distributed load, not a point load.

4. TIMING ALERT: Remember to install the inspection hatch roof panel relative to the sidewall ladder and roof rungs. The panels should be chosen as shown in the figure as “open” sites such that the rafter does not interfere while access. Also the roof rungs should be installed on the adjacent roof panel at the other “open” location. This is because sidewall ladders are usually installed in-line with the roof ladder and sidewall ladders, when properly installed, should be located beside an upright and not straddle it (see Timing Considerations in Ladder Manual). The “open” locations are the only locations that satisfy all of these requirements.

Figure 42. Installing the inspection hatch roof panel



5. Remember to install vent roof panels where required and as the roof is being assembled.

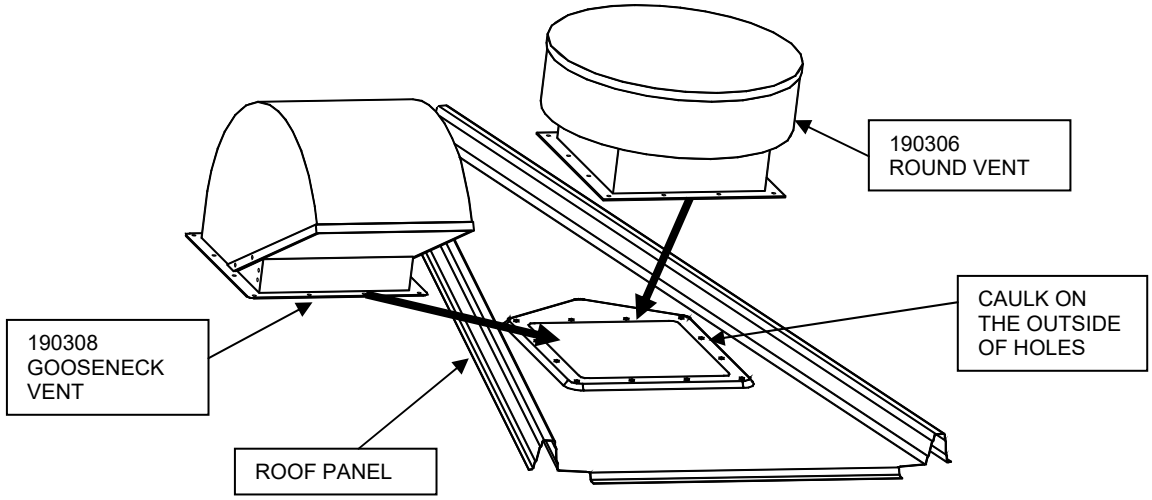
   They should be evenly distributed around the roof in both the top and bottom roof panel rings (if supplied this way) such that they do not interfere with other roof elements such as roof stairs or rungs, temperature cables, etc.

   Westeel supplied roof vents come in two styles: gooseneck and round. Both have pre-formed bolt holes for mounting to the roof panel. The vent roof panels have a raised mount section, mounting holes and a pre-cut ventilation opening. No on-site cutting is required.

   a. Assemble the vents to the roof panels at ground level before installing.

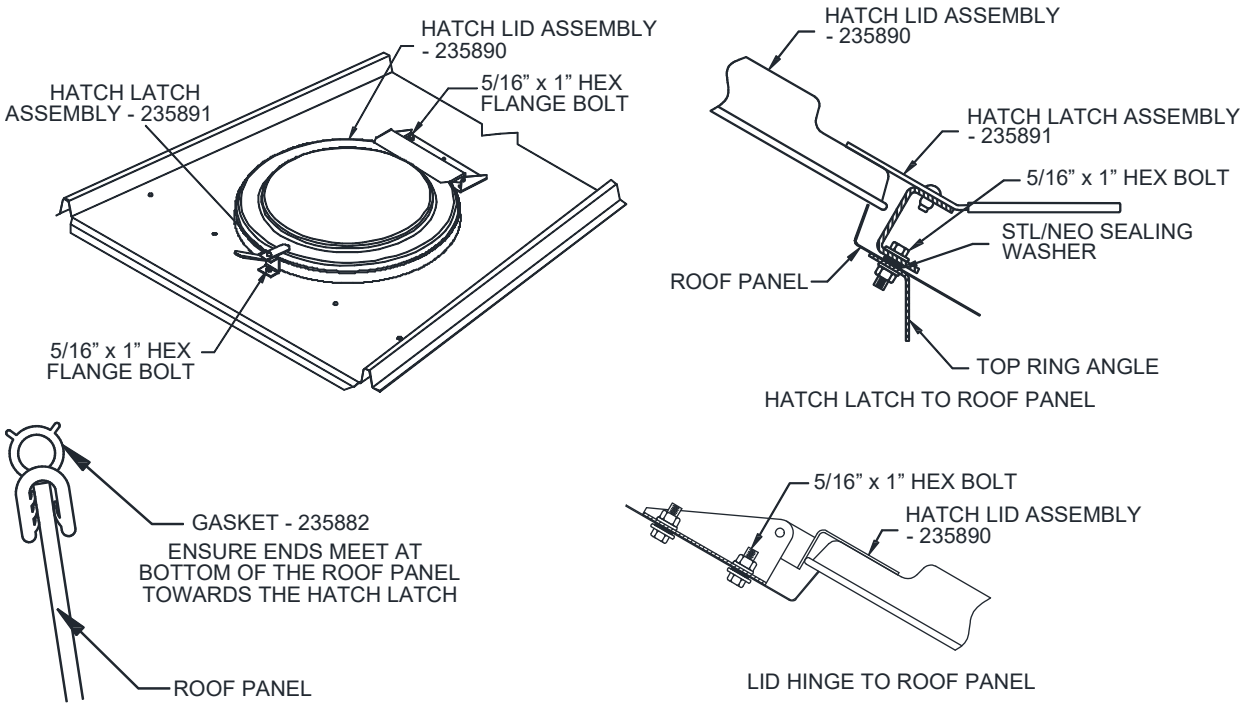
   b. Place a strip of caulking all the way around the weather side of the connection, position the vent, and bolt into place.

Figure 43. Sealing the Vent to Roof Connection



6. Install the inspection hatch components:
   a. Place inspection hatch gasket (235882) around lip of inspection hatch opening. Trim the gasket to fit if necessary.
   b. Bolt on the hatch lid assembly (235890) with 5/16” x 1” bolts provided for the roof. For best sealing results, the bolt heads should be on the underside of the roof panel, with the sealing washers pressed against the roof panel.
   c. Bolt on the latch assembly (235891) as shown below. The latch is positioned on the center hole of the roof panel and bolts through the top ring angle as shown.

Figure 44. Sealing the Inspection Hatch to Roof Connection



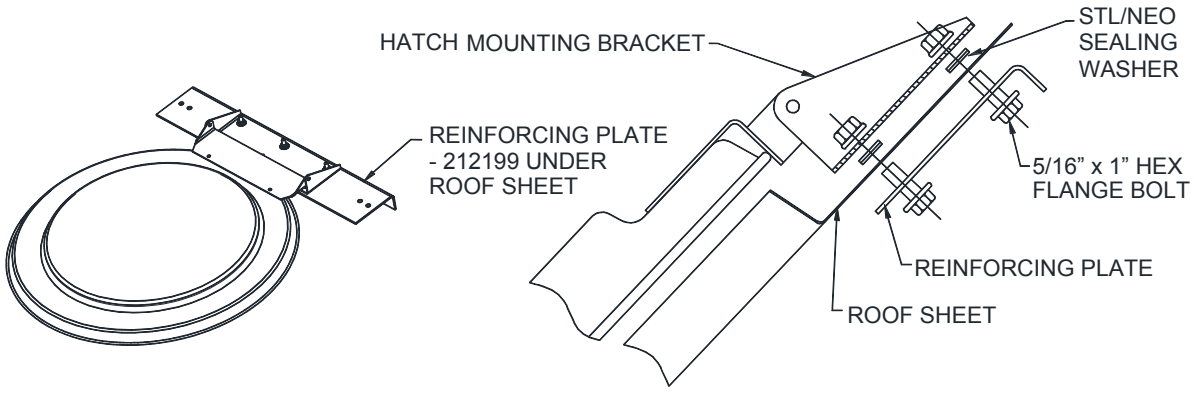
7. Install the inspection hatch reinforcing plate:

a. For high wind applications, place the inspection hatch reinforcing plate under the roof sheet and secure with 5/16” x 1” hex flange bolts and nuts.

b. The flange on the plate must be located away from the hatch opening to minimize the possibility of interference or injury with inspector.

c. The four outermost mounting holes are used for extra stiffening when the roof sheet width permits. Field drill the roof sheet as needed.

Figure 45. Inspection Hatch Reinforcing Plate Detail



5.6.10 Install Bird Stops

Bird stops are required at the bottom end of all roof panel ribs (top and bottom panels). They consist of a metal bird stop bracket, an adhesive backed foam closure and a nut and bolt.

1. Consider installing bird stops before attaching the roof panels (easier access to bolts and aids with timing).

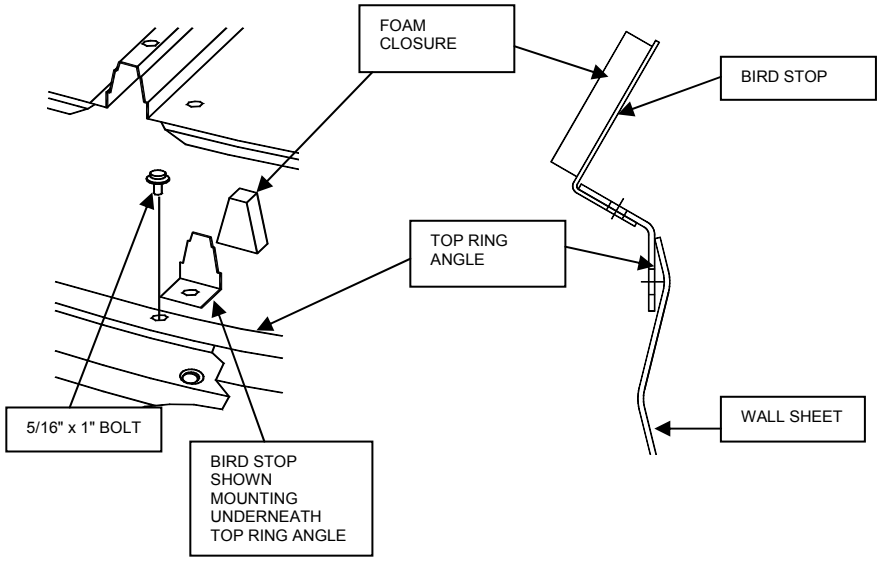
   Bird stop mounting locations are five holes to the left or right of the roof panel center mounting holes in the top ring angle and at the square hole locations in the Z-purlins.

2. The method shown here has the bird stop mounted under the top ring angle. Other installation methods are acceptable

   Note

   Mounting the bird stop under the top ring angle prevents it from turning when tightening the nut. Other methods of installing are acceptable.

Figure 46. Bird Stop Installation Detail



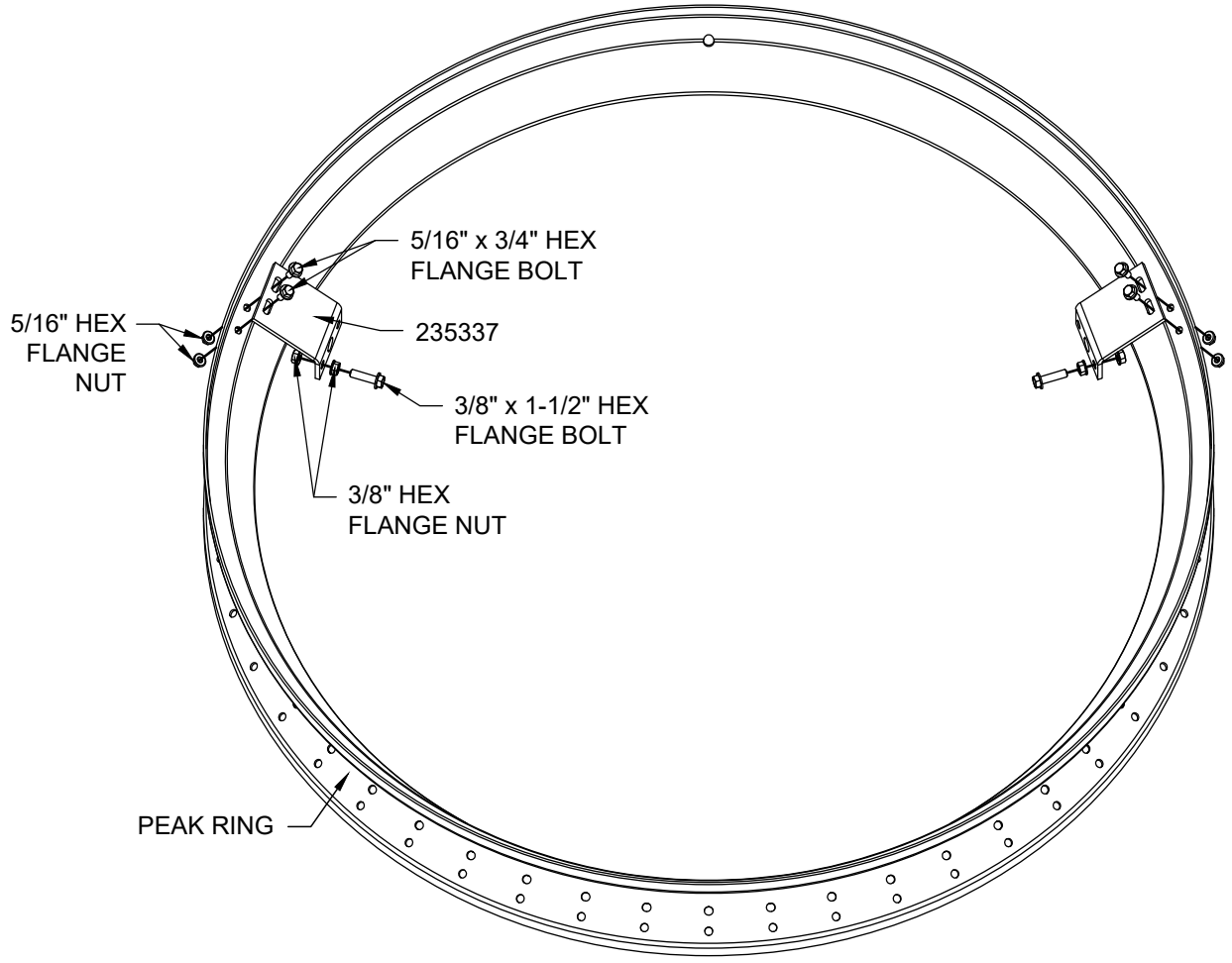
5.6.11 Dismantle the Installation Stairs and Platform

When the entire roof structure is stable and self supported:

1. Dismantle the installation stairs and platform
2. Move the equipment out of the interior, either under the wall sheets or out a roof opening.
3. Remove the center pole.

5.6.12 Remote Roof Cap Opener System for 60' Bins

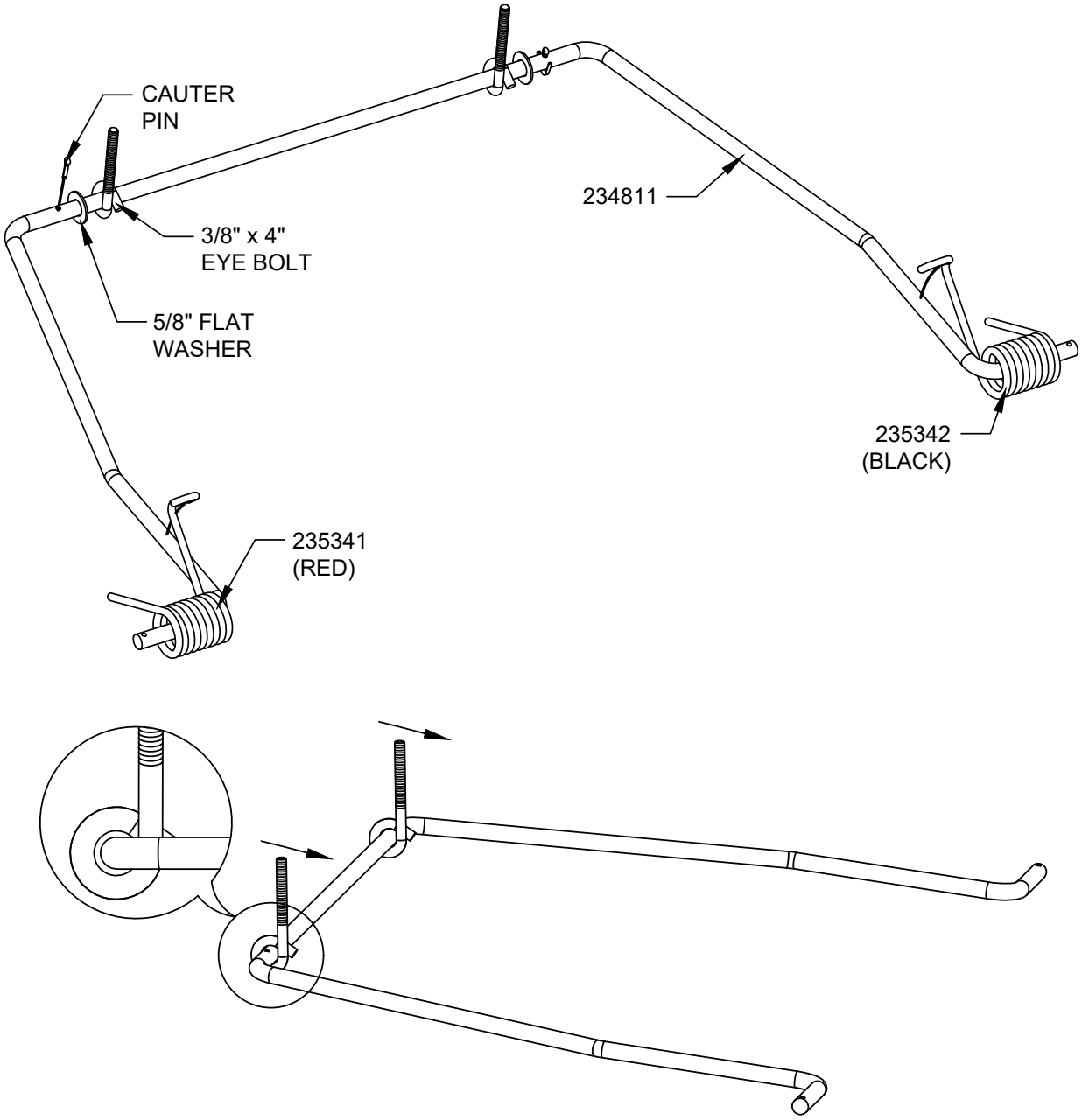
Install the Pivot Arm Brackets



Note

The brackets are interchangeable, right to left.

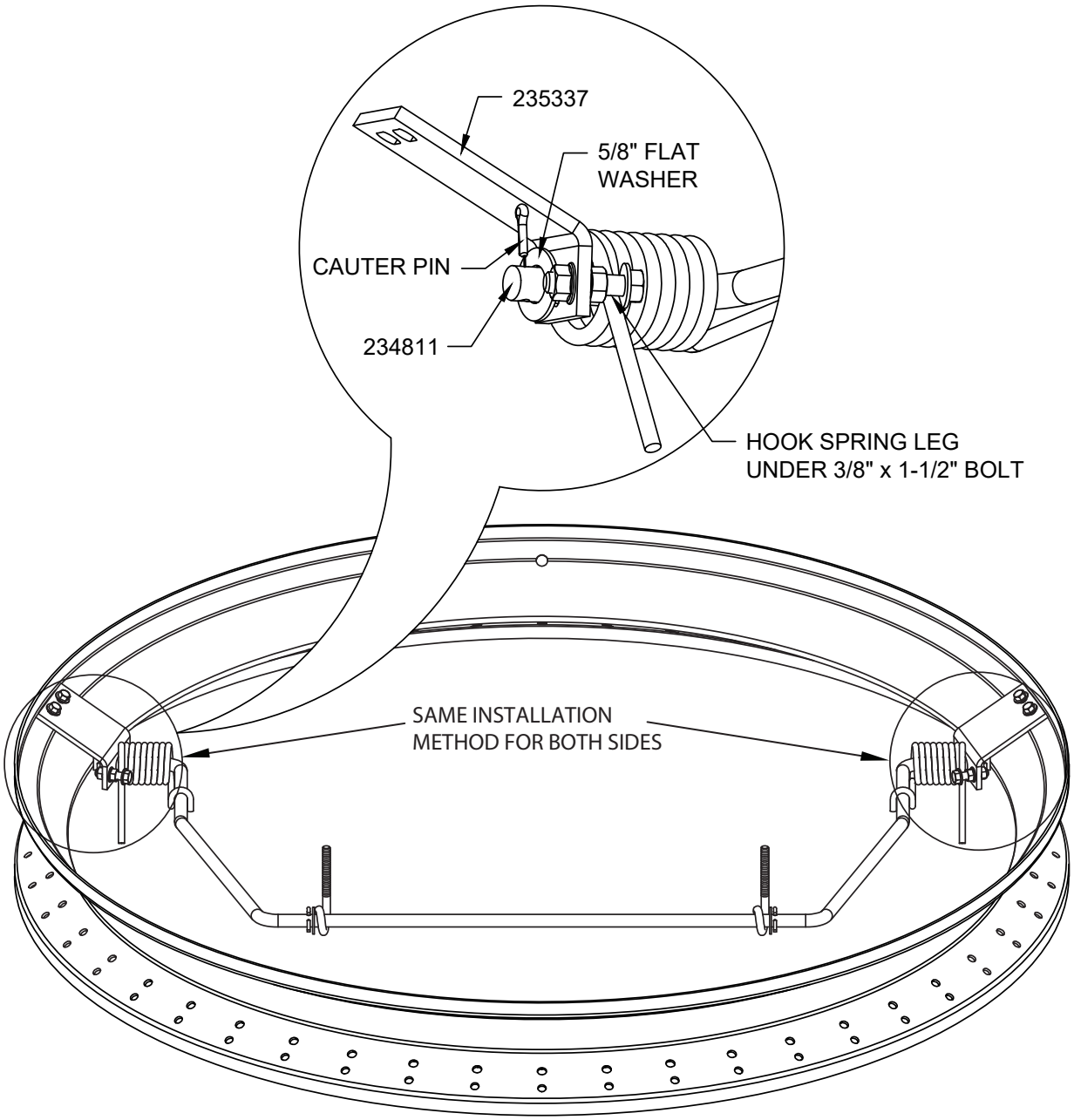
Install the Pivot Arm Hardware



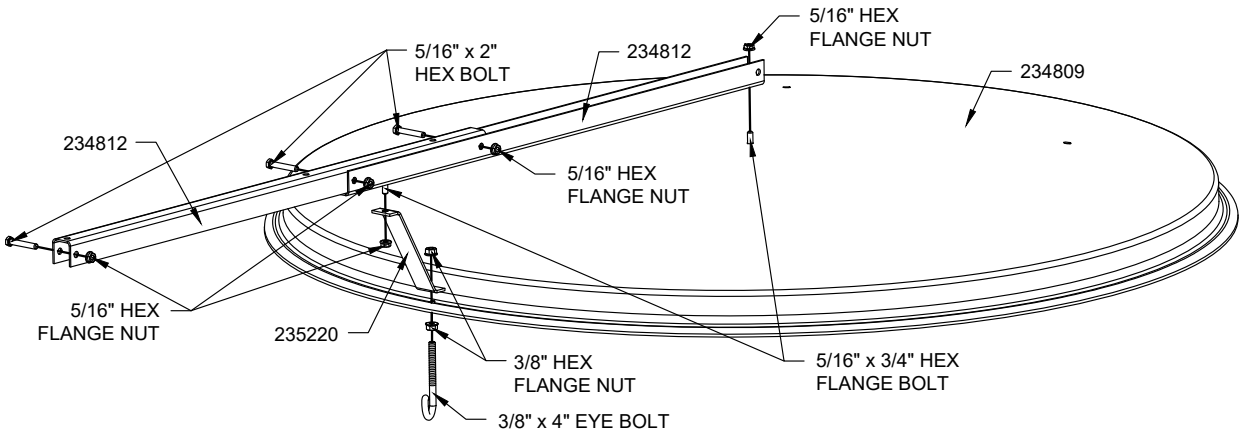
Important

Critical assembly feature — threaded rods of both eye bolts must be positioned towards the inside of the pivot arm.

Install the Pivot Arm to the Brackets



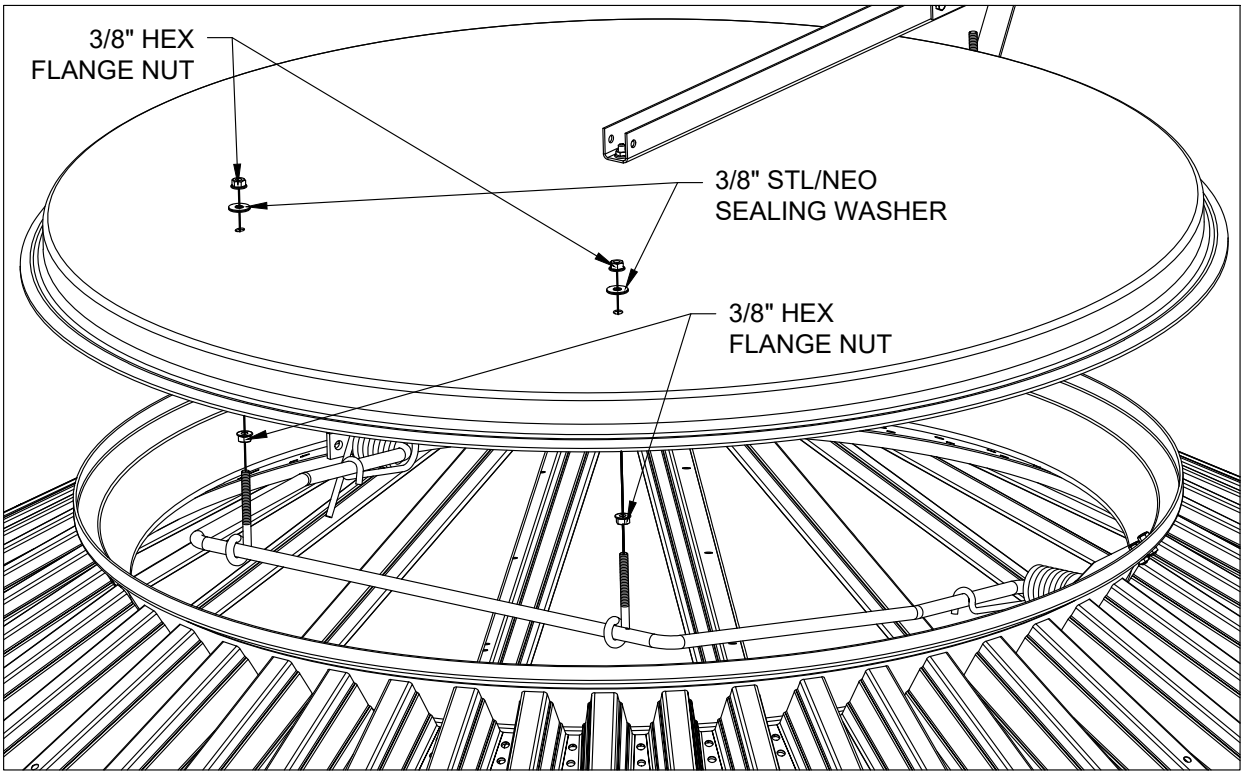
Pre-assemble the Roof Cap



Important

Do not tighten the 3/8" x 4" eye bolt until the slide rod has been fully installed.

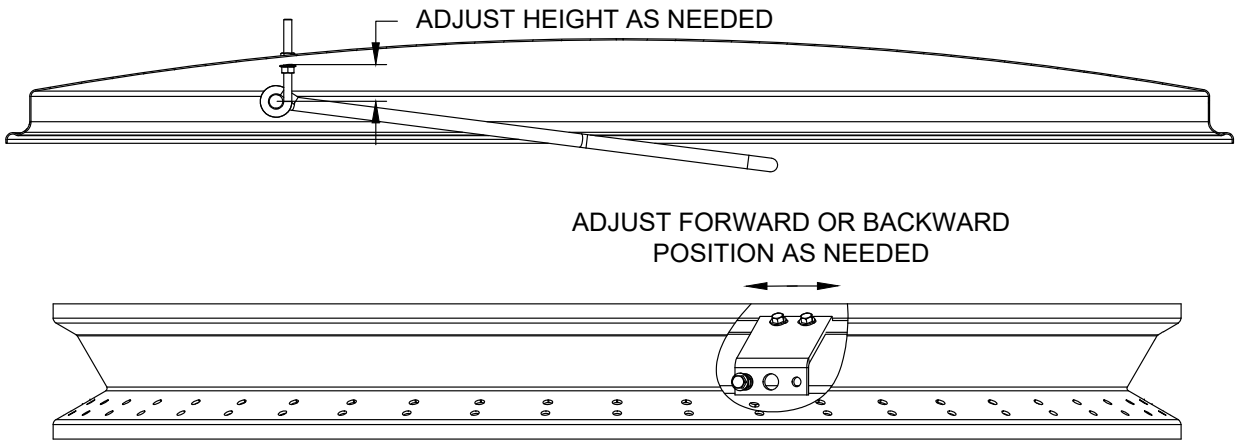
Install the Roof Cap to the Pivot Arm



Note

To help with installing the pivot arm eye bolts to the roof cap, rotate the pivot arm up and over the top of the peak ring. Then place a 2x4 across the peak ring, under the pivot arm.

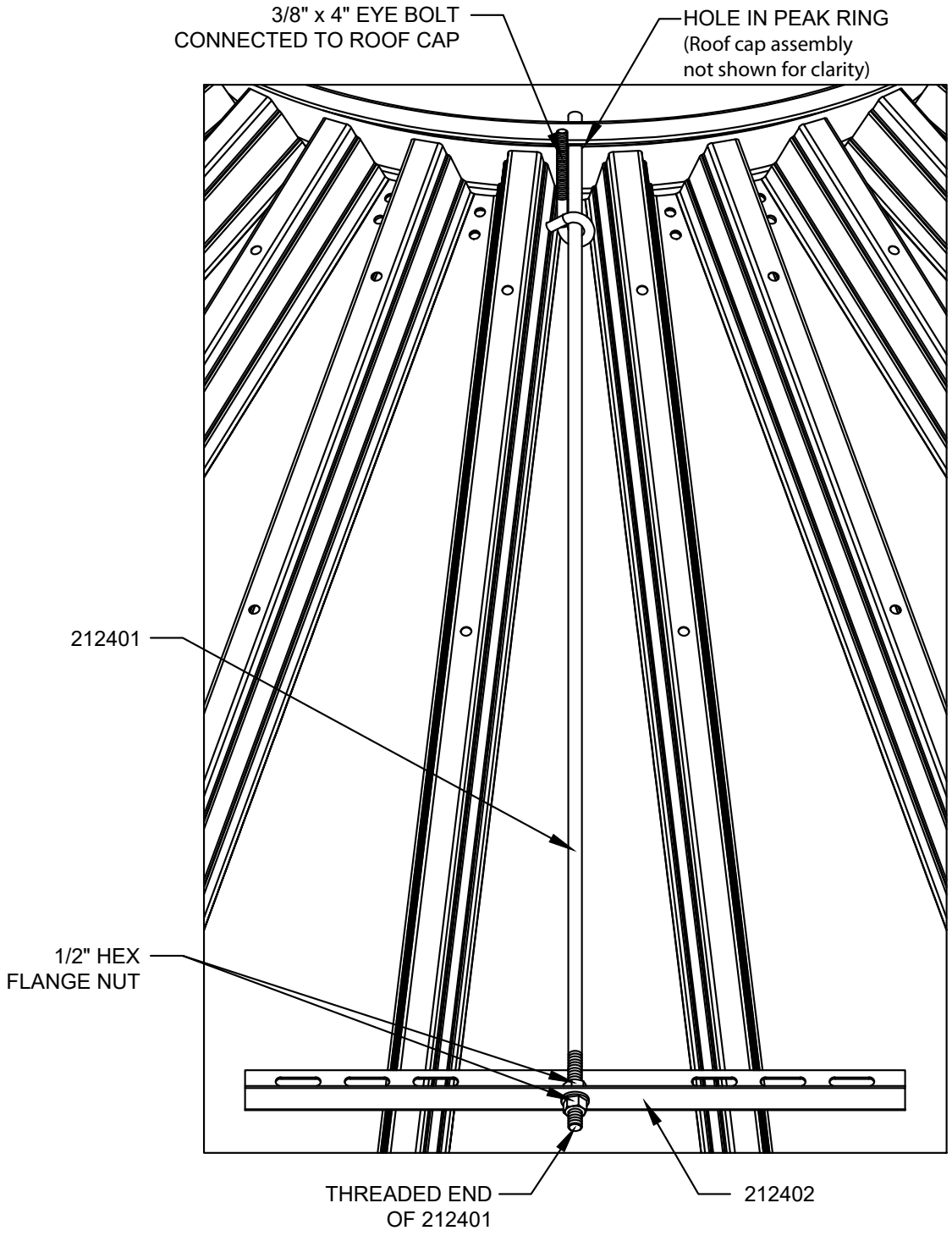
Center the Roof Cap



Note

Adjust position of pivot arm brackets in combination with pivot arm eye bolt nut height to center roof cap on peak ring.

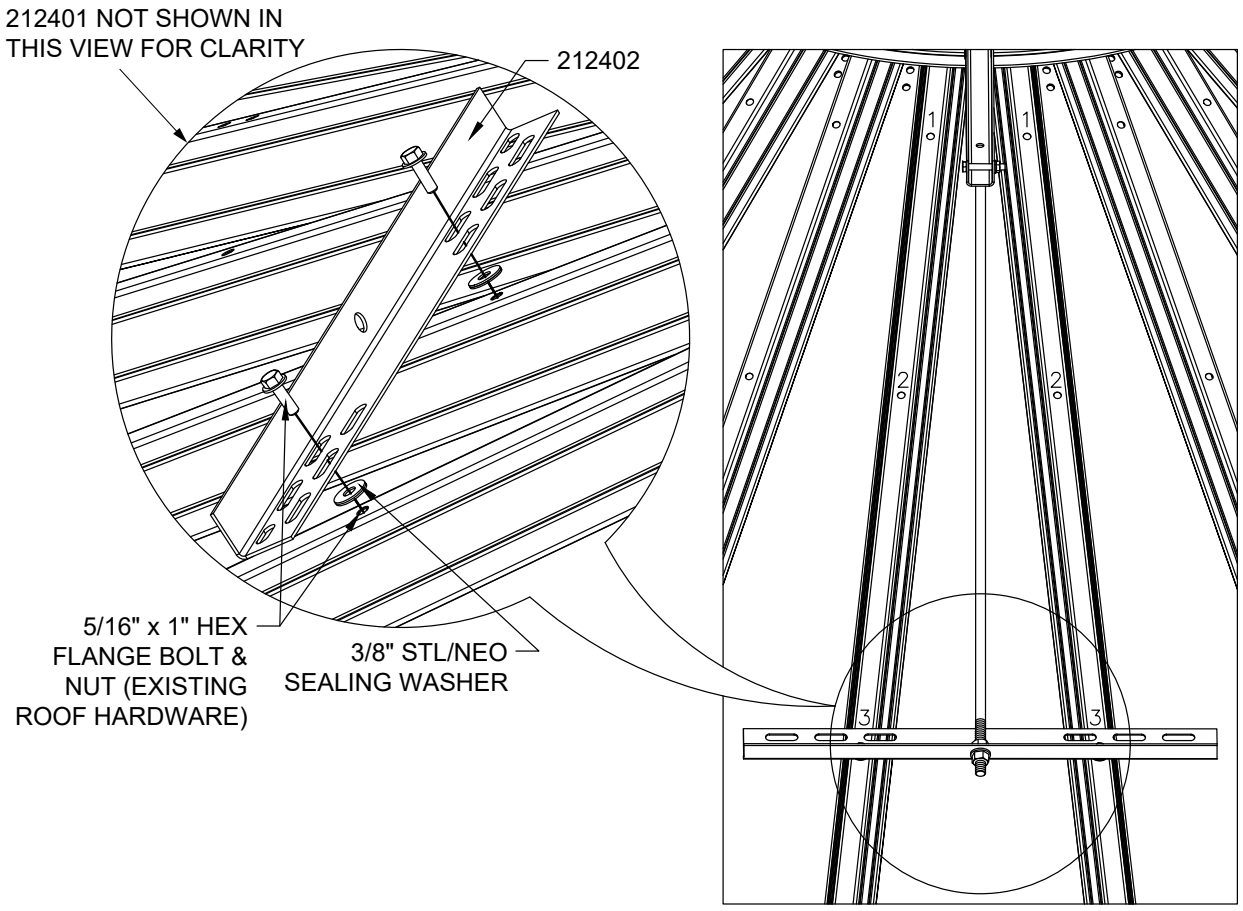
Install the Slide Rod



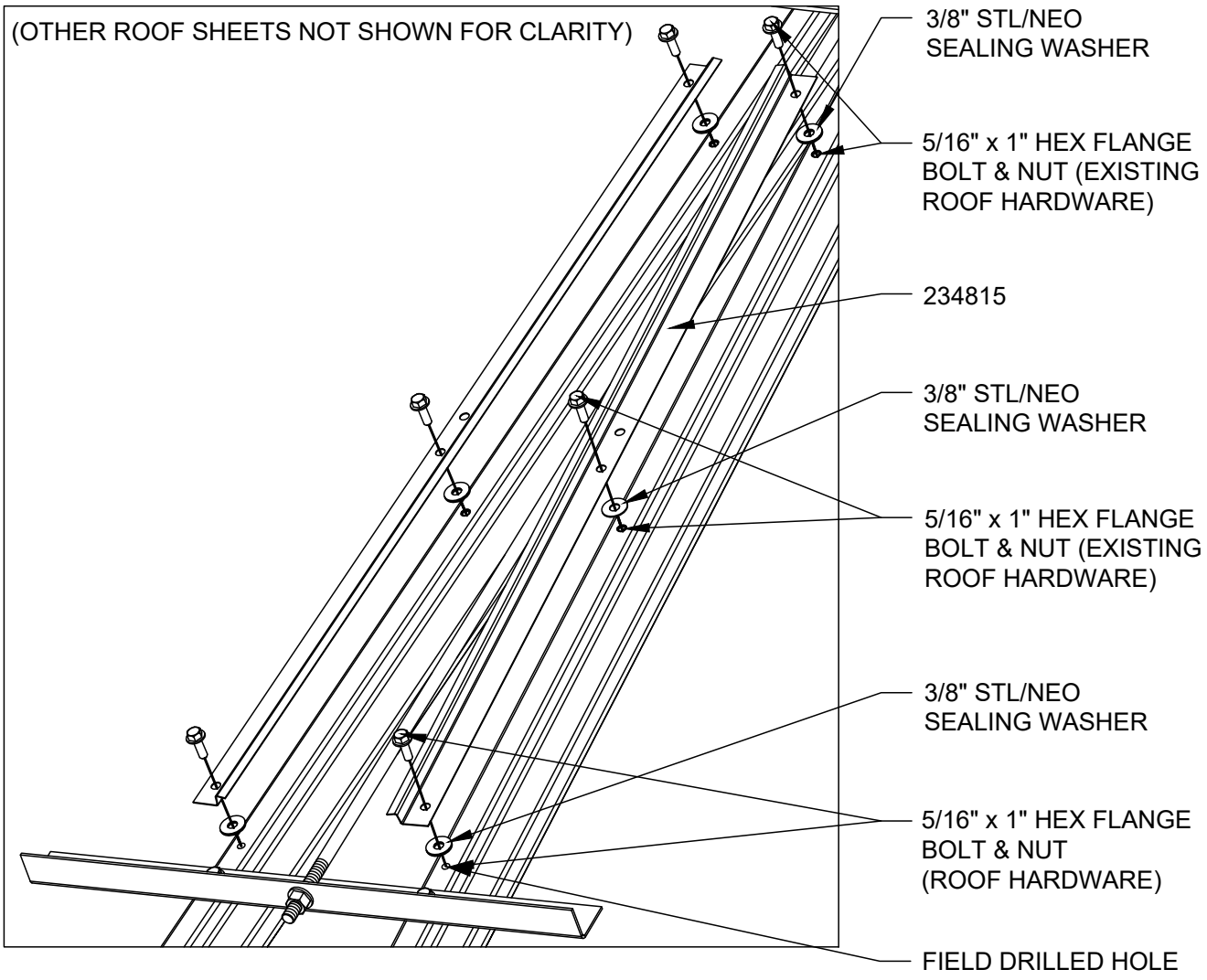
Note

Adjust the 3/8" x 4" eye bolt so that the roof cap is supported on the slide rod, and tighten the eye bolt hardware.

Install the Slide Rod Bracket



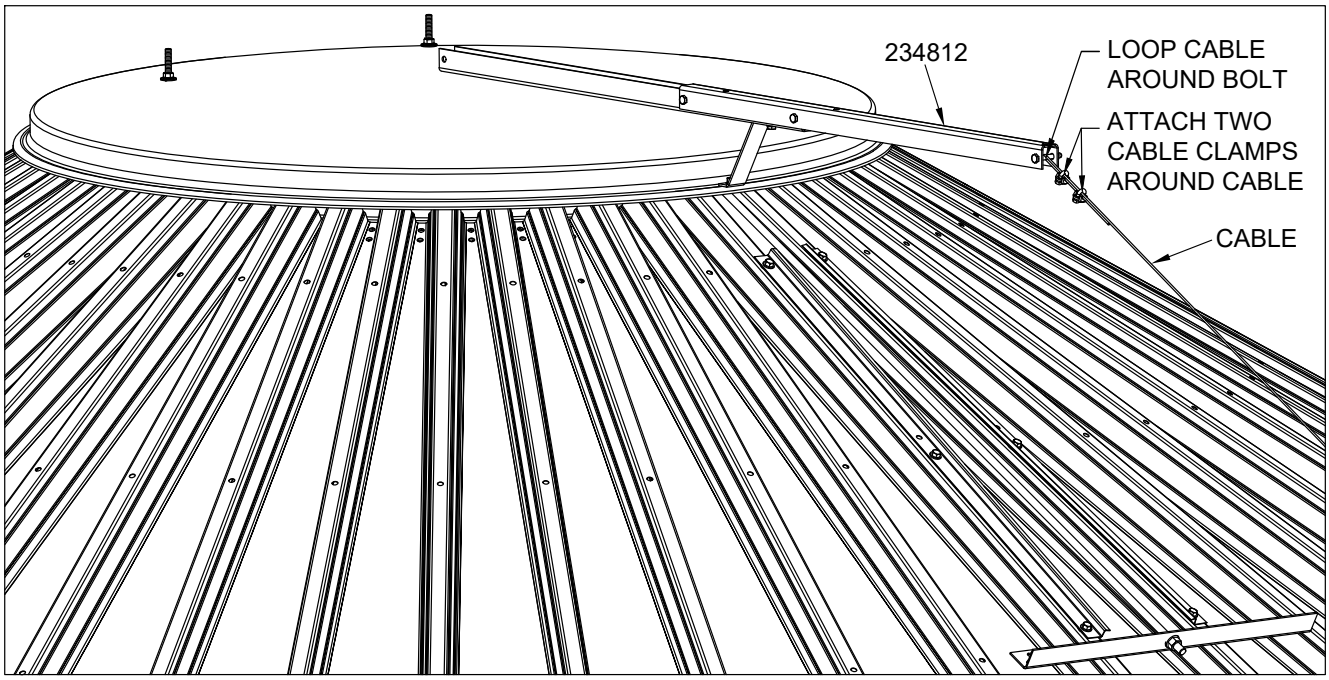
Install the Guide Rails



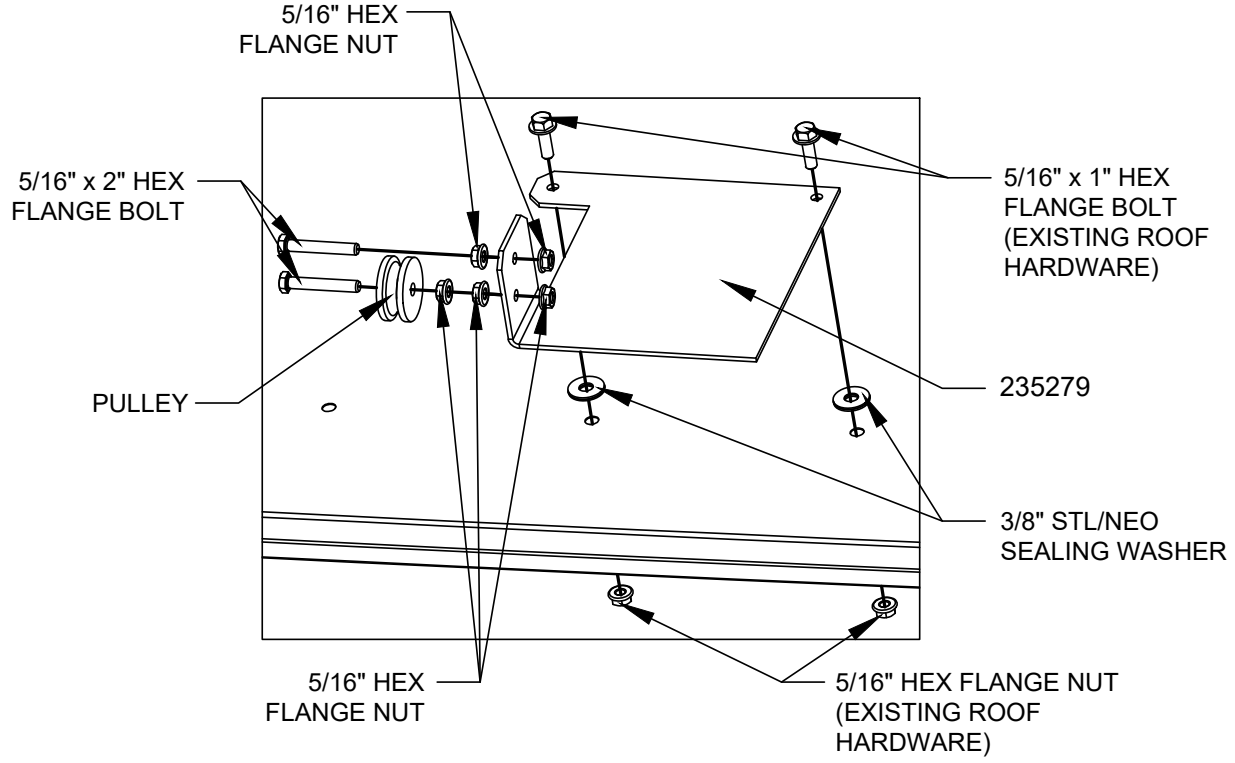
Note

Guide rails are interchangeable, right to left.

Attach the Cable to the Roof Cap Assembly



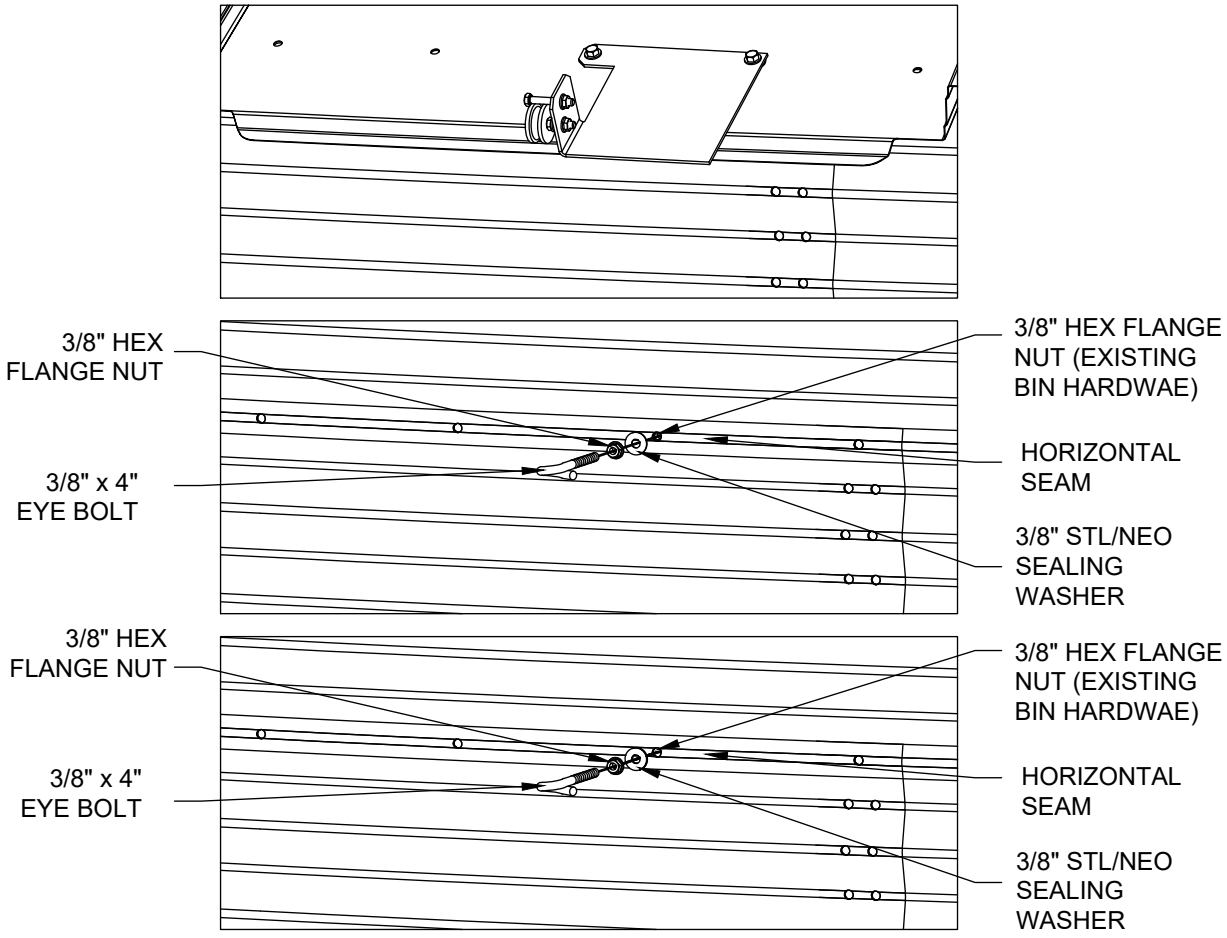
Install the Eave Guide Plate



Note

Align the pulley with the center of the roof sheet.

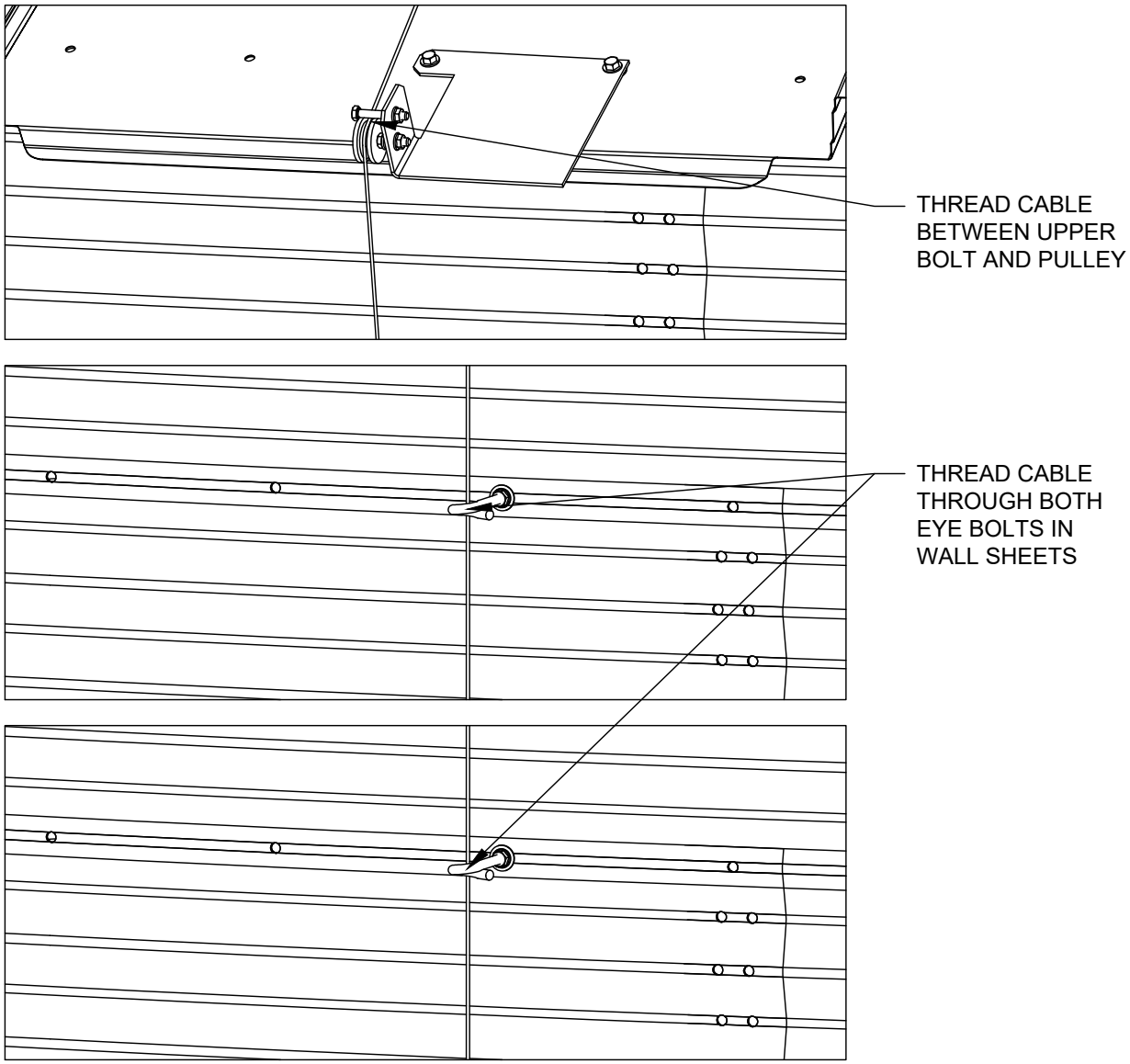
Install the Down Bin Eye Bolts



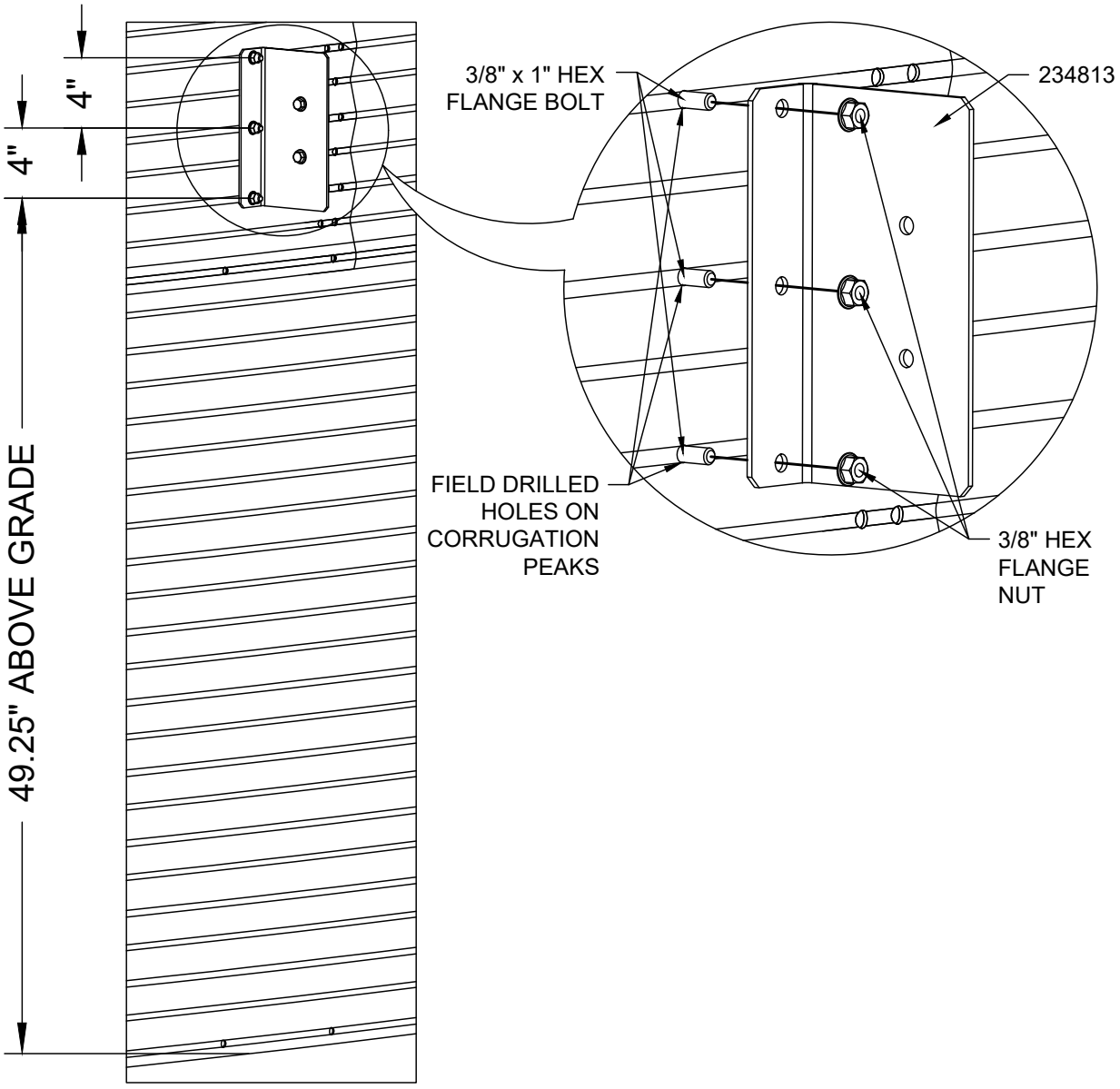
Note

Ensure eye bolts installed at horizontal seams are vertically aligned with the pulley. Space the eye bolts so there is an even distance between the eave guide plate, down bin eye bolts, and winch.

Thread the Cable Through the Eye Bolts



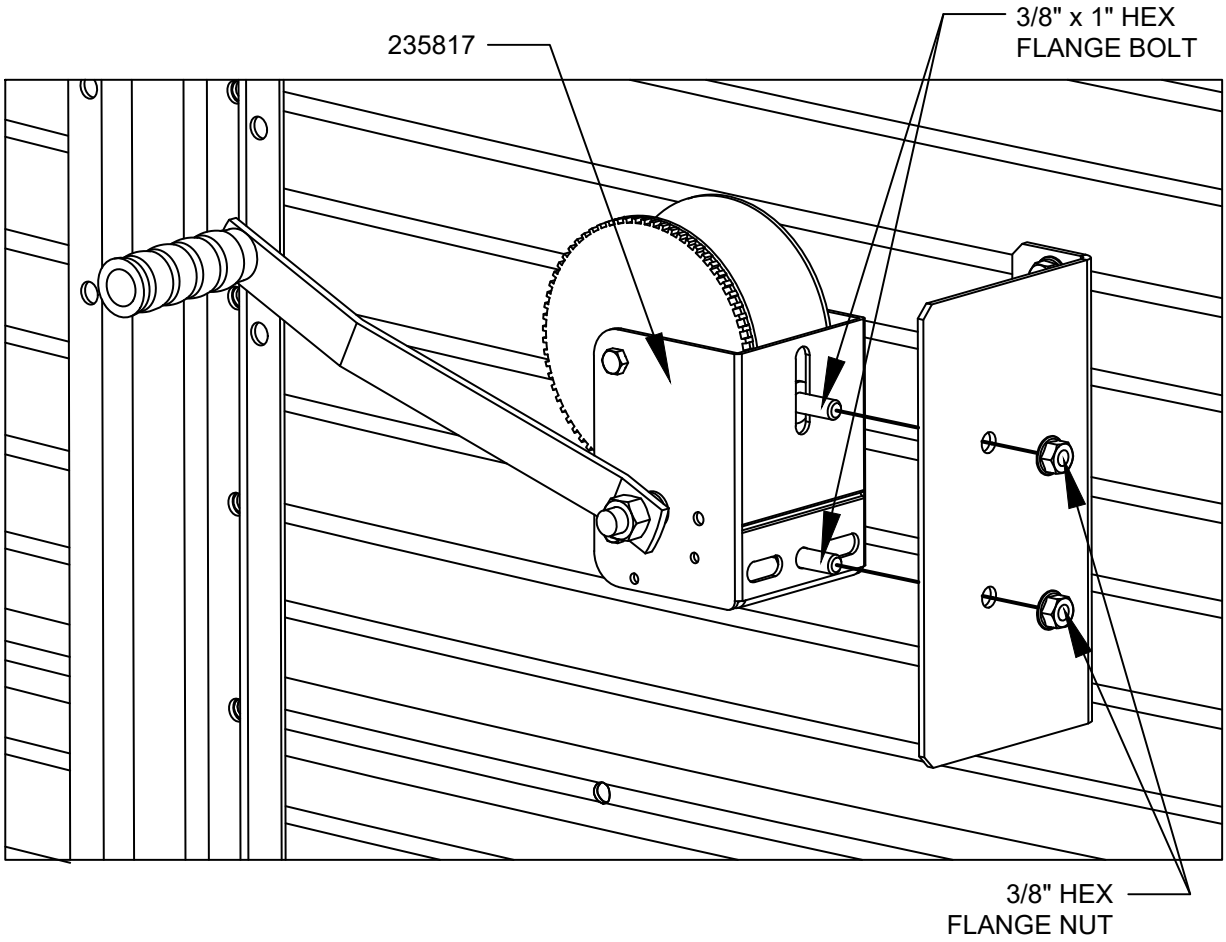
Install the Winch Bracket



Note

Ensure 234813 is offset approximately 3" from being vertically aligned with eye bolts installed at horizontal seams. This will ensure the drum of the Winch will be vertically aligned with the eye bolts.

Install the Winch



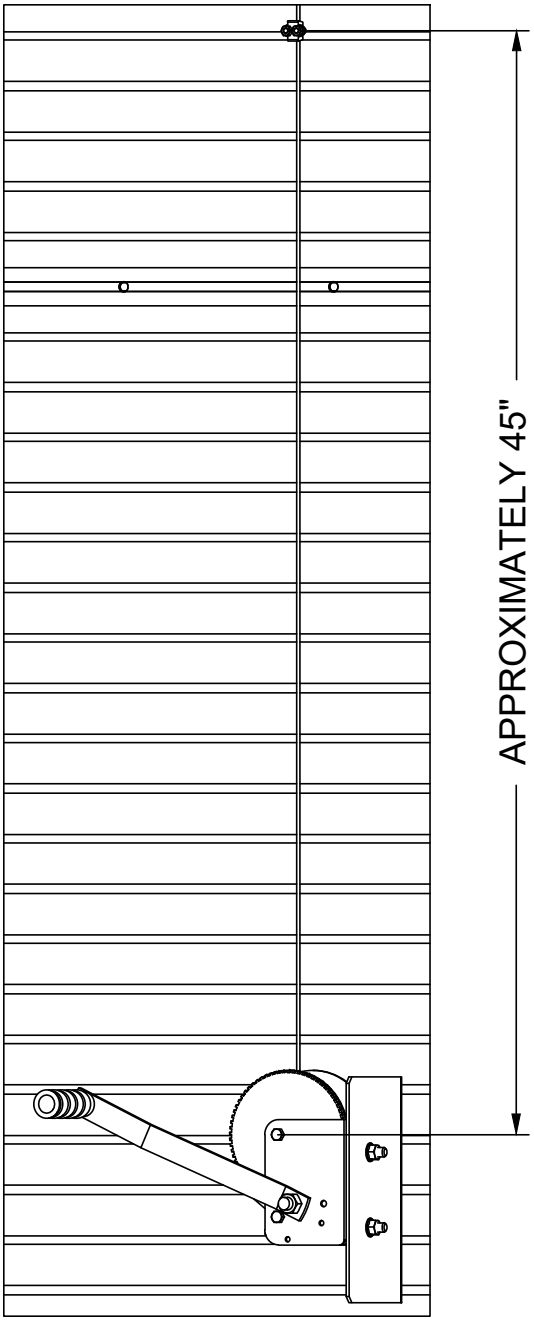
Note

Assemble the Winch as per the instructions supplied within the winch box.

Important

If installed on a stiffened bin, ensure the winch handle or cable does not interfere with any of the stiffeners.

Install the Indicator for Open Cap



1. Attach the cable to the winch as per the instructions supplied within the winch box.
2. With the lid closed, attach a cable clamp approximately 45" above the middle of the winch drum. This will act as the indicator for when the cap is fully opened.
3. Adjust the height of the cable clamp as needed for a more open, or more closed cap.
4. Do not increase the height to more than 50" as this may cause damage to the RCO assembly.

Remote Roof Cap Material List

Table 9. Remote Roof Cap Material

Item	Description	P/N	Quantity
1	ROPE ARM	234812	2
2	PIVOT ARM	234811	1
3	PIVOT ARM BRACKET	235337	2
4	SLIDE ROD	212401	1
5	SLIDE ROD ANGLE	212402	1
6	CABLE	235800	1
7	ROPE ARM SUPPORT	235220	1
8	GUIDE RAIL	234815	2
9	CABLE GUIDE EAVE PLATE	235279	1
10	WINCH	235817	1
11	WINCH BRACKET	234813	1
12*	5/32" X 1-1/4" COTTER PIN	154952	6
13*	3/8" STL/NEO SEALING WASHER	193775	20
14*	5/16" X 3/4" HFW BOLT	193801	10
15*	5/16" X 2" HEX BOLT	234588	6
16*	5/16" HEX NUT	193729	5
17*	5/16" HEX FLLK NUT	235923	25
18*	5/8" FLAT WASHER	154954	6
19*	3/8" x 4" EYE BOLT	150013	5
20*	3/8" x 1-1/2" HFW BOLT	235946	2
21*	3/8" HEX FLLK NUT	235955	15
22*	1/2" HEX FLLK NUT	154201	2
23*	RIGHT HANDED SPRING (RED)	235341	1
24*	LEFT HANDED SPRING (BLACK)	235342	1
25*	CABLE PULLEY	235224	1
26*	CABLE CLAMP	235804	5
27	PEAK RING BULB GASKET	195150	1

- Items 12 to 26 are packaged in a poly-bag, P/N 234805, and found in RCO Hardware Box, P/N 234807.
- Item 27 is supplied in the structural roof kit.

5.6.13 Flat Roof Cap Assembly

Figure 47. Flat Roof Cap Assembly Detail

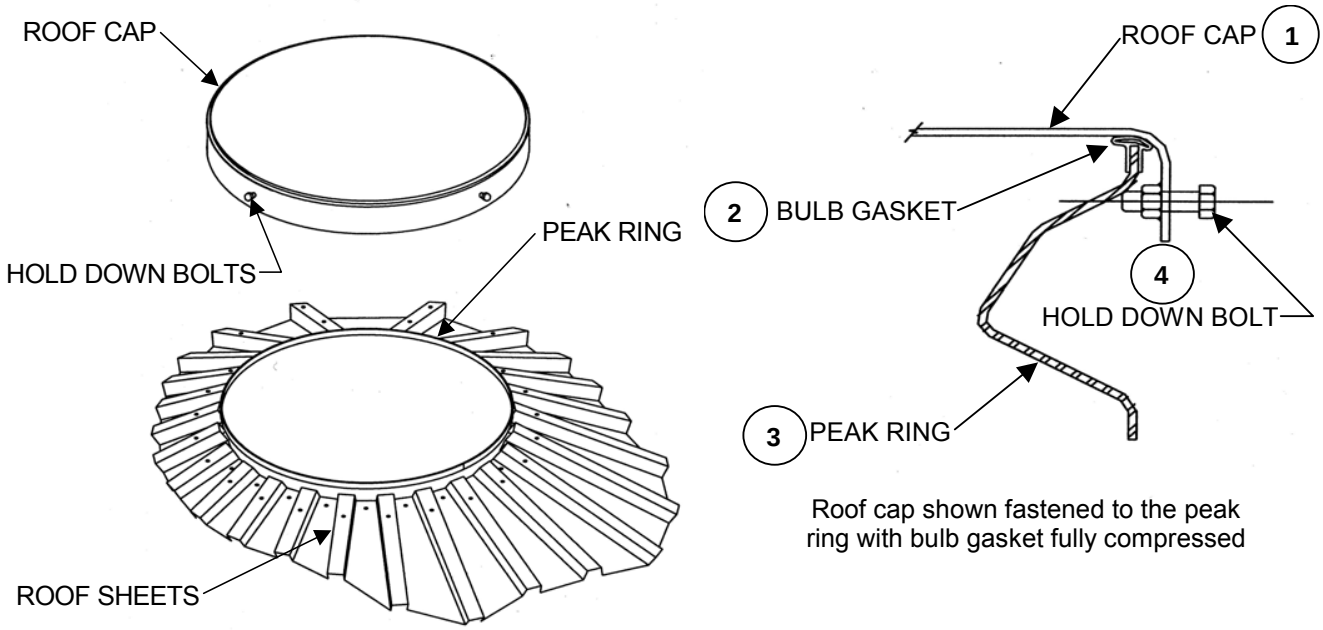


Table 10. Flat Roof Cap Part Numbers

Item	Description	Part No.	Used On
1	34" HEAVY DUTY FLAT CAP (for use with 33" peak ring)	195090	up to 27' Bin
	53.5" HEAVY DUTY FLAT CAP (for use with 52" peak ring)	195087	30' to 48' Bin
	61.5" HEAVY DUTY FLAT CAP (for use with 60" peak ring)	195091	51' & 54' Bin
2	PEAK RING BULB GASKET 105" LONG	195149	up to 27' Bin
	PEAK RING BULB GASKET 168" LONG	195150	30' to 48' Bin
	PEAK RING BULB GASKET 105" LONG	2 x 195149	51' & 54' Bin
3	3/8" x 1-1/2" HEX FLANGE BOLT (supplied with the lid)	193797	All

1. Fasten the bulb gasket onto the top rim of the peak ring. Trim to fit.
2. Place the roof cap on the peak ring with two of the hold down bolts, making sure they are clear of the roof ladder.
3. Locate bolts between the roof ribs.
4. Tighten the hold-down bolt opposite the roof ladder until approximately 3/8" of the bolt is protruding past the welded nut.
5. Tighten the two bolts near the roof ladder until the roof cap pulls down firmly and cannot be moved.
6. Tighten all other roof cap bolts similarly.
7. Ensure that the roof cap is fully secured around the peak ring.
8. For a non-structural roof that is supporting a catwalk, install six flat cap clips (213437) as shown in the Westeel catwalk manual 213440. These clips are provided in the Westeel catwalk peak support modules.

5.7. Peak Supports

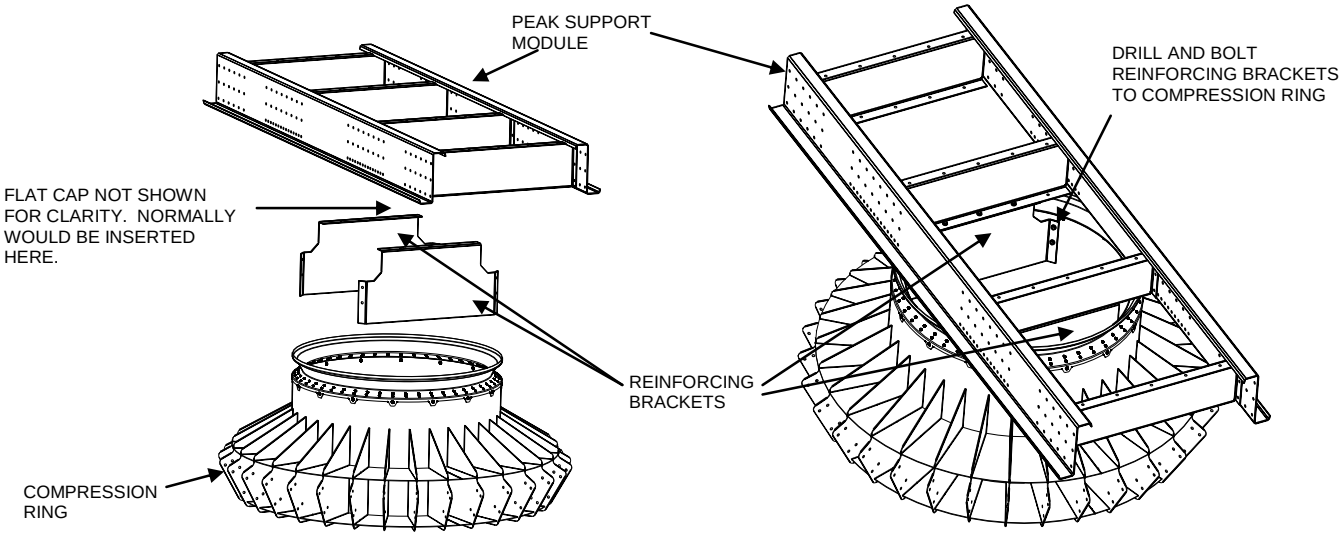
Note

The following peak support sections only apply if a Catwalk is going to be supported on the Westeel structural roof. The reinforcing brackets are not required for structural roofs that do not support a Catwalk.

5.7.1 Westeel Peak Support

Two reinforcing brackets (provided) are installed underneath the flat cap. They utilize the same bolts that secure the peak support to the flat cap. The reinforcing brackets provide vertical and lateral support across the peak ring. They must be drilled into the compression ring as illustrated (flat cap not shown for clarity). Secure with ½" x 1 ½" hardware.

Figure 48. Peak support to peak ring connection



5.7.2 Non-Westeel Peak Support

1. Install the two reinforcing brackets as shown in Section 5.7.1 – Westeel Peak Support on page 70 using ½" x 1 ½" Gr5 bolts.
2. Use the dimensions for the six holes shown in Figure 49 on page 71 when designing a non-Westeel peak support frame, to allow connection of the frame through the flat cap to the reinforcing bracket below.

Figure 49. Internal reinforcing bracket connection locations to non-Westeel peak support frame

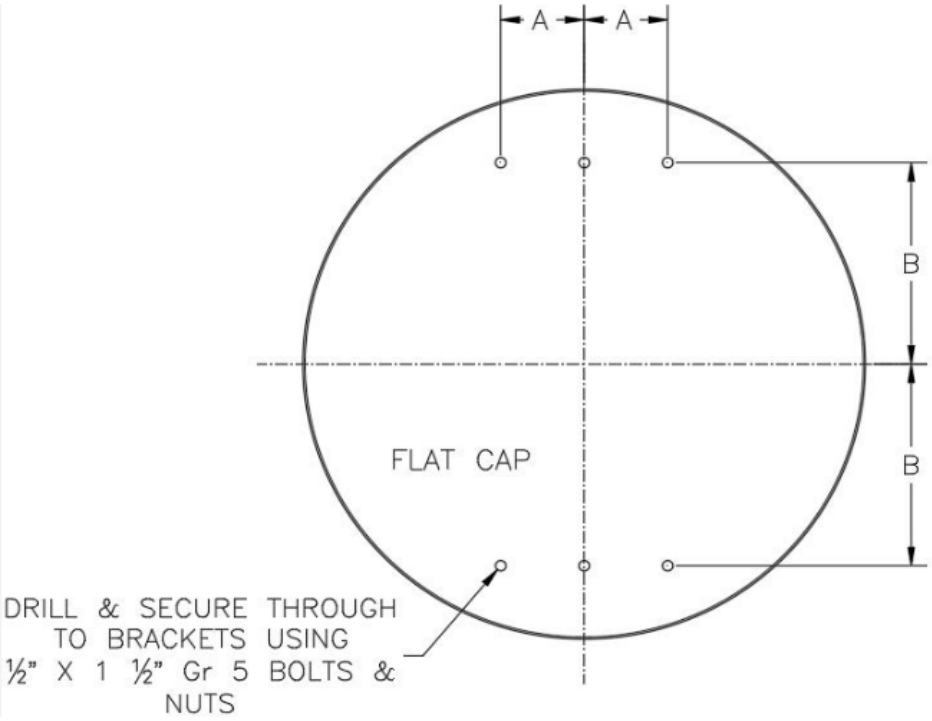


Table 11. Drilling dimensions for peak support brackets

Bin Series	Peak Ring Size	A	B
48, 60 to 96	52" Peak Ring	8.0"	19.75"
51, 54, 102 to 108	60" Peak Ring	9.0"	22.75"

5.8. Install the Temperature Cable Bracket on the Rafter (OPI)

(Single rafter)

1. Install the OPI cable hanger bracket as shown in the following diagrams:

Figure 50. Bolting the bracket onto the rafter

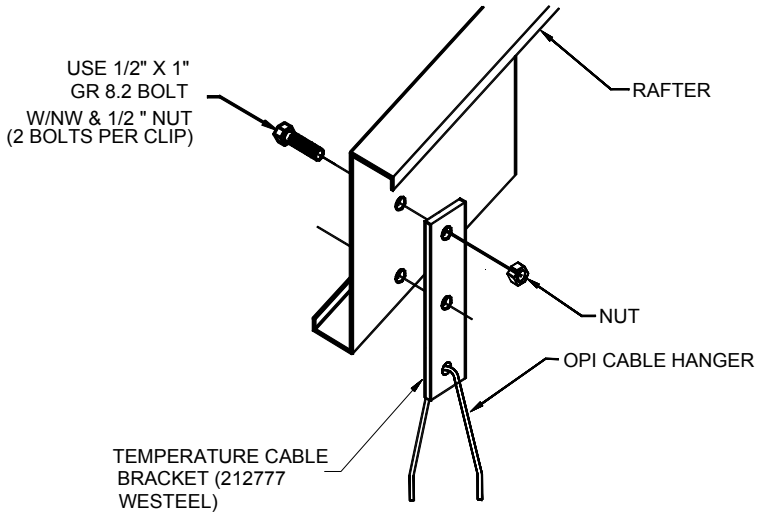


Figure 51. Side and edge views of the bracket

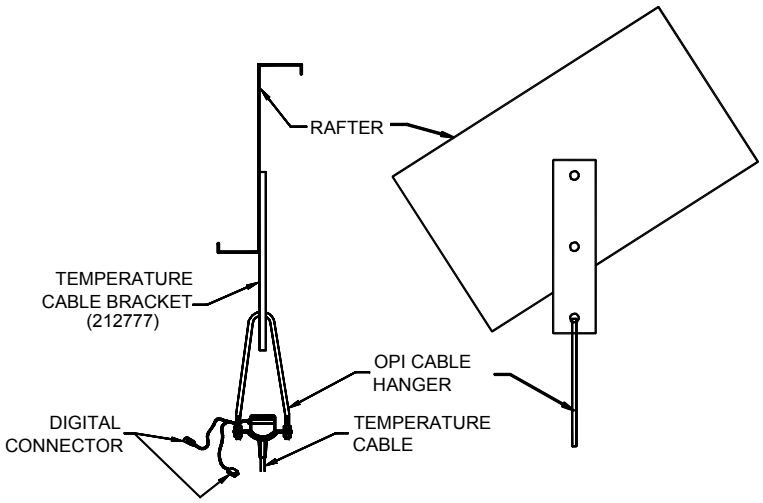
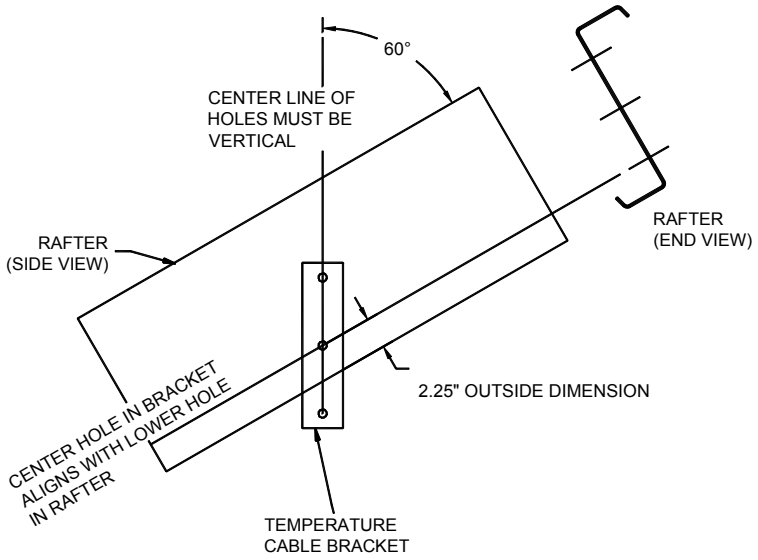


Figure 52. Side and end views of the rafter



Note

- All holes in the rafter that are necessary for attaching the brackets are 0.562” diameter and must be field drilled by the installer.
- Vertical alignment of the mounting holes is critical for transferring the load.
- Offset dimension for the first hole is an outside dimension.

5.9. Rafter Detail

Figure 53. 48’ & 51’ Rafter Side View with Accessories

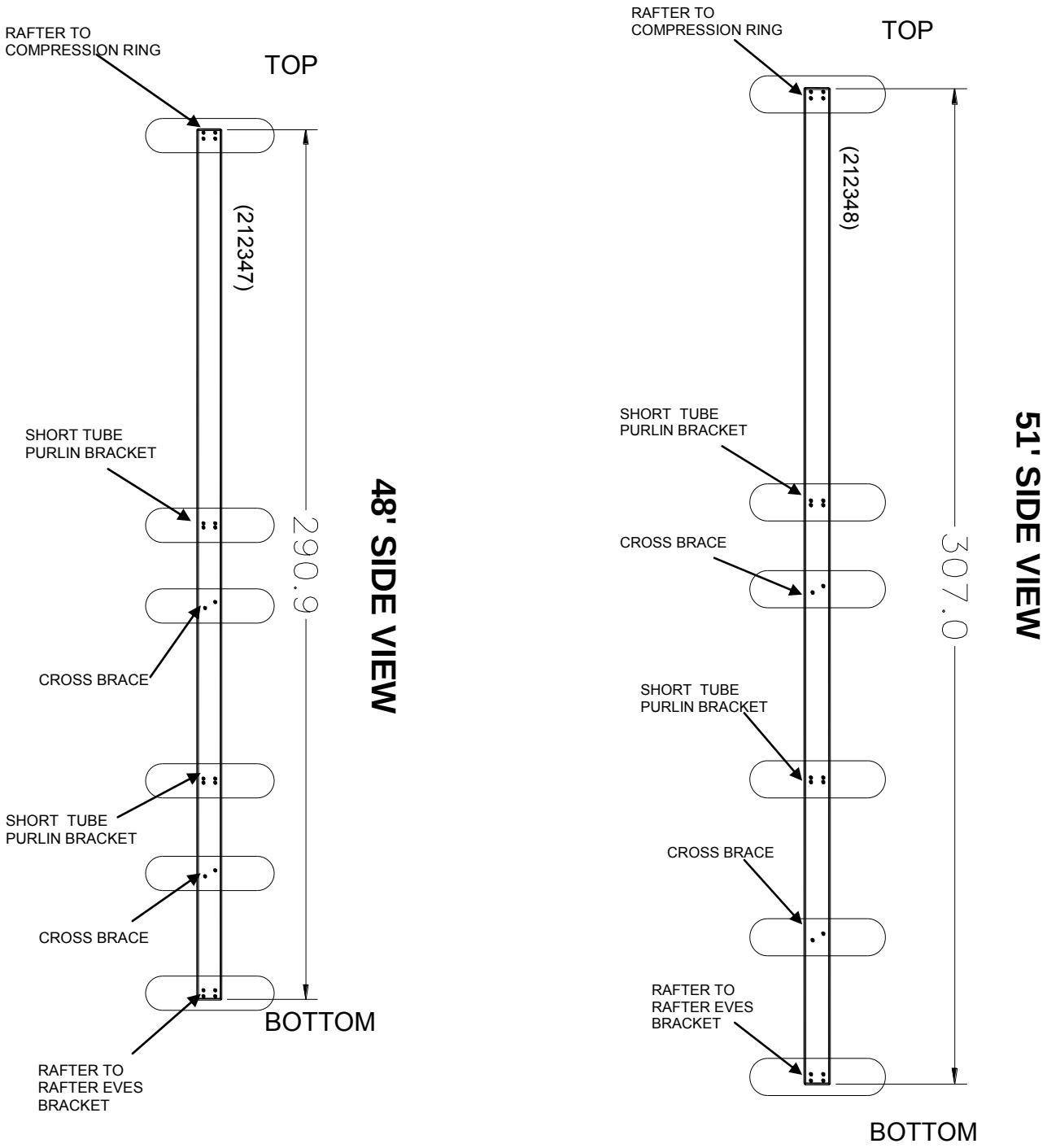


Figure 54. 54’ & 60’ Rafter Side View with Accessories

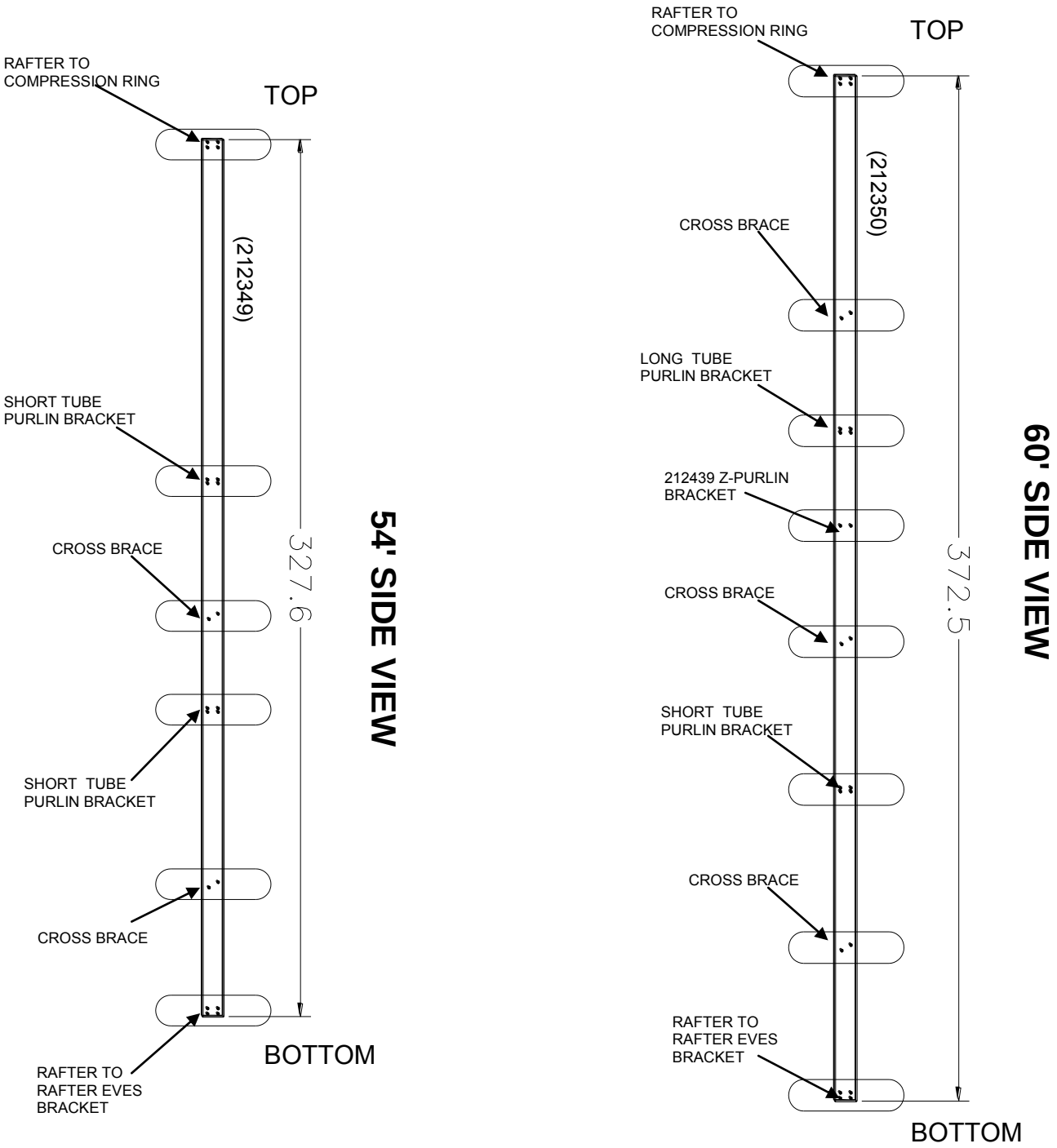


Figure 55. 66’ & 72’ Rafter Side View with Accessories

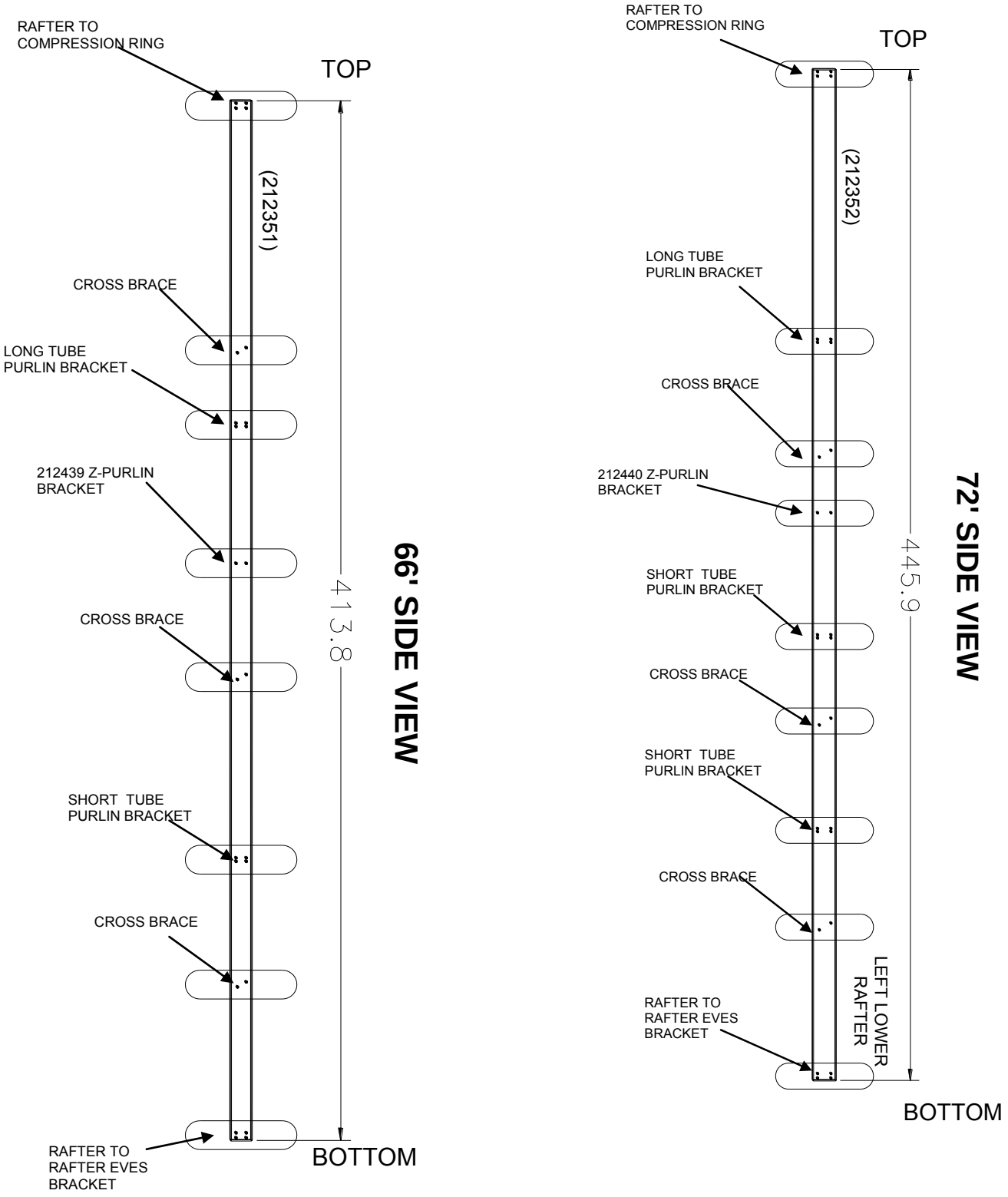


Figure 56. 75’ Rafter Side View with Accessories

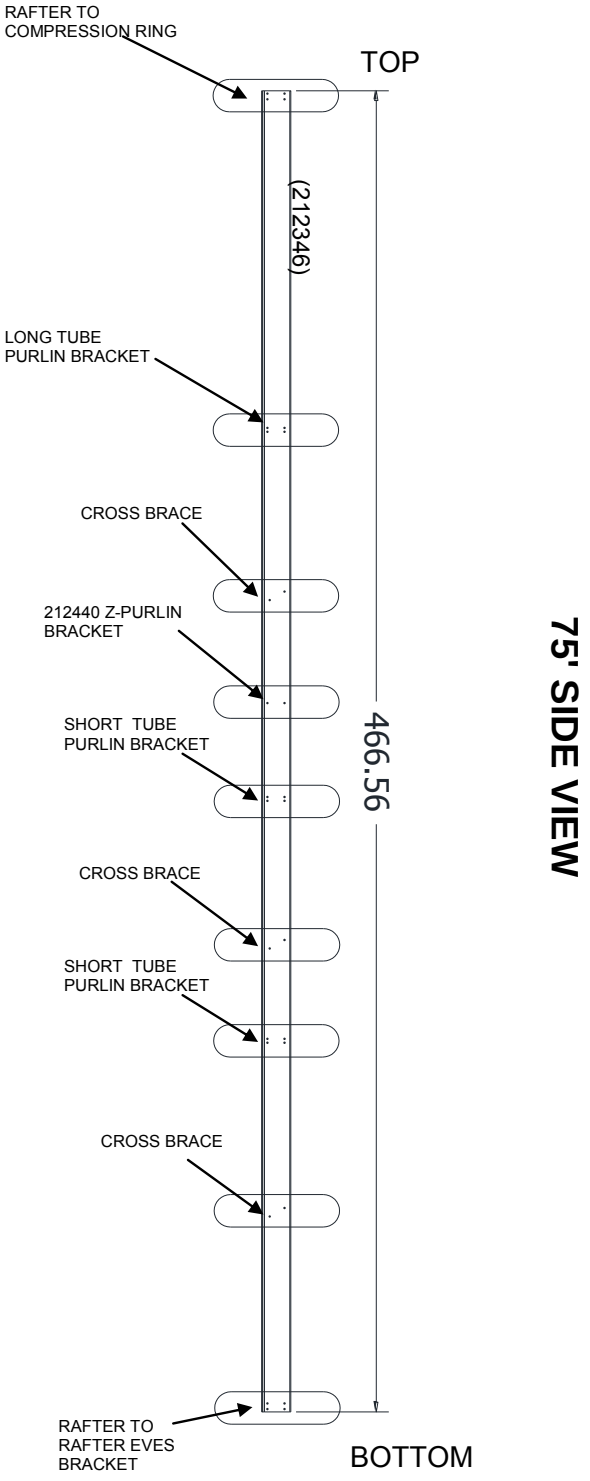


Figure 57. 78’ & 84’ Rafter Side View with Accessories

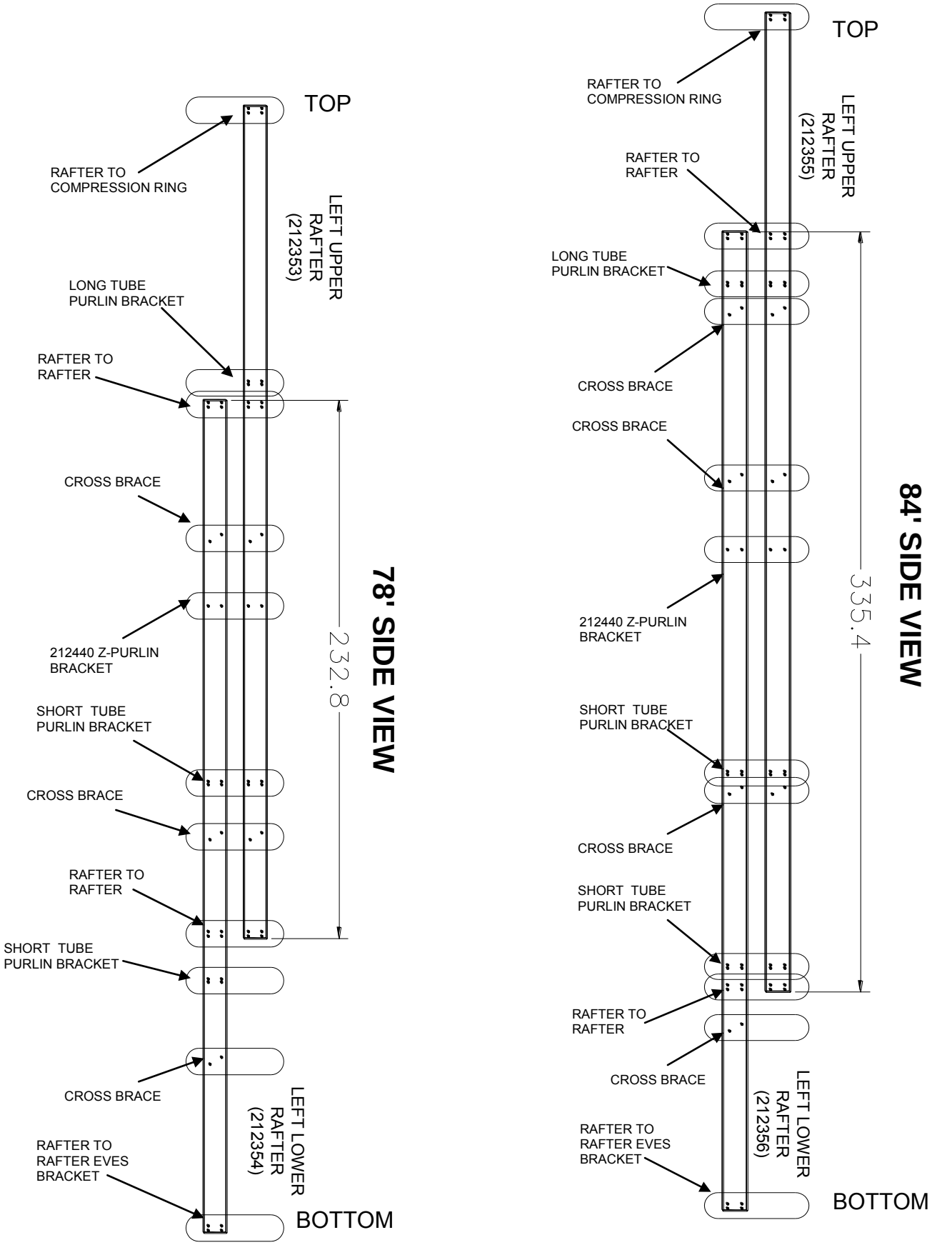


Figure 58. 90’ & 96’ Rafter Side View with Accessories

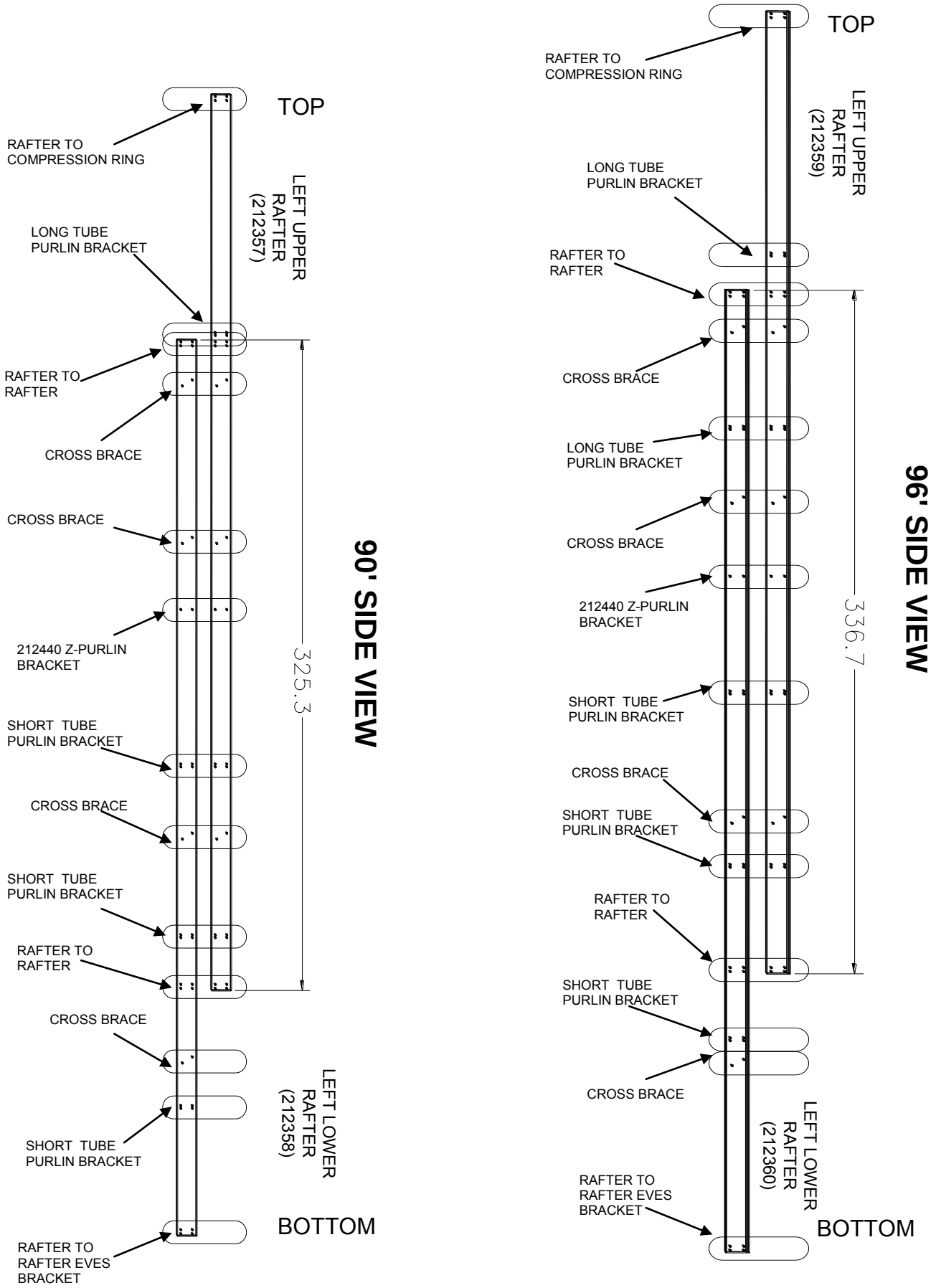


Figure 59. 102’ & 108’ Rafter Side View with Accessories

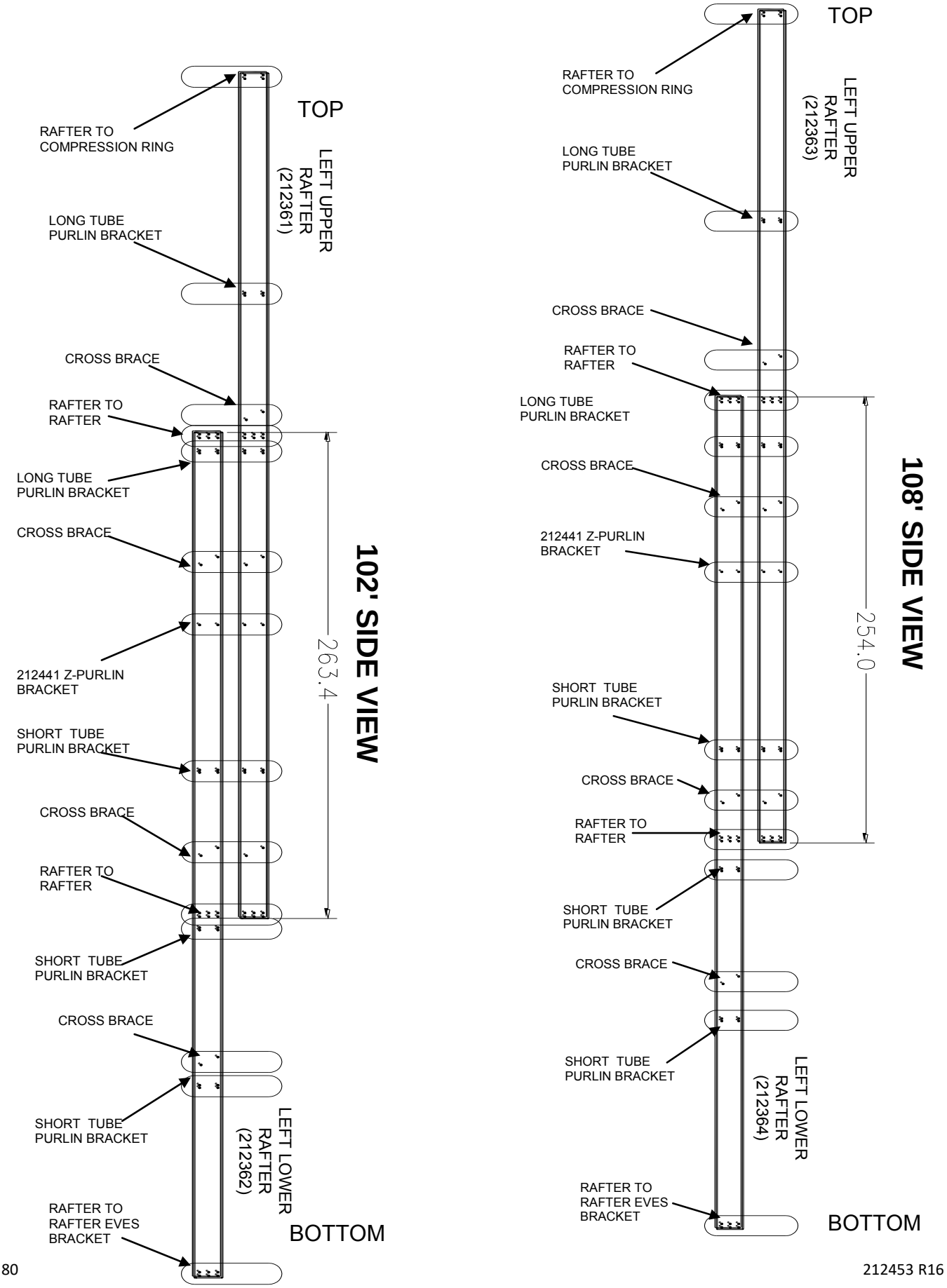
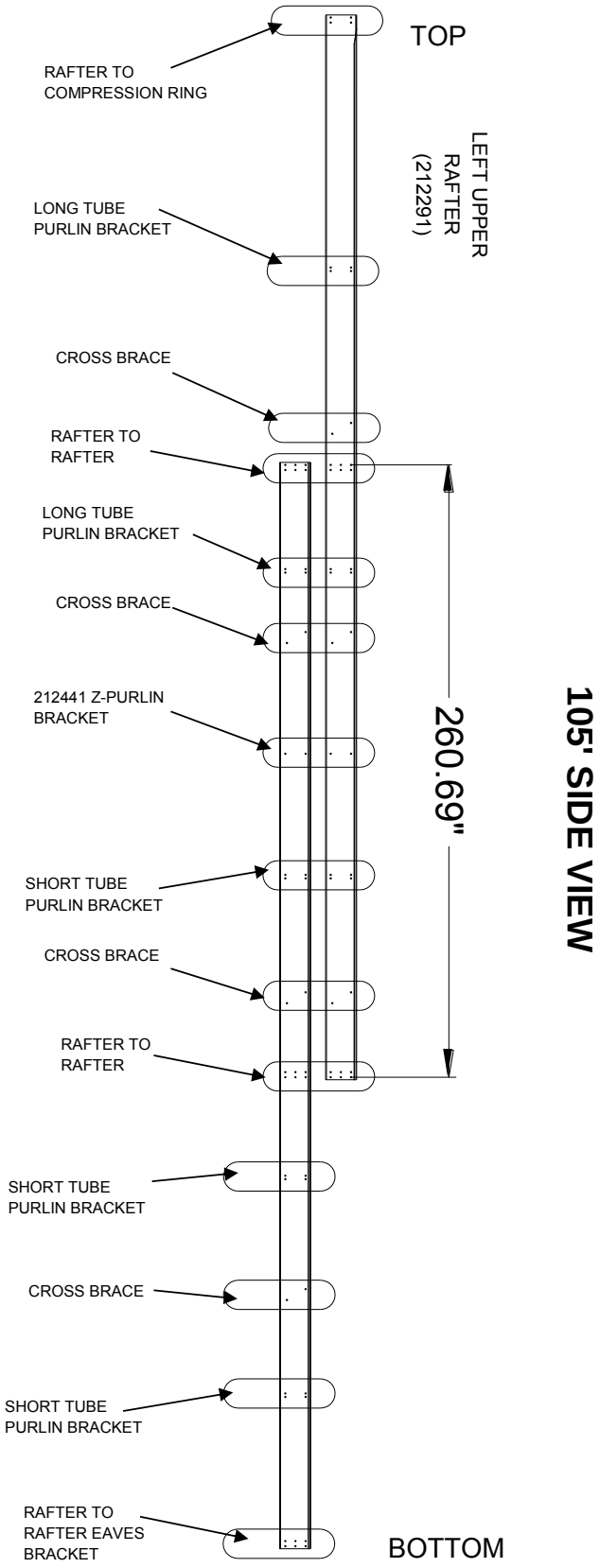


Figure 60. 105’ Rafter Side View with Accessories



6. Appendix

6.1. Parts Lists

Table 12. Parts List for Structural Roof 48’ & 51’

Part Number	Description	Unit Weight (lbs)	212598 - 48'	212599 - 51'
195091	ROOF LID FLAT 51'-54', 102'-108'	177.9	-	1
195087	ROOF LID FLAT 30'-48', 60'-96'	136.4	1	-
212109	PEAK RING 48' STRUCTURAL	49.8	1	-
212110	PEAK RING 51' STRUCTURAL	57.8	-	1
195149	PEAK RING BULB GASKET 105"	0.9	-	2
195150	PEAK RING BULB GASKET 168"	1.44	1	-
212228	PEAK RING FOAM CLOSURE 15-27	0.4	-	2
212229	PEAK RING FOAM CLOSURE 30-48	0.5	1	-
212297	COMPRESSION RING ASSY 48'	192.8	1	-
212298	COMPRESSION RING ASSY 51'	216.8	-	1
212380	ROOF CONNECTION UPRIGHT	10.2	16	17
212370	RAFTER EAVE BRACKET 54'-66' LH	2.5	16	17
212371	RAFTER EAVE BRACKET 54'-66' RH	2.5	16	17
212393	TENSION PLATE BRACKET 48-51'	6.34	16	17
212383	TENSION PLATE 48'-51'	45.5	16	17
212347L	RAFTER 48' LEFT	142.6	8	-
212347R	RAFTER 48' RIGHT	142.6	8	-
212348L	RAFTER 51' LEFT	148.1	-	8
212348R	RAFTER 51' RIGHT	148.1	-	9
212700	CROSS BRACE 54'-66' #1	31.2	8	9
212701	CROSS BRACE 54'-66' #2	21.4	8	9
212722	DIAGONAL BRACE 124.8"	18.6	-	8
212723	DIAGONAL BRACE 119.1"	17.9	8	-
212501	TUBING BRACKET 54'-66' LOWER	3.7	32	34
212410	TUBE PURLIN S4	54.6	4	4
212411	TUBE PURLIN S6	54.6	6	6
212452	INNER SPLICE	3.7	8	8
232769	WIND RING SPLICE	3.9	2	2
235890	INSPECTION HATCH LID ASSY	7.48	1	1
235891	INSPECTION HATCH LATCH	0.81	1	1
235882	INSPECTION HATCH BULB GASKET 76"	0.5	1	1
212230	BIRD STOP	0.127	48	51
212231	FOAM ROOF RIB CLOSURE (set of 12)	0.06	4	5
193078	LADDER RUNG 40.5 (38.0 CTR)	4.8	-	1
193077	LADDER RUNG 38.5 (36.0 CTR)	4.6	1	-
193076	LADDER RUNG 36.5 (34.0 CTR)	4.4	1	1
193075	LADDER RUNG 34.5 (32.0 CTR)	4.1	1	1
193074	LADDER RUNG 32.5 (30.0 CTR)	3.9	1	1
193073	LADDER RUNG 30.5 (28.0 CTR)	3.6	1	1

Table 12 Parts List for Structural Roof 48’ & 51’ (continued)

Part Number	Description	Unit Weight (lbs)	212598 - 48'	212599 - 51'
193072	LADDER RUNG 28.5 (26.0 CTR)	3.4	1	1
193071	LADDER RUNG 26.5 (24.0 CTR)	3.2	-	1
193070	LADDER RUNG 24.5 (22.0 CTR)	1.7	1	1
193069	LADDER RUNG 22.5 (20.0 CTR)	1.5	1	1
193068	LADDER RUNG 20.5 (18.0 CTR)	1.4	1	1
193067	LADDER RUNG 18.5 (16.0 CTR)	1.3	1	-
193066	LADDER RUNG 16.5 (14.0 CTR)	1.1	1	1
193065	LADDER RUNG 14.5 (12.0 CTR)	1	1	1
193064	LADDER RUNG 14.5 (10.0 CTR)	1	-	1
193063	LADDER RUNG 14.5 (8.0 CTR)	1	1	1
193062	LADDER RUNG 14.5 (6.0 CTR)	1	1	1
212048B	ROOF SHEET BUNDLE 48'	4508.35	1	-
212051B	ROOF SHEET BUNDLE 51'	5073.75	-	1
212255	TOP ANGLE 48'	9.8	16	-
212256	TOP ANGLE 51'	9.8	-	17
212740	FALL RESTRAINT BRACKET	0.3	2	2
235914	BOLT HFS .313 x 1.00 GR8.2 - BAG 250	8.5	5	6
235915	BOLT HFS .313 x 1.00 GR8.2 - BAG 50	1.7	2	1
235916	BOLT HFS .313 x 1.25 GR8.2 - BAG 80	3.04	3	-
235917	BOLT HFS .313 x 1.25 GR8.2 - BAG 50	1.9	-	5
235923	NUT HEX FLANGE .313 - BAG 250	3.5	6	7
235925	HEX FLANGE NUT .313 - BAG 50	0.7	2	1
235973	WSHR SEAL STL/NEO .313 - BAG (25)	0.13	2	2
235949	BOLT HEX .375 x 3.75 GR5 - BAG 10	1.27	5	5
235955	HEX FLANGE NUT .375 GR5 - Bag 50	0.95	5	5
193781	BLT HF .500 x 1.00 GR8.2 JS500	0.097	630	670
154201	NUT HEX FLLK .500 GR2 JS500	0.045	630	670
213428	PEAK REINFORCING BRACKET 52"	24.9	2	0
213429	PEAK REINFORCING BRACKET 60"	28.7	0	2
212453	MANUAL - ROOF STRUCTURAL	0.3	1	1

Table 13. Parts List for Structural Roof 54’, 60’ & 66’

Part Number	Description	Unit Weight (lbs)	212610 - 54'	212601 - 60'	212602 - 66'
195091	ROOF LID FLAT 51'-54', 102'-108'	177.9	1	-	-
195087	ROOF LID FLAT 30'-48', 60'-96'	136.4	-	1	1
212227	PEAK RING 54'	57.8	1	-	-
212216	PEAK RING 60'	49.8	-	1	-
212217	PEAK RING 66'	49.8	-	-	1
195149	PEAK RING BULB GASKET 105"	0.9	2	-	-
195150	PEAK RING BULB GASKET 168"	1.44	-	1	1
212228	PEAK RING FOAM CLOSURE 15-27	0.4	2	-	-
212229	PEAK RING FOAM CLOSURE 30-48	0.5	-	8	9
212299	COMPRESSION RING ASSY 54'	220	1	-	-
212300	COMPRESSION RING ASSY 60'	273.2	-	1	-
212301	COMPRESSION RING ASSY 66'	277.2	-	-	1
212380	ROOF CONNECTION UPRIGHT	10.2	18	20	22
212370	RAFTER EAVE BRACKET 54'-66' LH	2.5	18	20	22
212371	RAFTER EAVE BRACKET 54'-66' RH	2.5	18	20	22
212389	TENSION PLATE BRACKET 54-66'	6.34	18	20	22
212384	TENSION PLATE 54'	45.6	18	-	-
212385	TENSION PLATE 60'-66'	45.8	-	20	22
212349L	RAFTER 54' LEFT	160.6	9	-	-
212349R	RAFTER 54' RIGHT	160.6	9	-	-
212350L	RAFTER 60' LEFT	169.2	-	10	-
212350R	RAFTER 60' RIGHT	169.2	-	10	-
212351L	RAFTER 66' LEFT	188	-	-	11
212351R	RAFTER 66' RIGHT	188	-	-	11
212700	CROSS BRACE 54'-66' #1	31.2	9	10	11
212701	CROSS BRACE 54'-66' #2	21.4	9	10	11
212702	CROSS BRACE 54'-66' #3	10.9	-	10	11
212711	DIAGONAL BRACE 145.9"	22	-	-	11
212714	DIAGONAL BRACE 136.6"	20.6	-	10	-
212721	DIAGONAL BRACE 127.6"	19.2	9	-	-
212439	ROOF Z-PURLIN BRACKET 60'-66'	3.94	-	20	22
212430	ROOF Z-PURLIN 60'	32.7	-	10	-
212431	ROOF Z-PURLIN 66'	32.7	-	-	11
212500	TUBING BRACKET 60'-66' UPPER	5.3	-	20	22
212501	TUBING BRACKET 54'-66' LOWER	3.7	36	20	22
212410	TUBE PURLIN S4	54.6	4	4	4
212411	TUBE PURLIN S6	54.6	6	-	-
212412	TUBE PURLIN S7	54.6	-	7	-
212413	TUBE PURLIN S8	54.6	-	-	8
212452	INNER SPLICE	3.7	8	9	10
232769	WIND RING SPLICE	3.9	2	2	2
235890	INSPECTION HATCH LID ASSY	7.48	1	1	1
235891	INSPECTION HATCH LATCH	0.81	1	1	1
235882	INSPECTION HATCH BULB GASKET 76"	0.5	1	1	1
212230	BIRD STOP	0.127	54	90	99

Table 13 Parts List for Structural Roof 54', 60' & 66' (continued)

Part Number	Description	Unit Weight (lbs)	212610 - 54'	212601 - 60'	212602 - 66'
212231	FOAM ROOF RIB CLOSURE (set of 12)	0.06	5	8	9
193078	LADDER RUNG 40.5 (38.0 CTR)	4.8	1	-	-
193077	LADDER RUNG 38.5 (36.0CTR)	4.6	-	2	2
193076	LADDER RUNG 36.5 (34.0 CTR)	4.4	1	2	2
193075	LADDER RUNG 34.5 (32.0 CTR)	4.1	1	1	2
193074	LADDER RUNG 32.5 (30.0 CTR)	3.9	1	2	2
193073	LADDER RUNG 30.5 (28.0 CTR)	3.6	1	2	1
193072	LADDER RUNG 28.5 (26.0 CTR)	3.4	1	2	2
193071	LADDER RUNG 26.5 (24.0 CTR)	3.2	1	1	2
193070	LADDER RUNG 24.5 (22.0 CTR)	1.7	1	2	2
193069	LADDER RUNG 22.5 (20.0 CTR)	1.5	1	1	2
193068	LADDER RUNG 20.5 (18.0 CTR)	1.4	1	1	-
193067	LADDER RUNG 18.5 (16.0 CTR)	1.3	1	-	1
193066	LADDER RUNG 16.5 (14.0 CTR)	1.1	1	1	1
193065	LADDER RUNG 14.5 (12.0 CTR)	1	1	-	-
193064	LADDER RUNG 14.5 (10.0 CTR)	1	1	1	1
193063	LADDER RUNG 14.5 (8.0 CTR)	1	1	-	-
193062	LADDER RUNG 14.5 (6.0 CTR)	1	1	-	-
212054B	ROOF SHEET BUNDLE 54'	5689.35	1	-	-
212030BSTR	ROOF SHEET BUNDLE 30' STRUCTURAL	1751	-	1	-
212060B	ROOF SHEET BUNDLE 60'	4800.75	-	1	-
212033BSTR	ROOF SHEET BUNDLE 33' STRUCTURAL	2122.7	-	-	1
212066B	ROOF SHEET BUNDLE 66'	5786.55	-	-	1
212257	TOP ANGLE 54'	9.8	18	-	-
212258	TOP ANGLE 60'	9.8	-	20	-
212259	TOP ANGLE 66'	9.8	-	-	22
212740	FALL RESTRAINT BRACKET	0.3	2	2	2
235914	BOLT HFS .313 x 1.00 GR8.2 - BAG 250	8.5	6	7	8
235915	BOLT HFS .313 x 1.00 GR8.2 - BAG 50	1.7	4	-	1
235916	BOLT HFS .313 x 1.25 GR8.2 - BAG 80	3.04	2	3	4
235917	BOLT HFS .313 x 1.25 GR8.2 - BAG 50	1.9	2	1	-
235923	NUT HEX FLANGE .313 - BAG 250	3.5	7	8	9
235925	HEX FLANGE NUT .313 - BAG 50	0.7	4	1	3
235973	WSHR SEAL STL/NEO .313 - BAG (25)	0.13	2	2	2
235949	BOLT HEX .375 x 3.75 GR5 - BAG 10	1.27	5	6	6
235955	HEX FLANGE NUT .375 GR5 - Bag 50	0.95	5	6	7
193781	BLT HF .500 x 1.00 GR8.2 JS500	0.097	710	930	1030
154201	NUT HEX FLLK .500 GR2 JS500	0.045	710	930	1030
213428	PEAK REINFORCING BRACKET 52"	24.9	0	2	2
213429	PEAK REINFORCING BRACKET 60"	28.7	2	0	0
212453	MANUAL - ROOF STRUCTURAL	0.3	1	1	1

Table 14. Parts List for Structural Roof 72’ & 78’

Part Number	Description	Unit Weight (lbs)	212603 - 72'	212604 - 78'
195087	ROOF LID FLAT 30'-48', 60'-96'	136.4	1	1
212218	PEAK RING 72'	49.8	1	-
212219	PEAK RING 75' & 78'	49.8	-	1
195150	PEAK RING BULB GASKET 168"	1.44	1	1
212229	PEAK RING FOAM CLOSURE 30-48	0.5	10	11
212302	COMPRESSION RING ASSY 72'	668.7	1	-
212303	COMPRESSION RING ASSY 78'	683.8	-	1
212380	ROOF CONNECTION UPRIGHT	10.2	24	26
212372	RAFTER EAVE BRACKET 72'-96' LH	3.3	24	26
212373	RAFTER EAVE BRACKET 72'-96' RH	3.3	24	26
212390	TENSION PLATE BRACKET 72-84'	7.54	24	26
212386	TENSION PLATE 72'-84'	46	24	26
212352L	RAFTER 72' LEFT	246.1	12	-
212352R	RAFTER 72' RIGHT	246.1	12	-
212353L	RAFTER 78' UPPER LEFT	198.7	-	13
212353R	RAFTER 78' UPPER RIGHT	198.7	-	13
212354L	RAFTER 78' LOWER LEFT	198.7	-	13
212354R	RAFTER 78' LOWER RIGHT	198.7	-	13
212703	CROSS BRACE 72'-96' #1	36.8	12	13
212704	CROSS BRACE 72'-96' #2	29	12	13
212705	CROSS BRACE 72'-96' #3	18.7	12	13
212716	DIAGONAL BRACE 128.0"	19.3	-	13
212717	DIAGONAL BRACE 122.8"	18.5	12	-
212440	ROOF Z-PURLIN BRACKET 72'-96'	4.48	24	26
212432	ROOF Z-PURLIN 72'	32.7	12	-
212433	ROOF Z-PURLIN 78'	32.7	-	13
212502	TUBING BRACKET 72'-96' UPPER	6	24	26
212410	TUBE PURLIN S4	54.6	4	4
212503	TUBING BRACKET 72'-96' LOWER	4.4	48	52
212412	TUBE PURLIN S7	54.6	7	-
212413	TUBE PURLIN S8	54.6	-	8
212414	TUBE PURLIN S9	54.6	9	-
212415	TUBE PURLIN S10	54.6	-	10
212452	INNER SPLICE	3.7	17	19
232769	WIND RING SPLICE	3.9	3	3
235890	INSPECTION HATCH LID ASSY	7.48	1	1
235891	INSPECTION HATCH LATCH	0.81	1	1
235882	INSPECTION HATCH BULB GASKET 76"	0.5	1	1
212230	BIRD STOP	0.127	108	117
212231	FOAM ROOF RIB CLOSURE (set of 12)	0.06	9	10
193077	LADDER RUNG 38.5 (36.0CTR)	4.6	2	3
193076	LADDER RUNG 36.5 (34.0 CTR)	4.4	3	2
193075	LADDER RUNG 34.5 (32.0 CTR)	4.1	1	2
193074	LADDER RUNG 32.5 (30.0 CTR)	3.9	2	2
193073	LADDER RUNG 30.5 (28.0 CTR)	3.6	3	2

Table 14 Parts List for Structural Roof 72’ & 78’ (continued)

Part Number	Description	Unit Weight (lbs)	212603 - 72'	212604 - 78'
193072	LADDER RUNG 28.5 (26.0 CTR)	3.4	1	2
193071	LADDER RUNG 26.5 (24.0 CTR)	3.2	2	2
193070	LADDER RUNG 24.5 (22.0 CTR)	1.7	2	2
193069	LADDER RUNG 22.5 (20.0 CTR)	1.5	2	3
193068	LADDER RUNG 20.5 (18.0 CTR)	1.4	1	-
193067	LADDER RUNG 18.5 (16.0 CTR)	1.3	1	1
193066	LADDER RUNG 16.5 (14.0 CTR)	1.1	-	1
193065	LADDER RUNG 14.5 (12.0 CTR)	1	1	1
193063	LADDER RUNG 14.5 (8.0 CTR)	1	1	1
212036BSTR	ROOF SHEET BUNDLE 36' STRUCTURAL	2526.8	1	-
212072B	ROOF SHEET BUNDLE 72'	6864.75	1	-
212039BSTR	ROOF SHEET BUNDLE 39' STRUCTURAL	2970.2	-	1
212078B	ROOF SHEET BUNDLE 78'	8035.35	-	1
212260	TOP ANGLE 72'	9.8	24	-
212261	TOP ANGLE 78'	9.8	-	26
212740	FALL RESTRAINT BRACKET	0.3	2	2
235914	BOLT HFS .313 x 1.00 GR8.2 - BAG 250	8.5	9	10
235915	BOLT HFS .313 x 1.00 GR8.2 - BAG 50	1.7	2	4
235916	BOLT HFS .313 x 1.25 GR8.2 - BAG 80	3.04	-	1
235917	BOLT HFS .313 x 1.25 GR8.2 - BAG 50	1.9	7	6
235923	NUT HEX FLANGE .313 - BAG 250	3.5	10	12
235925	HEX FLANGE NUT .313 - BAG 50	0.7	4	2
235973	WSHR SEAL STL/NEO .313 - BAG (25)	0.13	2	2
235949	BOLT HEX .375 x 3.75 GR5 - BAG 10	1.27	10	11
235955	HEX FLANGE NUT .375 GR5 - Bag 50	0.95	8	8
193781	BLT HF .500 x 1.00 GR8.2 JS500	0.097	1320	1650
154201	NUT HEX FLLK .500 GR2 JS500	0.045	1320	1650
213428	PEAK REINFORCING BRACKET 52"	24.9	2	2
212453	MANUAL - ROOF STRUCTURAL	0.3	1	1

Table 15. Parts List for Structural Roof 75’

Part Number	Description	Unit Weight (lbs)	212611- 75'
195087	ROOF LID FLAT 30'-48', 60'-96'	136.4	1
212219	PEAK RING 75' & 78'	49.8	1
195150	PEAK RING BULB GASKET 168"	1.44	1
212229	PEAK RING FOAM CLOSURE 30-48	0.5	11
212394	COMPRESSION RING ASSY 75'	675.9	1
212380	ROOF CONNECTION UPRIGHT	10.2	25
212372	RAFTER EAVE BRACKET 72'-96' LH	3.3	25
212373	RAFTER EAVE BRACKET 72'-96' RH	3.3	25
212390	TENSION PLATE BRACKET 72-84'	7.54	25
212386	TENSION PLATE 72'-84'	46	25
212346L	RAFTER 75' LEFT	257.5	13
212346R	RAFTER 75' RIGHT	257.5	12
212705	CROSS BRACE 72'-96' #3	18.7	13
212703	CROSS BRACE 72'-96' #1	36.8	13
212704	CROSS BRACE 72'-96' #2	29	13
212724	DIAGONAL BRACE 125.7"	18.9	13
212440	ROOF Z-PURLIN BRACKET 72'-96'	4.48	25
212442	ROOF Z-PURLIN 75'	32.7	13
212443	ROOF Z-PURLIN SPLICE 75'	1.6	13
212502	TUBING BRACKET 72'-96' UPPER	6	25
212410	TUBE PURLIN S4	54.6	4
212503	TUBING BRACKET 72'-96' LOWER	4.4	50
212412	TUBE PURLIN S7	54.6	7
212414	TUBE PURLIN S9	54.6	9
212452	INNER SPLICE	3.7	17
232769	WIND RING SPLICE	3.9	3
235890	INSPECTION HATCH LID ASSY	7.48	1
235891	INSPECTION HATCH LATCH	0.81	1
235882	INSPECTION HATCH BULB GASKET 76"	0.5	1
212230	BIRD STOP	0.127	117
212231	FOAM ROOF RIB CLOSURE (set of 12)	0.06	10
193077	LADDER RUNG 38.5 (36.0CTR)	4.6	2
193076	LADDER RUNG 36.5 (34.0 CTR)	4.4	2
193075	LADDER RUNG 34.5 (32.0 CTR)	4.1	2
193074	LADDER RUNG 32.5 (30.0 CTR)	3.9	2
193073	LADDER RUNG 30.5 (28.0 CTR)	3.6	2
193072	LADDER RUNG 28.5 (26.0 CTR)	3.4	2
193071	LADDER RUNG 26.5 (24.0 CTR)	3.2	2
193070	LADDER RUNG 24.5 (22.0 CTR)	1.7	2
193069	LADDER RUNG 22.5 (20.0 CTR)	1.5	3
193067	LADDER RUNG 18.5 (16.0 CTR)	1.3	1
193066	LADDER RUNG 16.5 (14.0 CTR)	1.1	1
193065	LADDER RUNG 14.5 (12.0 CTR)	1	1
193063	LADDER RUNG 14.5 (8.0 CTR)	1	1
212039BSTR	ROOF SHEET BUNDLE 39' STRUCTURAL	2970.2	1

Table 15 Parts List for Structural Roof 75’ (continued)

Part Number	Description	Unit Weight (lbs)	212611- 75'
212075B	ROOF SHEET BUNDLE 75'	7022.25	1
212267-A	TOP ANGLE 75' FOR W/S 1, 2, 14, & 15	9.4	4
212267-B	TOP ANGLE 75' FOR W/S 3, 4, 16, & 17	9.4	4
212267-C	TOP ANGLE 75' FOR W/S 5, 6, 13, 18, 19 & 26	9.4	6
212267-D	TOP ANGLE 75' FOR W/S 7, 8, 20, & 21	9.4	4
212267-E	TOP ANGLE 75' FOR W/S 9, 10, 22, & 23	9.4	4
212267-F	TOP ANGLE 75' FOR W/S 11, 12, 24, & 25	9.4	4
212740	FALL RESTRAINT BRACKET	0.3	2
235914	BOLT HFS .313 x 1.00 GR8.2 - BAG 250	8.5	10
235915	BOLT HFS .313 x 1.00 GR8.2 - BAG 50	1.7	3
235916	BOLT HFS .313 x 1.25 GR8.2 - BAG 80	3.04	4
235917	BOLT HFS .313 x 1.25 GR8.2 - BAG 50	1.9	1
235923	NUT HEX FLANGE .313 - BAG 250	3.5	12
235973	WSHR SEAL STL/NEO .313 - BAG (25)	0.13	2
235949	BOLT HEX .375 x 3.75 GR5 - BAG 10	1.27	11
235955	HEX FLANGE NUT .375 GR5 - Bag 50	0.95	8
193781	BLT HF .500 x 1.00 GR8.2 JS500	0.097	1430
154201	NUT HEX FLLK .500 GR2 JS500	0.045	1430
213428	PEAK REINFORCING BRACKET 52"	24.9	2
212453	MANUAL - ROOF STRUCTURAL	0.3	1

Table 16. Parts List for Structural Roof 84’, 90’ & 96’

Part Number	Description	Unit Weight (lbs)	212605 - 84'	212606 - 90'	212607 - 96'
195087	ROOF LID FLAT 30'-48', 60'-96'	136.4	1	1	1
212220	PEAK RING 84'	49.8	1	-	-
212221	PEAK RING 90'	49.8	-	1	-
212222	PEAK RING 96'	49.8	-	-	1
195150	PEAK RING BULB GASKET 168"	1.44	1	1	1
212229	PEAK RING FOAM CLOSURE 30-48	0.5	11	12	13
212304	COMPRESSION RING ASSY 84'	708.3	1	-	-
212305	COMPRESSION RING ASSY 90'	730.1	-	1	-
212306	COMPRESSION RING ASSY 96'	752	-	-	1
212380	ROOF CONNECTION UPRIGHT	10.2	28	30	32
212372	RAFTER EAVE BRACKET 72'-96' LH	3.3	28	30	32
212373	RAFTER EAVE BRACKET 72'-96' RH	3.3	28	30	32
212390	TENSION PLATE BRACKET 72-84'	7.54	28	-	-
212391	TENSION PLATE BRACKET 90-96'	14	-	30	32
212386	TENSION PLATE 72'-84'	46	28	-	-
212387	TENSION PLATE 90'-96'	70.3	-	30	32
212355L	RAFTER 84' UPPER LEFT	238.4	14	-	-
212355R	RAFTER 84' UPPER RIGHT	238.4	14	-	-
212356L	RAFTER 84' LOWER LEFT	238.4	14	-	-
212356R	RAFTER 84' LOWER RIGHT	238.4	14	-	-
212357L	RAFTER 90' UPPER LEFT	247.2	-	15	-
212357R	RAFTER 90' UPPER RIGHT	247.2	-	15	-
212358L	RAFTER 90' LOWER LEFT	247.2	-	15	-
212358R	RAFTER 90' LOWER RIGHT	247.2	-	15	-
212359L	RAFTER 96' UPPER LEFT	258	-	-	16
212359R	RAFTER 96' UPPER RIGHT	258	-	-	16
212360L	RAFTER 96' LOWER LEFT	258.3	-	-	16
212360R	RAFTER 96' LOWER RIGHT	258.3	-	-	16
212703	CROSS BRACE 72'-96' #1	36.8	14	15	16
212704	CROSS BRACE 72'-96' #2	29	14	15	16
212705	CROSS BRACE 72'-96' #3	18.7	14	15	16
212706	CROSS BRACE 72'-96' #4	13.3	-	15	16
212711	DIAGONAL BRACE 145.9"	22	-	-	16
212713	DIAGONAL BRACE 139.8"	21	-	15	-
212715	DIAGONAL BRACE 133.8"	20.2	14	-	-
212718	DIAGONAL BRACE 93.9"	14.1	-	-	16
212720	DIAGONAL BRACE 89.1"	13.4	-	15	-
212440	ROOF Z-PURLIN BRACKET 72'-96'	4.48	28	30	32
212434	ROOF Z-PURLIN 84'	32.7	14	-	-
212435	ROOF Z-PURLIN 90'	32.7	-	15	-
212436	ROOF Z-PURLIN 96'	32.7	-	-	16
212502	TUBING BRACKET 72'-96' UPPER	6	28	30	64
212410	TUBE PURLIN S4	54.6	4	4	4
212411	TUBE PURLIN S6	54.6	-	-	6
212503	TUBING BRACKET 72'-96' LOWER	4.4	56	90	96

Table 16 Parts List for Structural Roof 84', 90' & 96' (continued)

Part Number	Description	Unit Weight (lbs)	212605 - 84'	212606 - 90'	212607 - 96'
212414	TUBE PURLIN S9	54.6	9	9	9
212416	TUBE PURLIN S11	54.6	11	11	11
212418	TUBE PURLIN S13	54.6	-	13	13
212452	INNER SPLICE	3.7	21	33	38
232769	WIND RING SPLICE	3.9	3	4	5
235890	INSPECTION HATCH LID ASSY	7.48	1	1	1
235891	INSPECTION HATCH LATCH	0.81	1	1	1
235882	INSPECTION HATCH BULB GASKET 76"	0.5	1	1	1
212230	BIRD STOP	0.127	126	135	144
212231	FOAM ROOF RIB CLOSURE (set of 12)	0.06	11	12	12
193078	LADDER RUNG 40.5 (38.0 CTR)	4.8	-	-	1
193077	LADDER RUNG 38.5 (36.0CTR)	4.6	3	3	2
193076	LADDER RUNG 36.5 (34.0 CTR)	4.4	2	2	3
193075	LADDER RUNG 34.5 (32.0 CTR)	4.1	3	3	2
193074	LADDER RUNG 32.5 (30.0 CTR)	3.9	1	3	3
193073	LADDER RUNG 30.5 (28.0 CTR)	3.6	3	1	3
193072	LADDER RUNG 28.5 (26.0 CTR)	3.4	2	3	2
193071	LADDER RUNG 26.5 (24.0 CTR)	3.2	3	2	2
193070	LADDER RUNG 24.5 (22.0 CTR)	1.7	1	3	3
193069	LADDER RUNG 22.5 (20.0 CTR)	1.5	3	3	3
193068	LADDER RUNG 20.5 (18.0 CTR)	1.4	1	1	1
193067	LADDER RUNG 18.5 (16.0 CTR)	1.3	1	1	1
193066	LADDER RUNG 16.5 (14.0 CTR)	1.1	-	-	1
193065	LADDER RUNG 14.5 (12.0 CTR)	1	1	1	1
193064	LADDER RUNG 14.5 (10.0 CTR)	1	1	1	-
193063	LADDER RUNG 14.5 (8.0 CTR)	1	-	-	1
193062	LADDER RUNG 14.5 (6.0 CTR)	1	-	-	1
212042BSTR	ROOF SHEET BUNDLE 42' STRUCTURAL	3449.6	1	-	-
212084B	ROOF SHEET BUNDLE 84'	9312.35	1	-	-
212045BSTR	ROOF SHEET BUNDLE 45' STRUCTURAL	3960.5	-	1	-
212090B	ROOF SHEET BUNDLE 90'	10658.75	-	1	-
212048BSTR	ROOF SHEET BUNDLE 48' STRUCTURAL	4511.6	-	-	1
212096B	ROOF SHEET BUNDLE 96'	12105.95	-	-	1
212262	TOP ANGLE 84'	9.8	28	-	-
212263	TOP ANGLE 90'	9.8	-	30	-
212264	TOP ANGLE 96'	9.8	-	-	32
212740	FALL RESTRAINT BRACKET	0.3	2	2	2
235914	BOLT HFS .313 x 1.00 GR8.2 - BAG 250	8.5	12	13	15
235915	BOLT HFS .313 x 1.00 GR8.2 - BAG 50	1.7	1	4	2
235916	BOLT HFS .313 x 1.25 GR8.2 - BAG 80	3.04	4	5	6
235917	BOLT HFS .313 x 1.25 GR8.2 - BAG 50	1.9	2	1	-
235923	NUT HEX FLANGE .313 - BAG 250	3.5	13	15	17
235925	HEX FLANGE NUT .313 - BAG 50	0.7	4	3	2
235973	WSHR SEAL STL/NEO .313 - BAG (25)	0.13	3	3	3
235949	BOLT HEX .375 x 3.75 GR5 - BAG 10	1.27	12	17	21

Table 16 Parts List for Structural Roof 84', 90' & 96' (continued)

Part Number	Description	Unit Weight (lbs)	212605 - 84'	212606 - 90'	212607 - 96'
235955	HEX FLANGE NUT .375 GR5 - Bag 50	0.95	9	11	12
193781	BLT HF .500 x 1.00 GR8.2 JS500	0.097	1840	2250	2540
154201	NUT HEX FLLK .500 GR2 JS500	0.045	1840	2250	2540
213428	PEAK REINFORCING BRACKET 52"	24.9	2	2	2
212453	MANUAL - ROOF STRUCTURAL	0.3	1	1	1

Table 17. Parts List for Structural Roof 102’ & 108’

Part Number	Description	Unit Weight (lbs)	212608 - 102'	212609 - 108'
195091	ROOF LID FLAT 51'-54', 102'-108'	177.9	1	1
212223	PEAK RING 102'	57.8	1	-
212224	PEAK RING 108'	57.8	-	1
195149	PEAK RING BULB GASKET 105"	0.9	2	2
212229	PEAK RING FOAM CLOSURE 30-48	0.5	14	15
212307	COMPRESSION RING ASSY 102'	656.4	1	-
212308	COMPRESSION RING ASSY 108'	672.5	-	1
212380	ROOF CONNECTION UPRIGHT	10.2	34	36
212374	RAFTER EAVE BRACKET 102'-108' LH	5.1	34	36
212375	RAFTER EAVE BRACKET 102'-108' RH	5.1	34	36
212392	TENSION PLATE BRACKET 102-108'	16.35	34	36
212388	TENSION PLATE 102'-108'	70.3	34	36
212361L	RAFTER 102' UPPER LEFT	281.1	17	-
212361R	RAFTER 102' UPPER RIGHT	281.1	17	-
212362L	RAFTER 102' LOWER LEFT	340.4	17	-
212362R	RAFTER 102' LOWER RIGHT	340.4	17	-
212363L	RAFTER 108' UPPER LEFT	286.6	-	18
212363R	RAFTER 108' UPPER RIGHT	286.6	-	18
212364L	RAFTER 108' LOWER LEFT	347.9	-	18
212364R	RAFTER 108' LOWER RIGHT	347.9	-	18
212707	CROSS BRACE 102'-108' #1	42.5	17	18
212708	CROSS BRACE 102'-108' #2	34.2	17	18
212709	CROSS BRACE 102'-108' #3	22.7	17	18
212710	CROSS BRACE 102'-108' #4	17	17	18
212711	DIAGONAL BRACE 145.9"	22	-	18
212712	DIAGONAL BRACE 140.4"	21.1	17	-
212718	DIAGONAL BRACE 93.9"	14.1	-	18
212719	DIAGONAL BRACE 89.7"	13.5	17	-
212441	ROOF Z-PURLIN BRACKET 102'-108'	5.02	34	36
212437	ROOF Z-PURLIN 102'	32.7	17	-
212438	ROOF Z-PURLIN 108'	32.7	-	18
212504	TUBING BRACKET 102'-108' UPPER	6.8	68	72
212410	TUBE PURLIN S4	54.6	4	4
212411	TUBE PURLIN S6	54.6	6	-
212412	TUBE PURLIN S7	54.6	-	7
212505	TUBING BRACKET 102'-108' LOWER	5.2	102	108
212465	TUBE PURLIN S10 HEAVY	68.3	10	-
212466	TUBE PURLIN S11 HEAVY	68.3	-	11
212467	TUBE PURLIN S12 HEAVY	68.3	12	-
212468	TUBE PURLIN S13 HEAVY	68.3	-	13
212469	TUBE PURLIN S14 HEAVY	68.3	14	-
212470	TUBE PURLIN S15 HEAVY	68.3	-	15
212452	INNER SPLICE	3.7	41	45
232769	WIND RING SPLICE	3.9	5	5
235890	INSPECTION HATCH LID ASSY	7.48	1	1

Table 17 Parts List for Structural Roof 102’ & 108’ (continued)

Part Number	Description	Unit Weight (lbs)	212608 - 102'	212609 - 108'
235891	INSPECTION HATCH LATCH	0.81	1	1
235882	INSPECTION HATCH BULB GASKET 76"	0.5	1	1
212230	BIRD STOP	0.127	153	162
212231	FOAM ROOF RIB CLOSURE (set of 12)	0.06	13	14
193078	LADDER RUNG 40.5 (38.0 CTR)	4.8	1	1
193077	LADDER RUNG 38.5 (36.0CTR)	4.6	2	2
193076	LADDER RUNG 36.5 (34.0 CTR)	4.4	3	3
193075	LADDER RUNG 34.5 (32.0 CTR)	4.1	3	3
193074	LADDER RUNG 32.5 (30.0 CTR)	3.9	2	3
193073	LADDER RUNG 30.5 (28.0 CTR)	3.6	3	3
193072	LADDER RUNG 28.5 (26.0 CTR)	3.4	3	3
193071	LADDER RUNG 26.5 (24.0 CTR)	3.2	3	3
193070	LADDER RUNG 24.5 (22.0 CTR)	1.7	3	3
193069	LADDER RUNG 22.5 (20.0 CTR)	1.5	3	3
193068	LADDER RUNG 20.5 (18.0 CTR)	1.4	1	1
193067	LADDER RUNG 18.5 (16.0 CTR)	1.3	-	1
193066	LADDER RUNG 16.5 (14.0 CTR)	1.1	1	1
193065	LADDER RUNG 14.5 (12.0 CTR)	1	1	1
193064	LADDER RUNG 14.5 (10.0 CTR)	1	1	1
193063	LADDER RUNG 14.5 (8.0 CTR)	1	1	1
193062	LADDER RUNG 14.5 (6.0 CTR)	1	1	1
212051BSTR	ROOF SHEET BUNDLE 51' STRUCTURAL	5077	1	-
212102B	ROOF SHEET BUNDLE 102'	13659.55	1	-
212054BSTR	ROOF SHEET BUNDLE 54' STRUCTURAL	5692.6	-	1
212108B	ROOF SHEET BUNDLE 108'	15291.55	-	1
212265	TOP ANGLE 102'	9.8	34	-
212266	TOP ANGLE 108'	9.8	-	36
212740	FALL RESTRAINT BRACKET	0.3	2	2
235914	BOLT HFS .313 x 1.00 GR8.2 - BAG 250	8.5	17	19
235915	BOLT HFS .313 x 1.00 GR8.2 - BAG 50	1.7	1	1
235916	BOLT HFS .313 x 1.25 GR8.2 - BAG 80	3.04	7	7
235923	NUT HEX FLANGE .313 - BAG 250	3.5	19	21
235925	HEX FLANGE NUT .313 - BAG 50	0.7	1	2
235973	WSHR SEAL STL/NEO .313 - BAG (25)	0.13	3	4
235949	BOLT HEX .375 x 3.75 GR5 - BAG 10	1.27	23	24
235955	HEX FLANGE NUT .375 GR5 - Bag 50	0.95	13	13
193781	BLT HF .500 x 1.00 GR8.2 JS500	0.097	3050	3230
154201	NUT HEX FLLK .500 GR2 JS500	0.045	3050	3230
213429	PEAK REINFORCING BRACKET 60"	28.7	2	2
212453	MANUAL - ROOF STRUCTURAL	0.3	1	1

Table 18. Parts List for Structural Roof 105’

Part Number	Description	Unit Weight (lbs)	212612 - 105'
195091	ROOF LID FLAT 51'-54', 102'-108'	177.9	1
212224	PEAK RING 108'	57.8	1
195149	PEAK RING BULB GASKET 105"	0.9	2
212229	PEAK RING FOAM CLOSURE 30-48	0.5	15
212381	COMPRESSION RING ASSY 105'	657	1
212380	ROOF CONNECTION UPRIGHT	10.2	35
212374	RAFTER EAVE BRACKET 102'-108' LH	5.1	35
212375	RAFTER EAVE BRACKET 102'-108' RH	5.1	35
212392	TENSION PLATE BRACKET 102-108'	16.35	35
212388	TENSION PLATE 102'-108'	70.3	35
212291L	RAFTER 105' UPPER LEFT	286.6	18
212291R	RAFTER 105' UPPER RIGHT	286.6	17
212292L	RAFTER 105' LOWER LEFT	347.9	18
212292R	RAFTER 105' LOWER RIGHT	347.9	17
212707	CROSS BRACE 102'-108' #1	42.5	18
212708	CROSS BRACE 102'-108' #2	34.2	18
212709	CROSS BRACE 102'-108' #3	22.7	18
212710	CROSS BRACE 102'-108' #4	17	18
212725	DIAGONAL BRACE 142.6"	21.5	17
212726	DIAGONAL BRACE 92.8"	14	17
212441	ROOF Z-PURLIN BRACKET 102'-108'	5.02	35
212444	ROOF Z-PURLIN 105'	32.7	18
212445	ROOF Z-PURLIN SPLICE 105'	1.89	18
212504	TUBING BRACKET 102'-108' UPPER	6.8	70
212460	TUBE PURLIN S4 HEAVY	68.3	4
212462	TUBE PURLIN S7 HEAVY	68.3	7
212505	TUBING BRACKET 102'-108' LOWER	5.2	105
212465	TUBE PURLIN S10 HEAVY	68.3	10
212468	TUBE PURLIN S13 HEAVY	68.3	13
212470	TUBE PURLIN S15 HEAVY	68.3	15
212452	INNER SPLICE	3.7	44
232769	WIND RING SPLICE	3.9	5
235890	INSPECTION HATCH LID ASSY	7.48	1
235891	INSPECTION HATCH LATCH	0.81	1
235882	INSPECTION HATCH BULB GASKET 76"	0.5	1
212230	BIRD STOP	0.127	162
212231	FOAM ROOF RIB CLOSURE (set of 12)	0.06	14
193077	LADDER RUNG 38.5 (36.0CTR)	4.6	2
193076	LADDER RUNG 36.5 (34.0 CTR)	4.4	3
193075	LADDER RUNG 34.5 (32.0 CTR)	4.1	3
193074	LADDER RUNG 32.5 (30.0 CTR)	3.9	3
193073	LADDER RUNG 30.5 (28.0 CTR)	3.6	3
193072	LADDER RUNG 28.5 (26.0 CTR)	3.4	3
193071	LADDER RUNG 26.5 (24.0 CTR)	3.2	3
193070	LADDER RUNG 24.5 (22.0 CTR)	1.7	3

Table 18 Parts List for Structural Roof 105’ (continued)

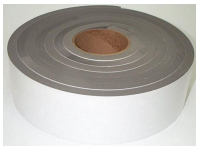
Part Number	Description	Unit Weight (lbs)	212612 - 105'
193069	LADDER RUNG 22.5 (20.0 CTR)	1.5	3
193068	LADDER RUNG 20.5 (18.0 CTR)	1.4	1
193067	LADDER RUNG 18.5 (16.0 CTR)	1.3	1
193066	LADDER RUNG 16.5 (14.0 CTR)	1.1	1
193065	LADDER RUNG 14.5 (12.0 CTR)	1	1
193064	LADDER RUNG 14.5 (10.0 CTR)	1	1
193063	LADDER RUNG 14.5 (8.0 CTR)	1	1
193062	LADDER RUNG 14.5 (6.0 CTR)	1	1
212054BSTR	ROOF SHEET BUNDLE 54' STRUCTURAL	5692.6	1
212105B	ROOF SHEET BUNDLE 105'	13881.25	1
212268	TOP ANGLE 105'	9.8	36
212740	FALL RESTRAINT BRACKET	0.3	2
235914	BOLT HFS .313 x 1.00 GR8.2 - BAG 250	8.5	18
235915	BOLT HFS .313 x 1.00 GR8.2 - BAG 50	1.7	2
235916	BOLT HFS .313 x 1.25 GR8.2 - BAG 80	3.04	7
235923	NUT HEX FLANGE .313 - BAG 250	3.5	20
235925	HEX FLANGE NUT .313 - BAG 50	0.7	2
235973	WSHR SEAL STL/NEO .313 - BAG (25)	0.13	3
235949	BOLT HEX .375 x 3.75 GR5 - BAG 10	1.27	24
235955	HEX FLANGE NUT .375 GR5 - Bag 50	0.95	13
193781	BLT HF .500 x 1.00 GR8.2 JS500	0.097	3300
154201	NUT HEX FLLK .500 GR2 JS500	0.045	3300
213429	PEAK REINFORCING BRACKET 60"	28.7	2
212453	MANUAL - ROOF STRUCTURAL	0.3	1

6.2. Roof Parts Box Part Identification

Table 19. Roof Parts Box Part Identification

195149 – Peak Ring Bulb Gasket (105")

195150 – Peak Ring Bulb Gasket (168")

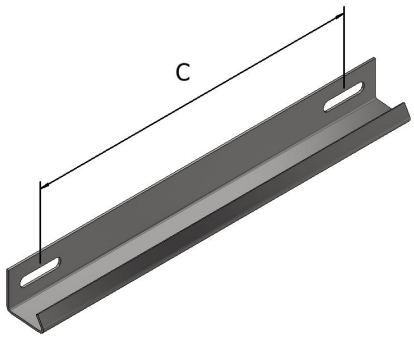


212228 – Peak Ring Foam Closure (15' - 27', 51' - 54')

212229 – Peak Ring Foam Closure (30' - 48')

212230 – Bird Stop

212231 – Roof Rib Foam Closure



P/N	C
193061	4
193062	6
193063	8
193064	10
193065	12
193066	14
193067	16
193068	18
193069	20
193070	22

P/N	C
193071	24
193072	26
193073	28
193074	30
193075	32
193076	34
193077	36
193078	38

"C" Dimension is in inches

193061-78 — Roof Ladder Rung

212370 – LH Rafter Eave Bracket (54' - 66')

212731 – RH Rafter Eave Bracket (not shown)

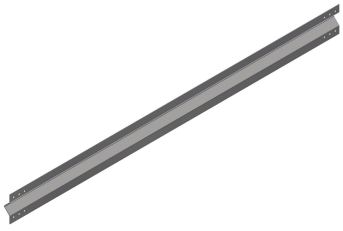
212372 – LH Rafter Eave Bracket (72' - 96')

212373 – RH Rafter Eave Bracket (not shown)

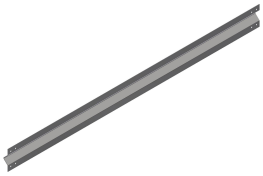
212374 – LH Rafter Eave Bracket (102' - 108')

212375 – RH Rafter Eave Bracket (not shown)

212380 – Roof Connection Upright



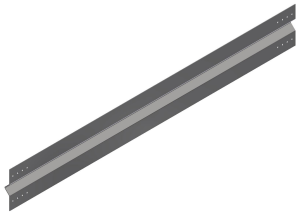
212386 - Tension Plate (72' - 84')



212383 – Tension Plate (48' - 51')

212384 – Tension Plate (54')

212385 – Tension Plate (60' - 66')



212387 – Tension Plate (90' - 96')

212388 – Tension Plate (102' 108')

212740 – Fall Restraint Bracket

212452 – Tube Purlin Inner Splice

212500 – Upper Tube Purlin Bracket (60' - 66')

212502 – Upper Tube Purlin Bracket (72' - 96')

212504 – Upper Tube Purlin Bracket (102' - 108')

212501 – Lower Tube Purlin Bracket (54' - 66')

212503 – Lower Tube Purlin Bracket (72' - 96')

212505 – Lower Tube Purlin Bracket (102' - 108')

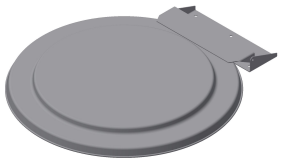
212439 – Z-Purlin Bracket (60' - 66')

212440 – Z-Purlin Bracket (72' - 96')

212441 – Z-Purlin Bracket (102' - 108')

232769 – Outer Wind Ring Splice (for Tube Purlin)

235882 – Inspection Hatch Bulb Gasket

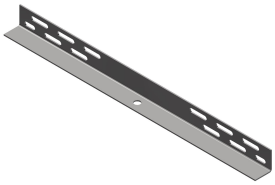


235890 – Inspection Hatch Lid Assembly

235891 – Inspection Hatch Latch Assembly

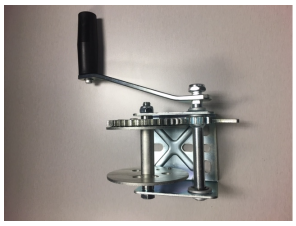
6.3. RCO Parts Box Part Identification

Table 20. RCO Parts Box Part Identification

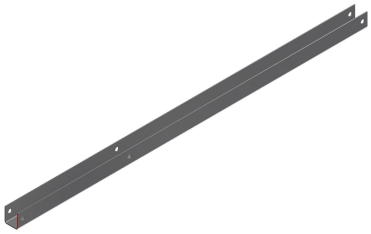


212402 – RCO Slide Rod Angle

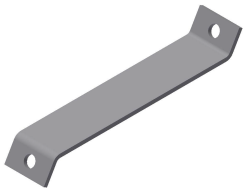
234815 – RCO Guide Rail (30' - 60') (41.35" Long)



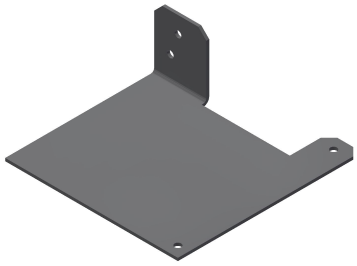
235817 – RCO Winch Assembly



234812 – RCO Rope Arm (36")



235220 – RCO Rope Arm Support



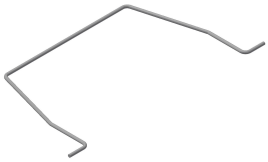
235279 – RCO Rope Guide Plate

234813 – RCO Winch Bracket

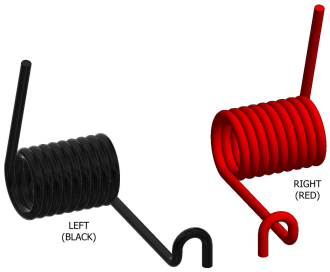
212401 – RCO Slide Rod (55" Long)

234805 – RCO Hardware Bag (30' - 60')

235337 – RCO Pivot Arm Bracket



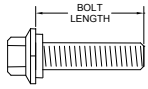
234811 – RCO Pivot Arm (30' - 60')



235341-42 – RCO Spring

6.4. Hardware Usage

Table 21. Roof Hardware

	5/16" x 1" Flanged Hex Bolt (Washer)	5/16" x 1-1/4" Flanged Hex Bolt (Washer)	5/16" Flanged Lock Nut	5/16" STL/NEO Sealing Washer	3/8" x 1-1/2" Flanged Hex Bolt (Washer)	3/8" x 3-3/4" Hex Bolt	3/8" Flanged Lock Nut	3/8" Hex Nut	3/8" STL/NEO Sealing Washer	1/2" x 1" Flanged Hex Bolt	1/2" Flanged Lock Nut
	235914 (250) 235915 (50)	235916 (80) 235917 (50)	235923 (250) 235925 (50)	235973 (25)	232852 (500)	235949 (10)	235954 (300) 235955 (50)	232850 (700) 232852 (500) 235950 (300) 235951 (100)	235975 (100)	193781	154201
TOP RING ANGLE to WALL SHEET		●	●								
ROOF SHEET to PEAK RING	●		●								
ROOF SHEET to Z-PURLIN	●		●								
ROOF SHEET to TOP RING ANGLE	●		●								
ROOF SHEET RIB to ROOF SHEET RIB	●		●								
LADDER RUNG to ROOF SHEET RIB		●	●	●							
LADDER RUNG to LADDER SUPPORT to ROOF SHEET RIB		●	●	●							
ROOF VENT to ROOF SHEET VENT CUTOUT	●		●								
INSPECTION HATCH LID ASSEMBLY to ROOF SHEET HATCH CUTOUT	●		●								
INSPECTION HATCH LATCH to ROOF SHEET	●		●								
BIRD STOP to TOP RING ANGLE	●		●								
FALL RESTRAINT BRACKET to TENSION PLATE	●		●								
FALL RESTRAINT BRACKET to RAFTER	●		●								
INSIDE ROOF CONNECTOR UPRIGHT to WALL SHEET to OUTSIDE UPRIGHT (DOUBLE NUT)					●		●	●	●		
TUBE PURLIN BRACKET CLOSURE						●		●			
TUBE PURLIN SPLICE						●		●			
PEAK RING to COMPRESSION RING										●	●
A-FRAME RAFTER ASSEMBLY (ALL CONNECTIONS)										●	●
PURLIN BRACKETS to A-FRAME RAFTER ASSEMBLY										●	●
A-FRAME RAFTER ASSEMBLY to COMPRESSION RING										●	●
A-FRAME RAFTER ASSEMBLY to INSIDE ROOF CONNECTOR UPRIGHT										●	●
Z-PURLIN to Z-PURLIN BRACKETS										●	●
Z-PURLIN SPLICE to Z-PURLIN										●	●
Z-PURLIN SPLICE to Z-PURLIN to Z-PURLIN BRACKET										●	●

6.5. Recommended Bolt Assembly

When tightening bolts, tighten the nut on the bolt until a “snug-tightened condition” has been achieved. A “snug-tightened condition” is defined in *Specification for Structural Joints Using ASTM A325 or A490 Bolts* (Research Council on Structural Connections: June 2004), which states:

“*The snug-tightened condition is the tightness that is attained with a few impacts of an impact wrench or the full effort of an ironworker using an ordinary spud wrench to bring the connected plies into firm contact.”*

A properly tightened bolt will compress the sealing washer noticeably. All assembly crew members must be made aware of this requirement, and must know how to achieve a snug-tightened condition using common bin-building tools.

It is important that the bolts in the vertical wall sheet seams are tightened enough to squeeze the caulking and bring the wall sheet surfaces into firm contact with each other. This is especially important to monitor when installing bolts in temperatures approaching -10°C (14°F).

The following table shows the minimum impact gun torque capacity necessary to achieve a snug-tightened condition for bolts used in the assembly process.

Table 22. Recommended Impact Gun Torque Values Capacity to Achieve Snug-Tightened Bolts

Bolt Diameter	Bolt Grade	Grade Mark	Recommended Torque Capacity		
			in-lb	ft-lb	N-m
1/4”	Grade 8.2		75	6	8
5/16"	Grade 8.2		215	18	24
3/8"	Grade 8.2		370	31	42
7/16"	Grade 8.2		600	50	68
1/2”	Grade 8.2		960	80	108
5/8”	Grade 8.2		1800	150	203
3/4”	Grade 5		3230	269	365

For proper sealing, do not overtighten the wall seam connections. Sealing is not critical on upright splice connections; these connections should be tightened securely to prevent loosening.

Hold the bolt head securely when tightening the nut to prevent damage to the sealing washer.

Important

Always tighten the nut, not the bolt.

Avoid bin assembly at temperatures below -10°C (14°F) if possible. Erection in low temperatures does not ensure strong, well sealed connections. Do not substitute bolts in place of those supplied by Westeel.

7. Limited Warranty: Westeel Grain Bin Products

Westeel – Ag Growth International ("Westeel") warrants products that it has manufactured and/or that are branded with its name (the "goods") subject to the following terms and limitations, (the "warranty"):

Duration of Warranty

This warranty will run from the date of purchase from the dealer or distributor, authorized by Westeel. The duration of the warranty is limited as follows:

Galvanized Bins	5 years
EasyFlow2	24 months
Westeel Fans	36 months
Floors	12 months
Catwalk	12 months
Bulk Feed Tanks	24 months
SeedStor-K Cones	
Paint	12 months
Structural	30 months
Elite Cones	
Paint	30 months
Structural	10 years
WESTEEL cones	
Paint	No Warranty
Structural	12 months
Smooth Wall Bins	
Paint	60 months
Structural	10 years
Commercial Smooth Wall Bins	
Paint	12 months
Structural	10 years

Limitation of Remedies Replacement

Within the warranty period, Westeel will replace the goods and/or original manufactured components thereof which are found, to Westeel's satisfaction, to be defective. Westeel is not responsible for direct, indirect, special, consequential, or any other damages of any kind, including personal injury to any individual, howsoever caused, including caused by transportation of the goods for repair or replacement.

Procedure for Obtaining Service

In the event of a warranty claim, the purchaser must complete any and all information required by Westeel in order to properly assess or investigate the claim. Westeel will not be responsible for the removal of any of the goods found to be defective, or transportation charges to and from Westeel's authorized dealer or distributor, or for installation of any replacement goods and/or parts furnished under the warranty.

Limitations as to Scope of Warranty

The warranty does not extend to defects or damage caused, in whole or in part, by:

1. use of a kind and/or to a degree not reasonably expected to be made of the goods;
2. improper storage of the goods both prior to and after purchase;
3. damage caused by, or in the course of, installation or assembly;
4. any use of the goods which is not an intended use as specified in Westeel's published product literature, or otherwise specified by Westeel in writing;
5. any equipment attached to or used in conjunction with the goods;
6. any field modifications or substitutions to original bin components;
7. inadequate ventilation or any other circumstance not in keeping with proper maintenance and/or use of the goods;
8. Acts of God, accident, neglect or abuse of the goods by the purchaser and/or any other individual or entity; or
9. Any use or installation inconsistent with Westeel’s Standard Disclaimers.

Limitations as to Manufacturer

The warranty does not cover products sold by Westeel that are not manufactured by Westeel. In those circumstances, the purchaser is referred to the manufacturer of those products.

Limitation of Implied Warranties and Other Remedies

To the extent allowed by law, neither Westeel nor its dealers, nor any company affiliated with Westeel makes any warranties, representations, or promises as to the quality, performance, or freedom from defect of any Product covered by this Warranty.

WESTEEL HEREBY DISCLAIMS, TO THE EXTENT APPLICABLE, ANY AND ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. A PURCHASER’S ONLY REMEDIES IN CONNECTION WITH THIS WARRANTY ARE THOSE SET FORTH IN THIS WARRANTY. IN NO EVENT WILL WESTEEL, ITS DEALERS, OR ANY COMPANY AFFILIATED WITH WESTEEL BE LIABLE FOR INCIDENTIAL, CONSEQUENTIAL OR PUNITIVE DAMAGES.

Some jurisdictions do not allow waivers of certain warranties, so the above waivers may not apply to you. In that event, any implied warranties are limited in duration to ninety (90) days from delivery of the products. You may also have other rights which vary from jurisdiction to jurisdiction.

Exclusive Warranty

This warranty is the only warranty provided by Westeel and all other warranties and/or commitments, whether express or implied and no matter by whom made, statutory or otherwise, are subsumed and replaced by it and are of no legal effect. If any provision of the warranty is held by a court of

competent jurisdiction to be void or unenforceable, in whole or in part, such provision shall be deemed severable and will not affect or impair the legal validity of any other provision of the warranty.

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Please include the part number listed on the cover page in your message.