



Installation Guide

BIN PIPING SYSTEMS

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Introduction

Congratulations on your choice of a Walinga pneumatic conveying system to complement your operation. This equipment has been designed, engineered and manufactured to meet the needs of the discriminating buyer for the efficient loading of bulk commodity storage structures.

Your safety and the performance of your system are the top priorities. This guide has been created for the express purpose of keeping you safe and providing education for the efficient, safe and correct installation of the components of your system.

Your system's appearance, structural design or configuration may differ from illustrations shown in the guide. Continuous design improvements for optimized field performance are on-going and may have been made to your system since the publication of the guide. Specifications, descriptions and all other information in the guide are subject to change and/or correction without notice. Contact your local dealer or Walinga representative for the most current revision of the guide or if you have any questions.

Accident prevention regulations, and all other generally recognized regulations on safety and occupational health and safety must be observed at all times. Any unauthorized modifications carried out to the pneumatic conveying system or components may relieve Walinga of liability for any resulting damage or injury and is considered contrary to the intended use.

System Configuration

Walinga's pneumatic conveying systems are highly customizable to meet the requirements of each operation while maintaining high levels of efficiency. A reference bin piping system layout is presented in **Figure 1** below.

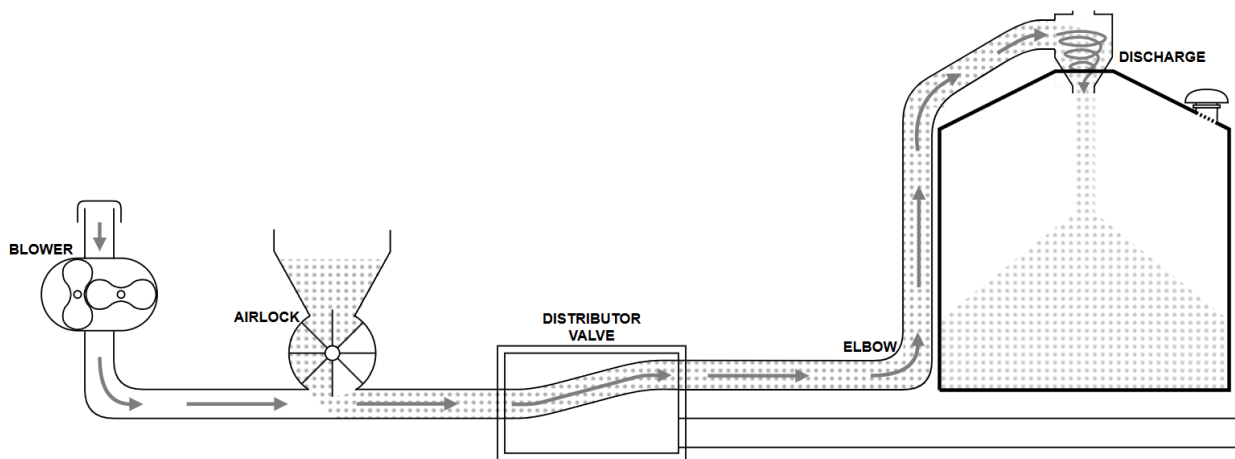


Figure 1: Basic bin piping system layout

PNEUMATIC CONVEYING BASICS

To better understand the importance of the established system requirements and best practices it is important to have basic knowledge of the science behind pneumatic conveying. Bernoulli's Principle provides key insights into fluid flow, the basis for dilute phase systems. The principle states that the pressure in a fluid decreases as its velocity increases. Applying this to a pneumatic conveying system, we can make the following key observations:

- Excessive pressure drops and subsequent velocity rises will lead to poor product flow, system instability and the eventual saltation of the product leading to system blockages. Product moving at higher velocities will lead to increased wear and product damage.
- At the outlet of the airlock, the system will have the highest pressure and the product will be moving at the slowest velocity.
- As product travels through a length of line the pressure will decrease due to turbulence and frictional losses and the velocity of the product will increase. The decrease in pressure is proportional to the length of the line, meaning the longer the line, the lower the pressure will drop and the higher the velocity will rise.
- An elbow or bend will cause an increase in the system pressure. A long radius bend (center line radius greater than five times the line diameter) will have a lower impact on the pressure variation and improve the overall system performance compared to the use of a short radius elbow.
- As the vertical height of product increases within the conveying lines, the pressure will decrease, causing a high velocity area.
- The discharge point of the system will experience the lowest pressure and highest velocity.

SYSTEM LAYOUT REQUIREMENTS AND BEST PRACTICES

Walinga's pneumatic conveying systems provide excellent flexibility for installation in unique facilities and locations. For best system performance and to achieve the system's maximum potential capacity, implement the following requirements and best practices:

BLOWER At the heart of the Walinga system is a positive-displacement blower, sometimes referred to as an air pump. The blower unit creates a pressurized air stream that moves past the outlet of the rotary airlock, where the conveyed product is introduced into the system. The pressurized air is the driving force to move product throughout the system.

- The blower may be positioned up to 60 ft (18.3 m) from the position of the airlock.
- To reduce the length or electrical cable required, position the blower close to the electrical power source.

- Short radius elbows (center-line radius less than five times the line diameter) may be used between the blower and airlock. These elbows are not designed to be used in the flow of product.
- If the system includes a connection to a dryer, the blower must not be positioned such that the blower inlet is exposed to the steam exhausted by the dryer. Exposure to steam in cold ambient temperatures can cause ice to form in the blower intake, or Smart-Flo sensor assembly (if equipped), causing premature damage and restricting the proper operation of the components.

AIRLOCK The airlock acts as a seal between the pressurized air stream from the blower and the product inlet. As the airlock rotor turns, the upward facing rotor pocket fills with falling material. As the pocket rotates, material is moved to the bottom of the airlock where it enters the pressurized air stream.

- The airlock requires regular maintenance. Ensure the airlock is positioned and connected to the system in a manner that allows easy access and removal for maintenance.
- The airlock inlet should allow for access or easy removal to permit the application of a rust inhibitor to the airlock interior to prevent seizing during the off-season.
- The standard airlock rotates in a counter-clockwise direction, as viewed from the driven end. Ensure the airlock is positioned such that the flow direction decal mounted to the airlock is pointed in the correct direction.
- The airlock may be positioned such that a dryer, if equipped, discharges directly into the inlet of the airlock.
- An airlock should never be positioned directly below a surge bin; the inlet of the airlock should be fed by a drag or auger from the surge bin. To control the flow of product into the airlock, the drag or auger should be equipped with a variable frequency drive (VFD). Ensure the airlock inlet is properly vented to prevent bridging and erratic flow.

CONVEYING LINES While it may be the simplest of the system components, the conveying lines can have the largest effect on the overall efficiency of the system. Both the overall layout and installation of the lines are critical for overall system performance.

- Keep all conveying lines as short and as straight as possible. The system should be planned to minimize the distance and total number of elbows required.
- There must be a minimum of 20 ft (6.1 m) of straight line installed directly after the airlock. Installation of an elbow within this distance can lead to excessive wear, excessive pressure, system blockages, and unstable flow. Due to the limited disruption of flow, a distributor valve may be installed within 20 ft (6.1 m) of the airlock.

- To monitor the flow of product to all system lines, the sight glass should be installed between the airlock and the first distributor or diverter valve.
- It is critical that all components (lines, elbows, valves, and discharge assemblies) are the same size. It is not sufficient for two tube components to be the same outer diameter, the wall thickness (gauge) must also be the same. Similarly, it is not appropriate to install a tube and pipe component of the “same” diameter. Installing two components with varying internal diameters will lead to increased turbulence, wear and product damage, and poor system performance.
- All horizontal lines should be installed such that they are level within 5°. An excessive angle in a horizontal line can lead to increased turbulence, saltation, system blockages, premature wear, product damage and poor system performance.
- All conveying lines must be adequately supported. Refer to the subsection *Loading and Support Structures* for further information and requirements.
- If conveying lines are to be installed underground:
 - Galvanized lines must be used.
 - It is recommended that the lines be installed in a buried pipe or culvert for protection and not buried directly in the earth.
 - It is recommended that 30° elbows are used if the lines must be angled underground.
 - It is important to note that even with correct installation, underground lines are prone to excess moisture. A high water table can cause water to seep or wick into the lines. Due to the heat-sinking nature of soil, underground lines will have a more pronounced temperature gradient, leading to higher levels of condensation when the warmer air of the system is introduced. The distributor valve located after the underground lines should be positioned to allow for access to blow any accumulated water out of the system.

ELBOWS While the total number of elbows should be limited as much as possible, it is important to correctly select and install any elbows that are used.

- Ensure the elbows used are compatible with the conveying lines of the system (i.e. the nominal size and wall thickness (gauge) must be the same).
- Long radius elbows (center line radius greater than five times the line diameter) are to be used. Short radius elbows are only acceptable for use between the blower and airlock.

- Installation of elbows in close proximity to another elbow will lead to excessive pressure drops, increased wear and product damage, potential blockages, and poor system performance. A sufficient length of straight line must be installed following an elbow before another elbow is installed; reference **Table 1** below.

Note: the elbow spacing requirement does not apply to the typical 30° and 60° elbows installed at the top of a vertical run on the roof of a bin directly before the discharge point.

Table 1: Straight line required after an elbow

Line Size	Recommended		Minimum	
	[ft]	([m])	[ft]	([m])
2"	20.0	(6.1)	15.0	(4.6)
3"	20.0	(6.1)	15.0	(4.6)
4"	20.0	(6.1)	15.0	(4.6)
5"	25.0	(7.6)	20.8	(2.5)
6"	30.0	(9.1)	25.0	(6.3)
7"	35.0	(10.7)	29.2	(8.9)
8"	40.0	(12.2)	33.3	(10.1)
10"	50.0	(15.2)	41.7	(12.7)

MISCELLANEOUS For efficient and ideal operation of the system, the following should be observed:

- All joints between sections of lines, components and elbows should be secured using compression couplings. To prevent excessive turbulence, it is important that the ends within the coupling are butted flush together. Tighten all compression couplings to the specified torque; overtightening of the couplings can lead to deformation and leaks. Refer to subsection *Compression Coupling Installation* for the detailed installation procedure.
- All bins and storage structures must be properly vented. The system discharge point introduces a significant amount of pressurised air. Additionally, the discharged product displaces air within the bin. This pressurized air and displaced air must have an unobstructed and unrestricted path out of the bin. Failure to provide adequate venting can result in catastrophic failure of the bin potentially leading to death, serious injury or extensive property damage.
- All discharge assemblies must be adequately supported. Ensure the structural integrity of the bin is not compromised. Reference subsection *Loading and Support Structures* for detailed information.

- To prevent the introduction of water, pests or debris, any open ends of lines or components should be equipped with sealing apparatus such as a coupler, cap or cover.
- To monitor the system performance and for additional troubleshooting information as required, each system should be equipped with a pressure gauge. Typically this gauge should be mounted along the outlet of the blower before the airlock.
- To prevent damage to the blower, the system should be equipped with a pressure relief valve. Standard Walinga blowers are not rated for use in systems operating at pressures above 15 psi (103.4 kPa). In the event of a line blockage, the pressure relief valve allows the release of air to prevent overpressurization and permanent damage to the equipment.
- For the most efficient operation of the system, the blower may be equipped with Walinga's Smart-Flo system. The Smart-Flo adjusts the operational speed of the blower to meet the instantaneous needs of the system, adapting to changes in product flow, condition or conveying distance.
- Ensure the installation of any components does not compromise the integrity of the bin. Any holes made in the walls or roof of the bin must be well sealed to prevent the ingress of water, pests or debris.

LOADING AND SUPPORT STRUCTURES

The support structures for a pneumatic conveying system must be sufficient to support both the static and dynamic loading experienced by the components. The following information is for reference only; for a detailed loading analysis, consult the bin manufacturer or a licensed mechanical and / or structural engineer. Unless otherwise stated, all reference data and loading equations assume the system is conveying dry corn approximately 100 ft (30.5 m) and ambient conditions are at standard atmospheric pressure and temperature. Refer to all local building codes and regulations to ensure compliance. It is standard industry practice to apply a safety factor of 3.0 to 4.0 to all dynamic loads and a safety factor of 1.5 to 2.0 for all static loads; the loading equations listed in *Appendix II* do **not** include a safety factor.

The support structures for pneumatic conveying systems must be able to support a wide range of loading experienced by the components including but not limited to:

STATIC LOAD (F_s) The static load is calculated as the sum of the empty weight of the component and the weight of the product that would fill the component in the event of a blockage. Reference *Appendix II* for the static loading equation.

MOMENTUM LOAD (F_m) The momentum load is an application of Newton's Second Law applied through the linear momentum equation. It accounts for the forces experienced within the components due to the movement of the mass. Reference *Appendix II* for the momentum loading equation.

THERMAL LOAD (F_t) The thermal load is a combination of thermal strain and Hooke's Law. It represents the forces experienced from the expansion of the lines against a restraint due to the temperature difference between the conveyed product and the ambient temperature. Reference *Appendix II* for the thermal loading equation.

PRESSURE THRUST LOAD (F_p) The pressure thrust load is derived from vector statistics and Pascal's Law. It represents the resultant force a component, such as an elbow, exerts on its restraints due to the internal pressure acting through a change in direction. Reference *Appendix II* for the pressure thrust loading equation.

CENTRIFUGAL LOAD (F_c) The centrifugal load is an application of Newton's Second Law to an object moving in a circular path. It represents the radial forces exerted on the restraints of a circular component, such as a discharge cyclone. Reference *Appendix II* for the centrifugal loading equation.

WIND LOAD (F_w) The wind load is a derivation of Bernoulli's principle. It represents the force exerted on an object from the wind due to the rapid deceleration and transformation of the air's kinetic energy into a high-pressure zone. Reference *Appendix II* for the wind loading equation.

SEISMIC LOAD (F_q) The seismic load is an adaptation of Newton's Second Law to account for the seismic resonance experienced during an earthquake. This load represents the lateral inertial forces exerted by the oscillating component on its restraints. Reference *Appendix II* for the seismic loading equation.

RECOIL LOAD (F_r) The recoil load is an application of Newton's Third Law. This load represents the massive lateral thrust load that is exerted on the supports of the component equipped with an explosion vent during a deflagration. It is important to note that this load will also create a massive moment on the support structure due to the typical raised position of the explosion vent on a dustless discharge cyclone. Reference *Appendix II* for the recoil loading equation.

The overall load a support structure must withstand is defined under the *Load Combination Equation* as specified by local, national or international building codes, standards or regulations. This equation combines the dead, live and occasional loadings with safety factors to ensure structural stability.

The following represent the typical best practices for support structures; all applicable local codes, standards and regulations must be followed.

- Lines may be supported through a variety of support accessories as appropriate including but not limited to: hanger supports, stand off brackets and clamps, and truss kits. Reference *Appendix I* for supports available from Walinga.
- A support should be positioned on each side of a sight glass.
- Each horizontal length of line should typically have a minimum of two supports to maintain support in the event a section of line is removed for maintenance.
- Each elbow should have a minimum of two supports that are structurally anchored and capable of resisting the forces exerted from the elbow. It is not suitable to use hanger supports on an elbow.
- For a horizontal length of line conveying dry corn, the recommended support spacing to prevent saltation, poor performance and line blockages due to sagging is detailed in **Table 2**. Reference *Appendix II* for the recommended support spacing in systems conveying other products.
- For an elevated length of line, such as one spanning between the roofs of two bins, if the length of the line exceeds the recommended horizontal installation spacing distance, additional support, such as a truss kit, must be utilized.
- For a vertical length of line conveying dry corn, the recommended lateral guide support spacing to prevent bowing, swaying and excessive vibration is detailed in **Table 2**.
- The weight-bearing support at the base of a vertical length of line must be sufficient to support the entire weight of the vertical line in addition to the weight of product that could be contained within that section of line if it were to be completely full of product.
- Supports positioned in close proximity to the blower, airlock, or other areas with high temperature gradients should permit some lateral movement of the line to assist in reducing the thermal loads. Excessive restriction of lines exposed to high temperature gradients can result in bending, bowing or buckling.

Table 2: Line support spacing

Line Size		Horizontal Installation				Vertical Installation	
		Recommended		Maximum		Maximum	
		[ft]	([m])	[ft]	([m])	[ft]	([m])
2	16 ga	8.0	(2.44)	10.0	(3.05)	12.0	(3.66)
	SCH 40	9.0	(2.74)	11.0	(3.35)		
3	11 ga	9.5	(2.90)	12.0	(3.66)	12.0	(3.66)
	SCH 40	11.0	(3.35)	13.5	(4.11)		
4	11 ga	11.0	(3.35)	15.0	(4.57)	15.0	(4.57)
	SCH 40	12.0	(3.66)	15.0	(4.57)		
5	11 ga	12.0	(3.66)	15.0	(4.57)	15.0	(4.57)
	SCH 40	13.0	(3.96)	17.0	(5.18)		
6	11 ga	13.0	(3.96)	16.0	(4.88)	15.0	(4.57)
	SCH 40	14.5	(4.42)	18.0	(5.49)		
7	11 ga	13.5	(4.11)	17.0	(5.18)	15.0	(4.57)
8	11 ga	14.0	(4.27)	18.0	(5.49)	20.0	(6.10)
	SCH 40	16.0	(4.88)	20.5	(6.25)		
10	7 ga	16.0	(4.88)	20.5	(6.25)	20.0	(6.10)
	SCH 40	18.0	(5.49)	23.0	(7.01)		

System Installation Procedures

It is important that an overall system layout is developed prior to the installation of any component. Ensure the location of key components such as the blower, airlock, distributor valves, elbows and discharge assemblies follow the requirements and best practices identified in the *System Configuration* section. Always keep in mind:

- Minimize the total length of line required.
- Minimize the total number of elbows used.
- Ensure all elbows are separated by the required length of straight line.
- Ensure all lines and components can be adequately supported without compromising the integrity of any other component or installation.
- Be mindful of the ease of access for system maintenance.
 - Ensure the airlock can be easily accessed and removed.
 - Ensure all line joints are accessible.
 - If the bin is equipped with an upper working platform, it is ideal to position the upper elbow connected to the vertical line directly next to the platform.
- Ensure the intended line route is clear of immovable obstructions such as bin vents, access platforms, ladders, stairs, equipment, etc.. Make any adjustments as required to the intended line route.
- Each joint increases the risk of system leaks, turbulence, excessive system wear, product damage, and decreased system performance. Do not introduce joints unnecessarily; if a 40 ft (12.2 m) straight run is required, an installation using two 20 ft (6.1 m) sections of line will perform better than an installation using four 10 ft (3.0 m) sections of line.

LINE CUTTING

When cutting a section of line, proceed as follows:

1. Ensure the area is clear of any bystanders and individuals not involved in the installation of the system, especially small children.
2. Verify the required length of line. Measure twice and cut once.
3. It is crucial that the cut is made exactly 90° (perpendicular) to the centerline. Any deviation, even slight, can result in the formation of a gap or pocket during the installation of the joint's compression coupling, leading to turbulence, excessive system wear, product damage, and decreased system performance.
4. Use a tool, such as a guided band saw, that is capable of making a clean, perpendicular cut. Avoid the use of freehand or unguided tools.

5. Once cut, all burrs must be removed from the end of the line.
 - a. Internal deburring must be performed to prevent the formation of “streamers” or build-up.
 - b. External deburring must be performed to prevent damage to the internal gasket of the compression couplings and to ensure a good seal is formed.
6. Clean and degrease the end of the line extending at least 6 in (15.2 cm) past the cut end to remove any metal shavings, dirt, debris or cutting oils to prevent contamination of the conveyed product. Dirt and debris can also prevent the compression coupling from forming an effective seal. Cutting oils can degrade the inner gasket of the seal, leading to leaks.
7. Check the line for roundness. Improper cutting or machining may lead to deformations. Any line that is out-of-round will not form an effective seal when the compression coupling is installed, leading to turbulence, excessive system wear, product damage, and decreased system performance.

ELBOW CUTTING

Typical installations on a bin larger than 24 ft (7.3 m) in diameter will use a 60° and 30° elbow to connect the vertical line section to the discharge assembly. It is recommended that the 60° and 30° elbows specifically identified in *Appendix I* are used for this application. These elbows have a tangential section of straight line at each end of the elbow, allowing for easier installation and a better compression coupling seal. However, a 90° elbow may be cut to produce the two required elbows if necessary. When installing an elbow that has been cut, the straight tangent must be installed to be the downstream end (closer to the discharge point). To cut an elbow, proceed as follows:

1. Ensure the area is clear of any bystanders and individuals not involved in the installation of the system, especially small children.
2. Measure the total length of the elbow along the **outer** radius of the elbow.

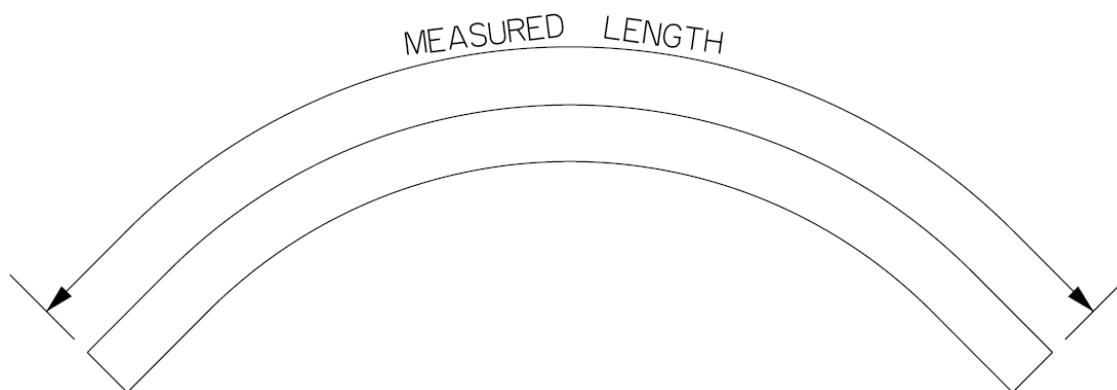
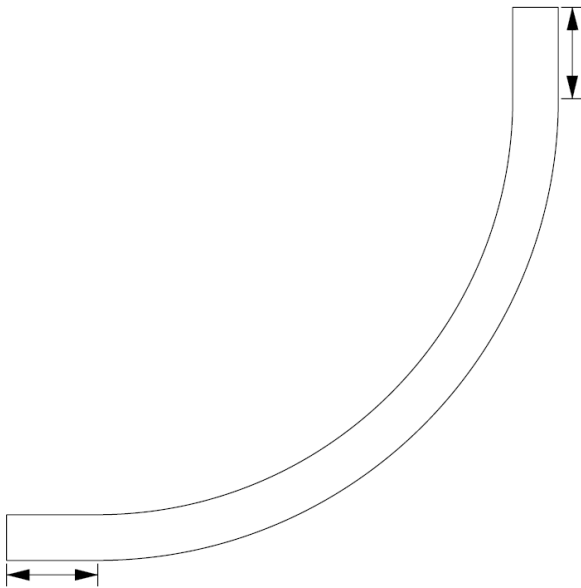


Figure 2: Elbow length measurement

- Calculate the required length of the cut using the following equation and the data from **Table 3** below. Mark the *Cut Length* on the outer radius of the elbow.

$$\text{Cut Length} = \frac{\text{Measured Length} - (2 \times \text{Straight End Length})}{3} + \text{Straight End Length}$$

Table 3: Standard elbow straight end length



Line Size	Standard Straight End Length	
	[in]	([cm])
2"	6	(15.2)
3"	6	(15.2)
4"	8	(20.3)
5"	10	(25.4)
6"	12	(30.5)
7"	14	(35.6)
8"	16	(40.6)
10"	22	(55.9)

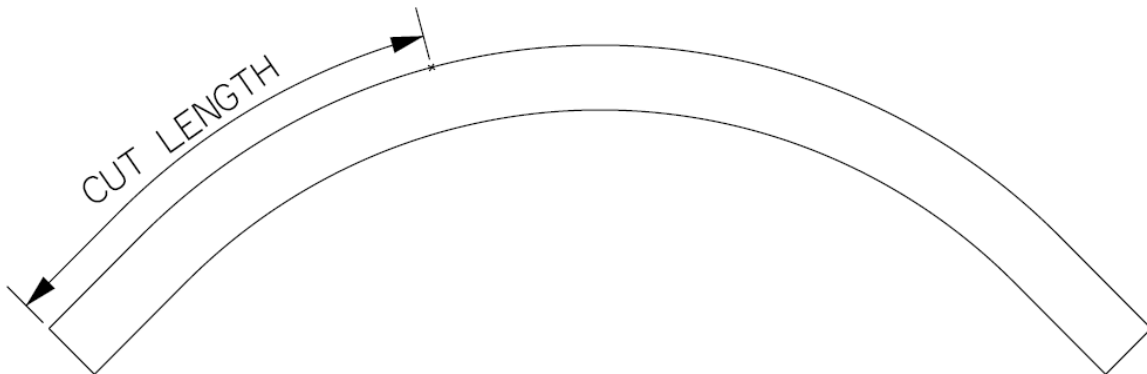


Figure 3: Elbow marking

4. It is crucial that the cut is made exactly 90° (perpendicular) to the centerline. Any deviation, even slight, can result in the formation of a gap or pocket during the installation of the joint's compression coupling, leading to turbulence, excessive system wear, product damage, and decreased system performance.

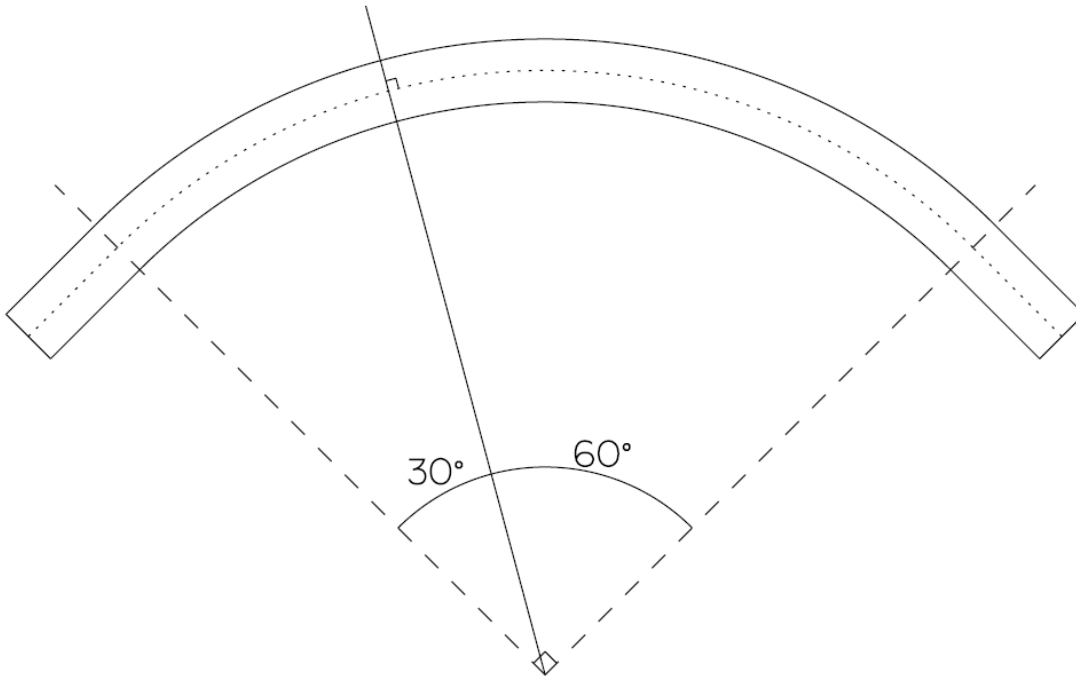


Figure 4: Elbow cutting

5. Use a tool, such as a guided band saw, that is capable of making a clean, perpendicular cut. Avoid the use of freehand or unguided tools.
6. Once cut, all burrs must be removed from the end of the line.
 - a. Internal deburring must be performed to prevent the formation of “streamers” or build-up.
 - b. External deburring must be performed to prevent damage to the internal gasket of the compression couplings and to ensure a good seal is formed.
7. Clean and degrease the end of the line extending at least 6 in (15.2 cm) past the cut end to remove any metal shavings, dirt, debris or cutting oils to prevent contamination of the conveyed product. Dirt and debris can also prevent the compression coupling from forming an effective seal. Cutting oils can degrade the inner gasket of the seal, leading to leaks.
8. Check the line for roundness. Improper cutting or machining may lead to deformations. Any line that is out-of-round will not form an effective seal when the compression coupling is installed, leading to turbulence, excessive system wear, product damage, and decreased system performance.

COMPRESSION COUPLING INSTALLATION

Joints in the system are secured with compression couplings. Poorly installed couplings will cause turbulence, excessive system wear, product damage, and decreased system performance. It should also be noted that, over time, lines and components may shift due to forces experienced during normal operation and the coupling seals may degrade. Even a properly installed compression coupling may loosen. Regular inspection and adjustment of the compression couplings and joints is required to maintain efficiency and stability, prolong the life of the system and reduce product damage. To install a compression coupling, proceed as follows:

1. Inspect the component and / or line(s) that are to be joined.
 - a. Verify that the ends are dry clean of any metal shavings, dirt, debris and oils. Clean as required.
 - b. Verify that the ends show no signs of damage or deformities. Ends that are too out-of-round will not form an effective seal; some slight variation is tolerable and is to be expected.
 - c. Verify that the two are both of the same diameter and gauge. Improperly matched lines / components will lead to turbulence, excessive system wear, product damage, and decreased system performance.
2. Position the ends of the lines such that they are flush and tightly butted against each other.
3. Inspect the coupling to ensure it is free of dirt and debris. Verify that the gasket and sleeve partings are **not** aligned, rotate the gasket as necessary.
4. Position the compression coupling so that it is centered above the tightly butted joint. Mark the end of the coupling on the line(s) / component to verify it is properly centered during installation.

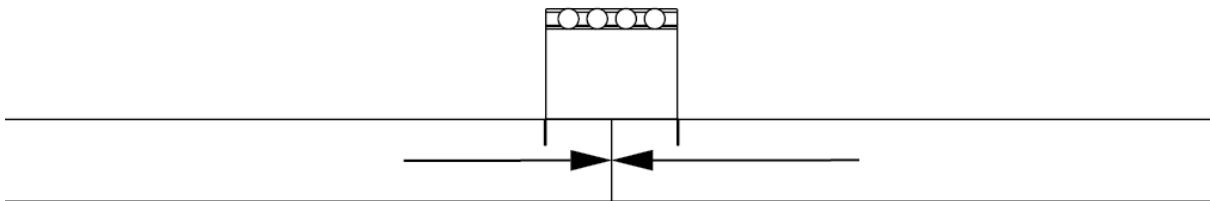


Figure 5: Compression coupling position marking

5. Slide the compression coupling onto one line and then tightly butt the other line / component against the first line. The joint must be tight to prevent turbulence, excessive system wear, product damage, and decreased system performance.
6. Using the marks made in **Step 3**, center the compression coupling over the joint. Ensure the inner gasket is properly positioned and has not shifted during installation and that any grounding strip, if equipped, is in contact with both line(s) / component.

7. Partially tighten the bolts of the coupling in a uniform manner to allow the sleeve and gasket to properly seat.
8. Tighten the bolts to the torque specified in **Table 4** below. Note that when properly installed and tightened, the bolt flanges will **not** be parallel; only the **top** edges of the bolt flanges will touch. Do not overtighten.

Table 4: Compression coupling installation torque

Line Size	Torque	
	[ft-lbs]	([Nm])
2"	45	(61)
3"	95	(129)
4"	95	(129)
5"	95	(129)
6"	95	(129)
7"	95	(129)
8"	95	(129)
10"	95	(129)

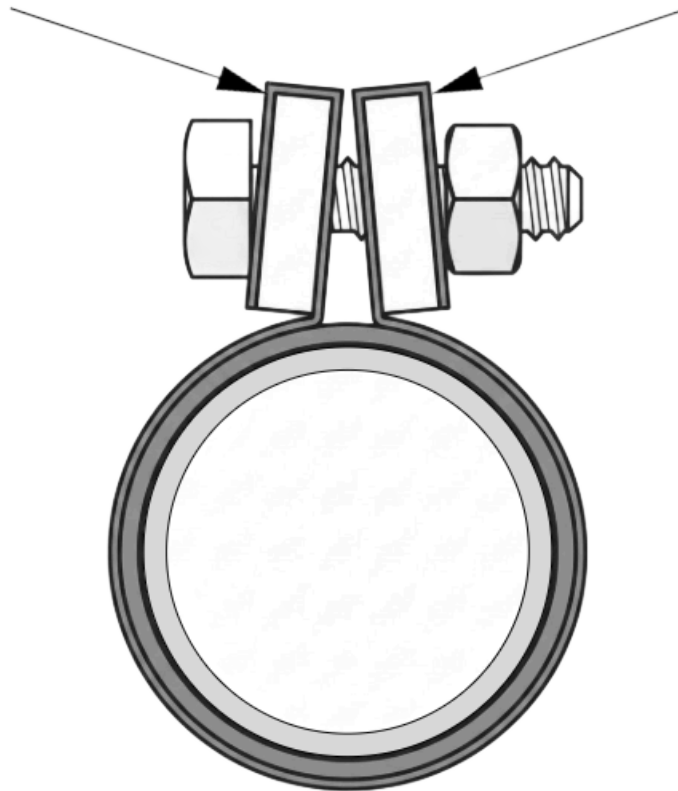


Figure 6: Flange position of correctly installed compression coupling

VERTICAL LINE SUPPORT INSTALLATION

To install the supports attached to the bin for the vertical line, proceed as follows:

1. Ensure the area is clear of any bystanders and individuals not involved in the installation of the system, especially small children.
2. Verify the required positioning of the supports. Ensure the position will align with the desired route of the horizontal upstream lines and the desired location of the upper elbow next to any elevated platform or access.

NOTE: If the concrete footing of the bin foundation extends further than 7 in (17.8 cm) from the bin wall, the heavy duty (HD) variation of the stand-off brackets must be used to ensure the lower elbow will not contact the foundation.

3. Determine the total number and spacing of supports required.
 - a. The top support should be positioned as high as possible such that it is as close as possible to the lower joint of the elbow that will be installed at the roof eave. Ensure there is sufficient clearance for the installation of the joint's compression coupling. The maximum allowable distance from the joint is 24 in (61.0 cm). Note that standard long radius elbows have straight ends, refer to **Table 3** for the length of the straight sections.

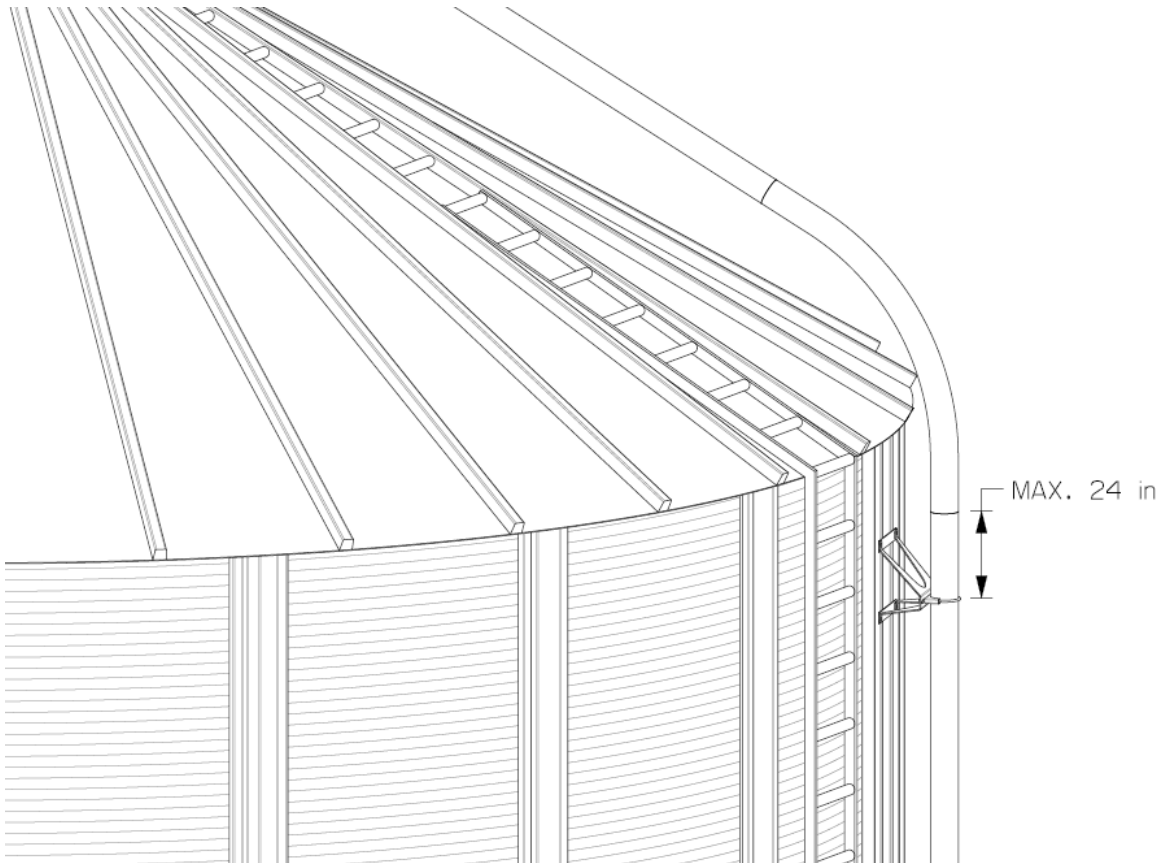


Figure 7: Positioning of top-most support

- b. The bottom support should be positioned such that it is within 12 in to 24 in (30.5 cm to 61.0 cm) of the top joint of the elbow that will be installed at the bottom of the vertical line. Note that standard long radius elbows have straight ends, refer to **Table 3** for the length of the straight sections. Ensure the support will not interfere with the elbow compression coupling.

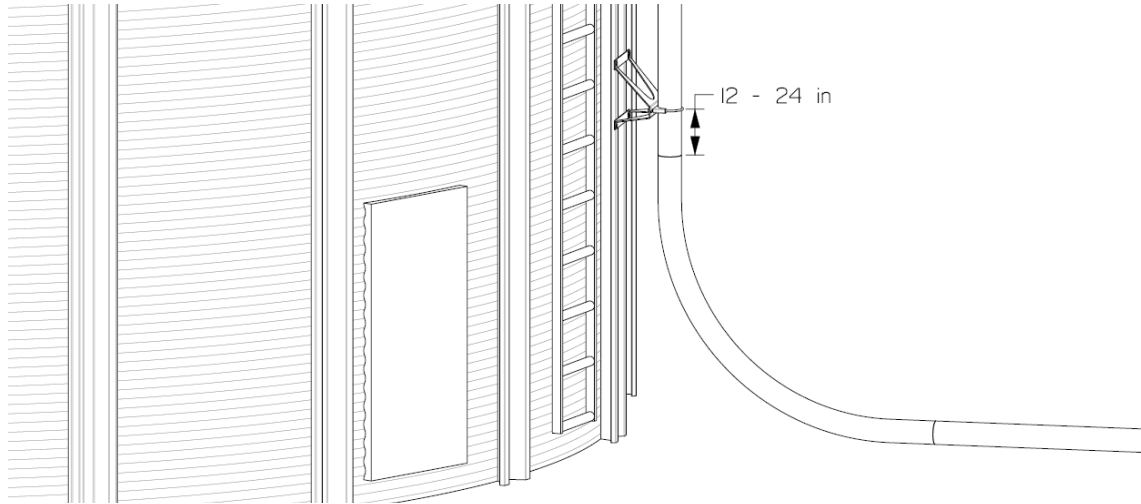


Figure 8: Positioning of bottom-most support

- c. Refer to **Table 2** to determine the appropriate support spacing. The supports should be spaced evenly between the predetermined upper and lower support locations. Do not exceed the recommended support spacing.
4. For bins equipped with outer stiffeners, the stand-off bracket supports may be secured to the stiffeners as follows:
 - a. Prepare two pieces of flat bar 14.25 in (36.20 cm) long for standard stand-off brackets (wide stand-off brackets will require a length of 15.75 in (40.00 cm)).
 - b. Secure the first flat bar to the stiffener such that it allows the lower short legs of the bracket to be properly positioned for the required support location.

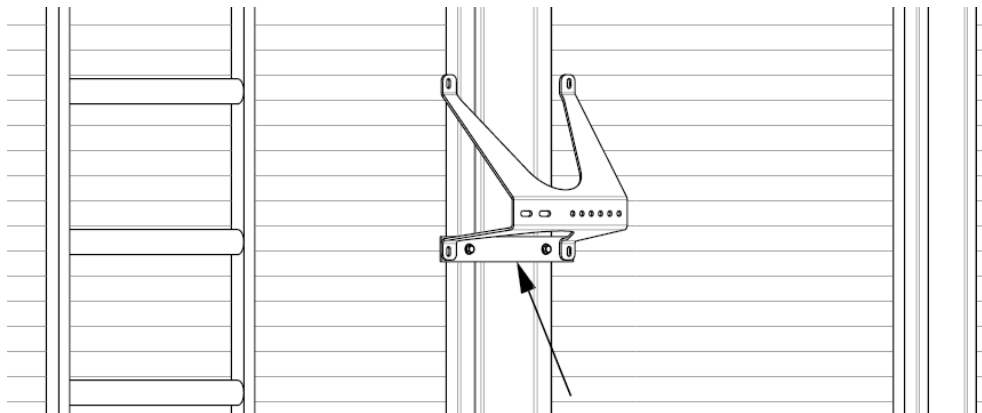


Figure 9: Proper stand-off bracket orientation with lower flat bar

- c. Secure the second flat bar such that it aligns with the upper long legs of the bracket.
- d. Secure the stand-off bracket to the flat bar using 3/8" hardware. Ensure the bracket is level.

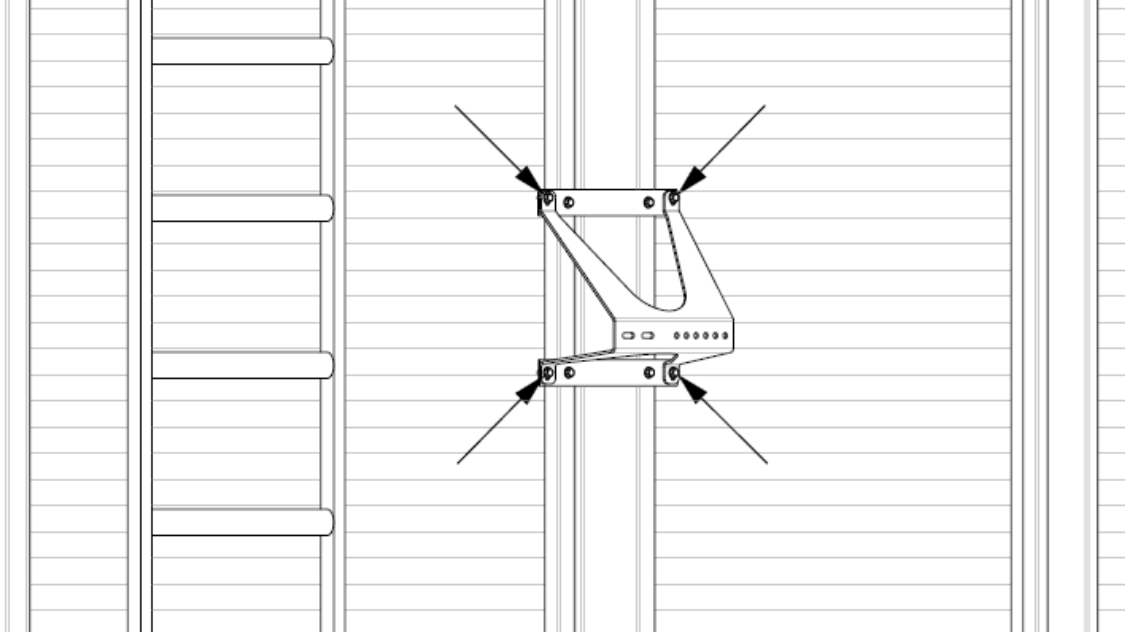


Figure 10: Stand-off bracket securement to stiffeners

- e. Repeat **Step 4a to 4d** to secure all stand-off brackets at the required position.
5. For all other bins, the stand-off bracket supports are to be secured to the bin as follows:
 - a. Identify the required position of the first stand-off bracket. Note that the longer angled legs must be positioned upwards, as seen in **Figure 9**. Ensure the bracket is level.
 - b. Mark the location of the stand-off bracket mounting holes on the bin with a marker or center punch.
 - c. Verify the required drill size specified by the manufacturer of the rivet nut that is to be used. An oversized hole will prevent proper engagement of the rivet nut with the bin wall and may cause separation of the bracket from the bin. Drill the marked locations.
 - d. Remove any debris or burrs from the holes to allow the rivet nut to sit flush against the bin for proper engagement.
 - e. For galvanized bins, if available, apply a layer of cold galvanizing spray to the drilled holes to protect the exposed metal from corrosion.
 - f. Apply a layer of silicone to the first drilled hole to form an effective seal against the bin and rivet nuts to maintain the integrity of the bin.

- g. Thread a 3/8" rivet nut onto the mandrel of the installation tool and insert the rivet nut into the prepared hole until the flange is tight against the bin wall.

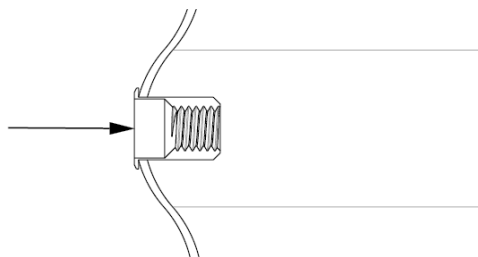


Figure 11: Insertion of rivet nut

- h. Set the rivet nut by actuating the installation tool. Ensure the rivet nut is perpendicular to the surface of the bin to prevent an uneven set.

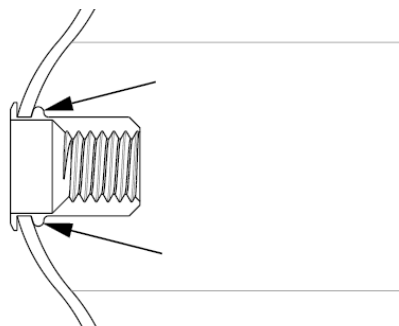


Figure 12: Rivet nut setting

- i. Disengage the mandrel of the installation tool from the rivet nut.
j. Repeat **Step 5f** to **5i** for the remaining rivet nuts.
k. Position the stand-off bracket against the bin and secure with 3/8" hardware.

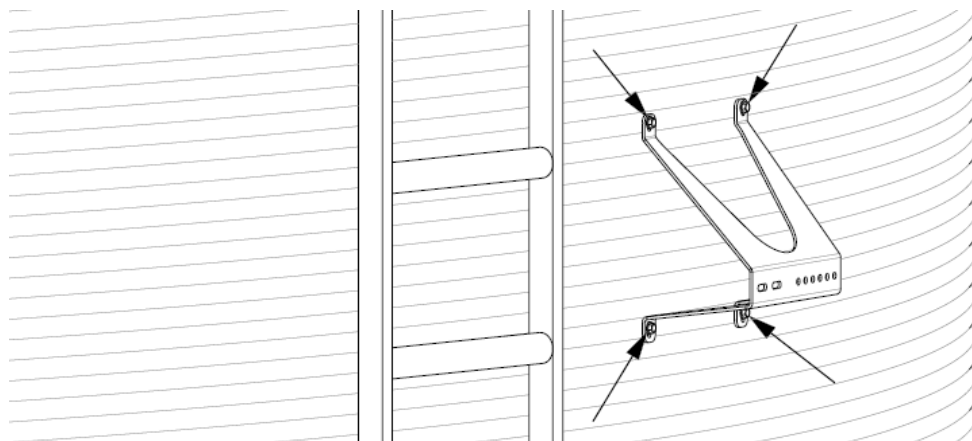


Figure 13: Stand-off bracket securement to bin wall

- l. Repeat **Step 5a** to **5k** for all remaining stand-off brackets.

DISCHARGE ASSEMBLY INSTALLATION

Before attempting to install any discharge assembly verify that a detailed loading analysis has been performed with consultation from the bin manufacturer or a licensed mechanical and / or structural engineer. The bin roof must be capable of supporting the load of the discharge assembly and lines; additional reinforcements or support structures must be installed as required. Failure to ensure the bin is capable of supporting the loading may lead to catastrophic failure of the bin potentially leading to death, serious injury or extensive property damage.

Cyclone Installation

To install a discharge cyclone, proceed as follows:

1. Ensure the area is clear of any bystanders and individuals not involved in the installation of the system, especially small children.
2. Verify the bin peak structure is capable of supporting the loading of the cyclone and lines without compromising the structural integrity of the bin. Ensure any required reinforcements or additional support structures are or will be installed.
3. Measure the circumference of the cyclone body directly below the mounting flange. The diameter of the cyclone body at the mounting height can be calculated as:

$$\text{Mounting Diameter} = \frac{\text{Measured Circumference}}{3.14}$$

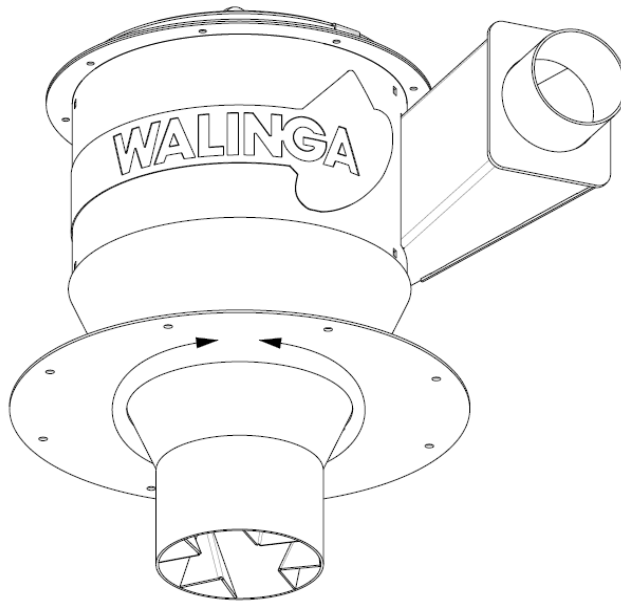


Figure 14: Cyclone mounting circumference

4. Mark a circle on the bin peak that is 0.25 in (0.64 cm) larger than the diameter calculated in **Step 3**, ensure the circle is centered.
5. Cut the hole in the bin peak. Do not oversize the hole as this may lead to water ingress.
6. Remove any debris or burrs from the hole to allow the cyclone to sit flush on the bin.

7. Lift the cyclone into position and rotate the assembly as required to align the cyclone inlet with the bin stand-off brackets where the vertical line will be installed.

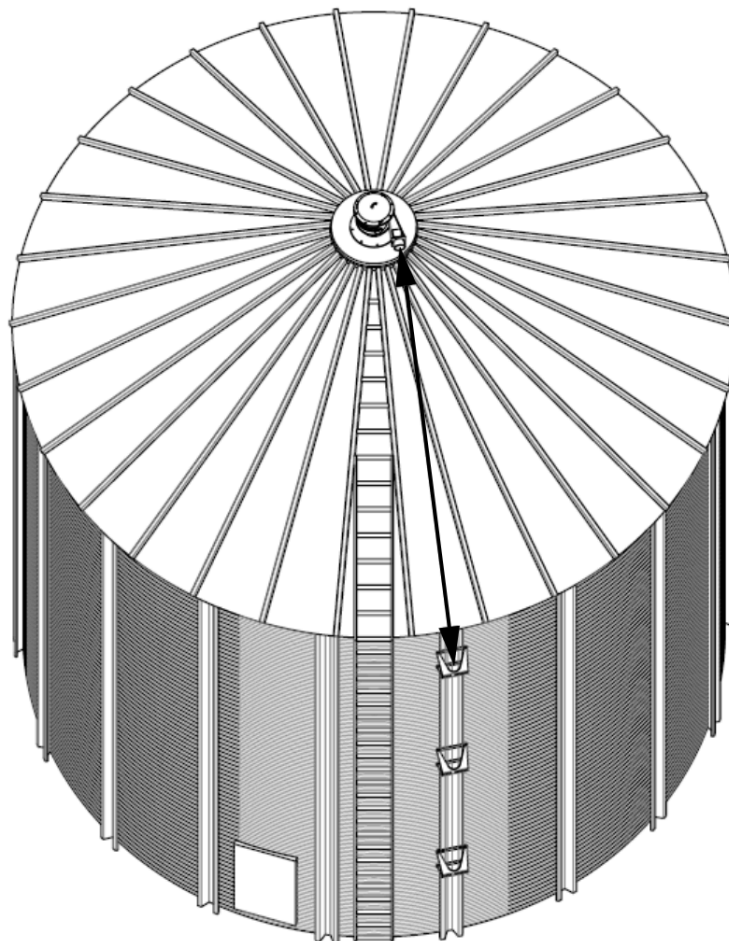


Figure 15: Cyclone inlet alignment

8. Once aligned, use a center punch or mark the locations of each mounting hardware hole of the mounting flange onto the bin peak.
9. Lift the cyclone and drill the marked holes. Remove any debris or burrs from the hole to allow the cyclone to sit flush on the bin.
10. For galvanized bins, if available, apply a layer of cold galvanizing spray to the edge of the holes to protect the exposed metal from corrosion.
11. Apply a layer of silicone around the edge of the center hole and mounting holes to form an effective seal against the bin and cyclone to maintain the integrity of the bin.
12. Lower the cyclone into position and ensure the inlet is aligned and the mounting flange sits flush.
13. Secure the cyclone in place with the required mounting hardware.
14. Ensure any required support structure is properly installed and secured to the cyclone.

Dustless Cyclone Installation

To install a dustless discharge cyclone (DDC), proceed as follows:

1. Ensure the area is clear of any bystanders and individuals not involved in the assembly and installation of the DDC, especially small children.
2. Verify the bin roof structure is capable of supporting the loading of the DDC and lines without compromising the structural integrity of the bin. Ensure any required reinforcements or additional support structures are or will be installed.
3. Create an opening in the roof to allow for the mounting of the DDC. Reference **Figure 16** for the dimensions of the DDC mounting surface. All dimensions shown are in inches.

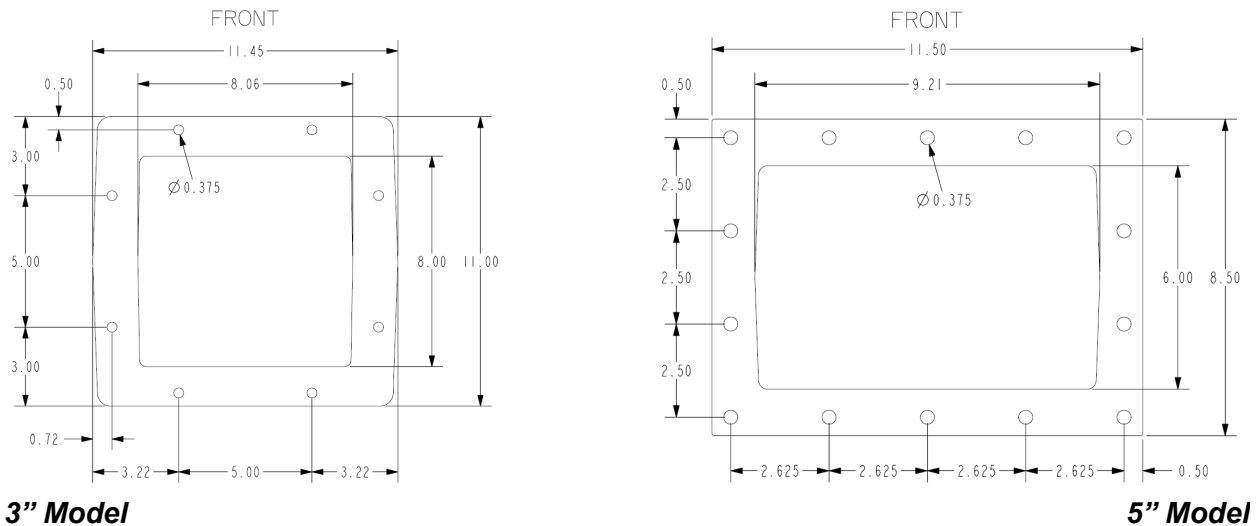


Figure 16: Dustless cyclone mounting dimensions

4. Remove the airlock outlet shipping plate and any other shipping covers or protectors from the DDC. Installation and operation with these covers in place can result in significant damage to the machine and serious injury.

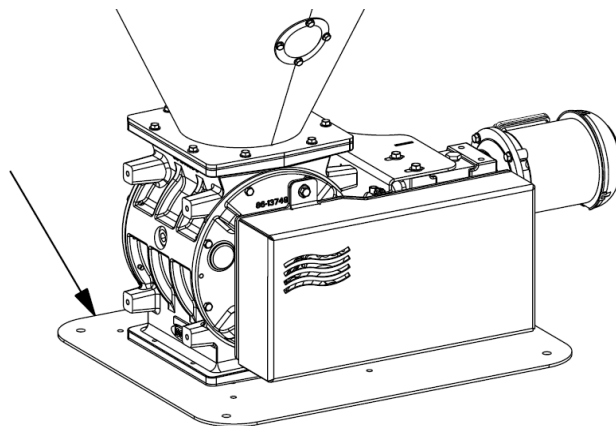


Figure 17: Airlock shipping protector plate

- The DDC must be installed such that the outlet of the airlock is level in all directions. Note that the filter access door is angled to assist in preventing water/snow accumulation. Make any required modifications to the mounting frame to allow for the correct positioning of the DDC.

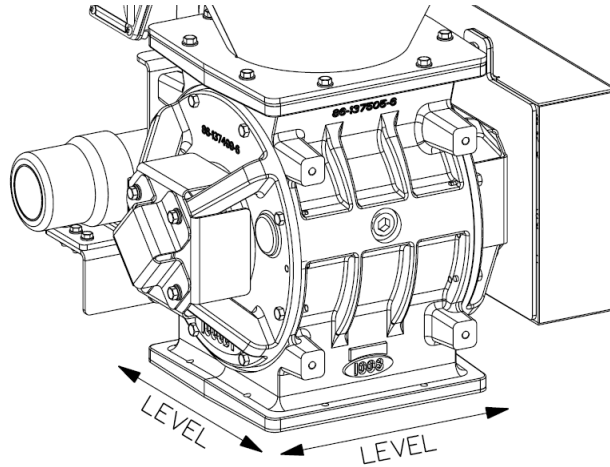


Figure 18: DDC level mounting requirement

- Ensure the mounting frame positioning allows the AMS inlet to be aligned with the discharge point of the pneumatic conveying system.

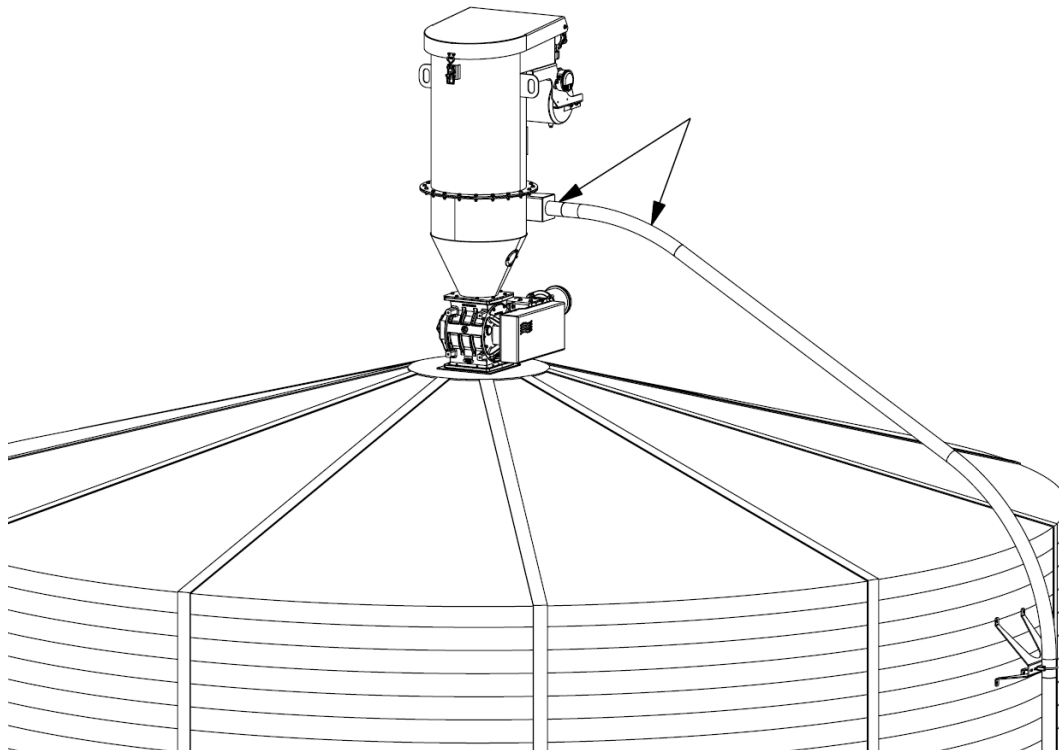


Figure 19: AMS inlet alignment

7. Position a mounting gasket on the bin.

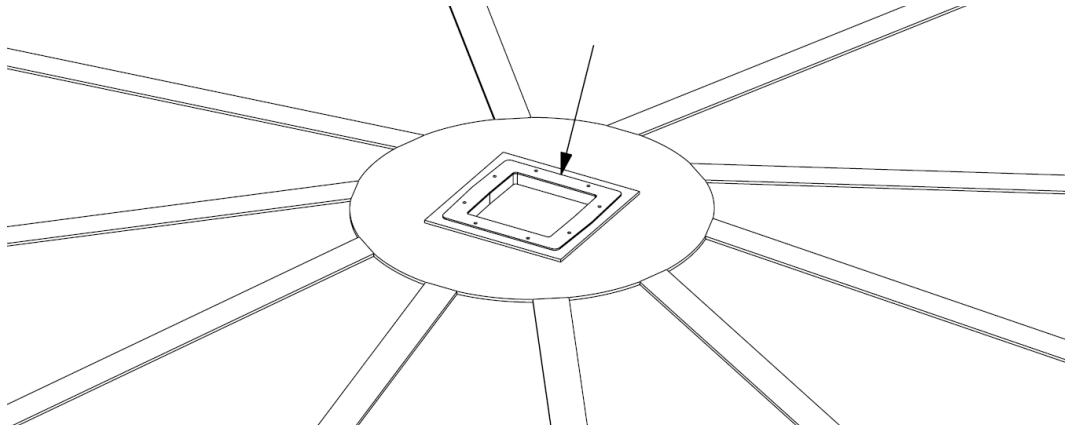


Figure 20: Mounting gasket positioning

8. Lift and lower the DDC into position, aligning the airlock with the holes of the mounting frame. Drift pins may be used to assist with alignment.

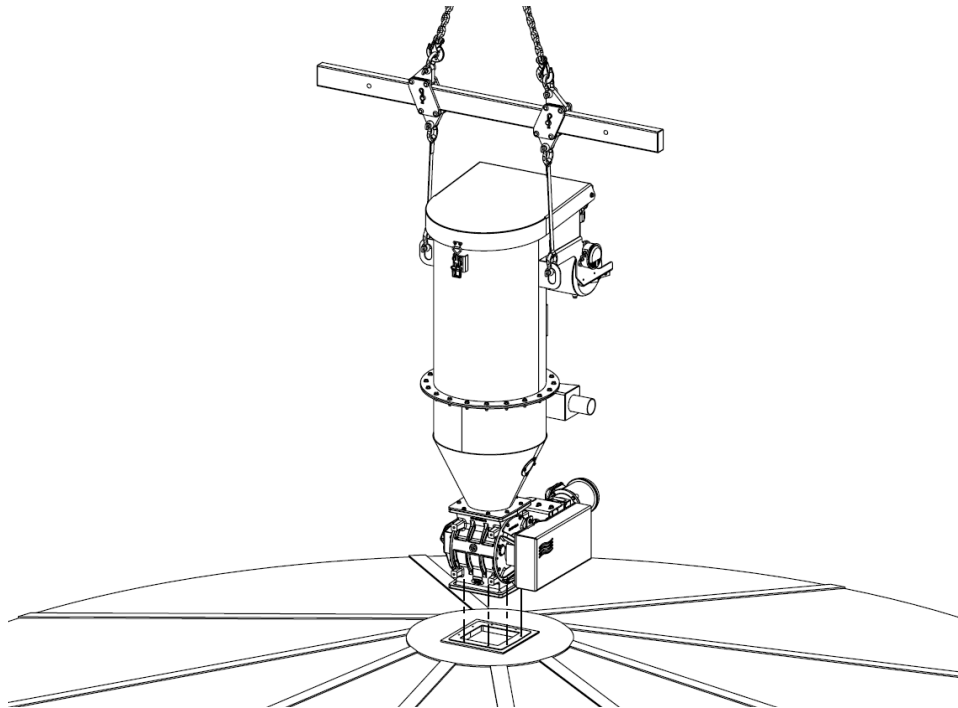


Figure 21: Mounting hole alignment

9. Install and tighten all mounting fasteners to the required torque.

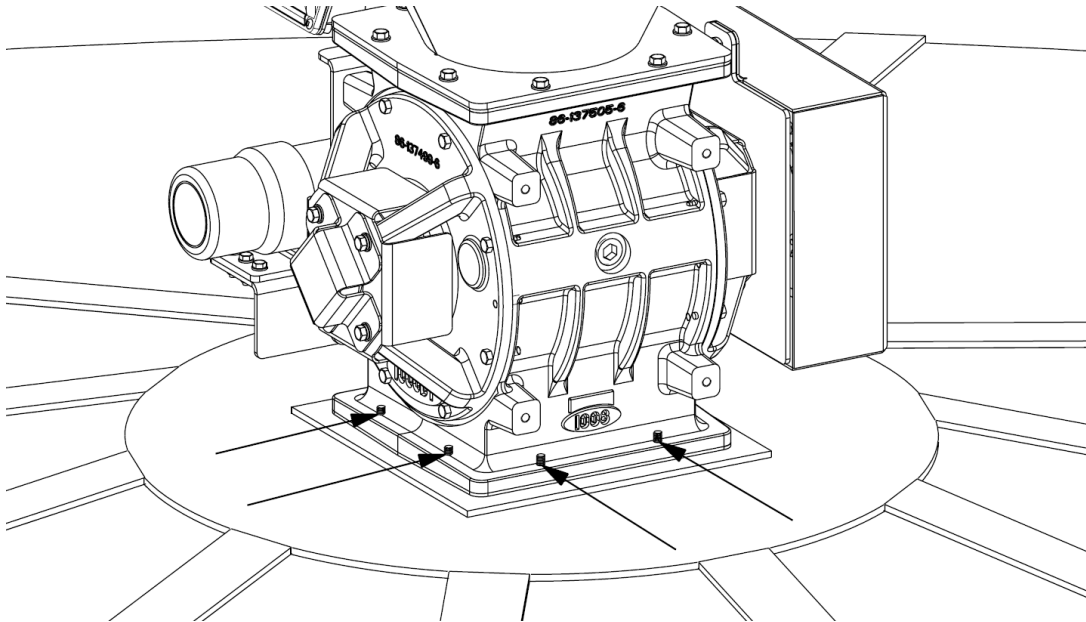


Figure 22: DDC mounting fasteners

10. Install any additional supports to ensure the DDC is stabilized. It is the responsibility of the owner and/or operator to ensure the mounting structure, frame, and/or supports are sufficient and installed to stabilize and support the DDC under all loading conditions.
11. Ensure the filters are properly grounded by measuring the electrical continuity between the filters and the DDC housing. The resistance must be less than 10 Ω .

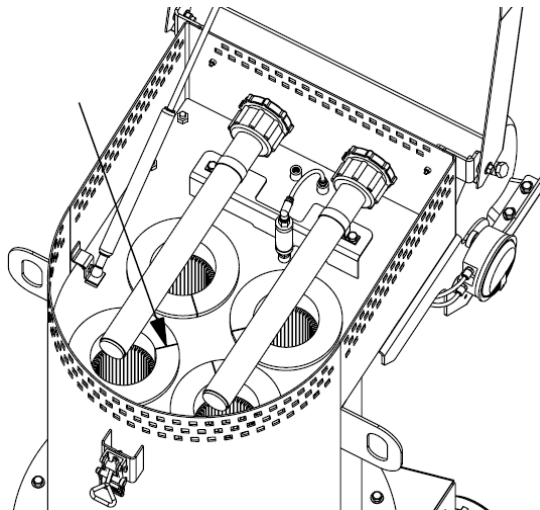


Figure 23: Filter grounding strip

12. Refer to the [operator's manual](#) of the DDC to proceed with initial set-up.

Deflector and Flashing Installation

To install a deflector and flashing assembly, proceed as follows:

1. Ensure the area is clear of any bystanders and individuals not involved in the installation of the system, especially small children.
2. Verify the bin roof structure is capable of supporting the loading of the flashing, deflector and lines without compromising the structural integrity of the bin. Ensure any required reinforcements or additional support structures are or will be installed.
3. Locate the roof section that is aligned with the vertical line stand-off brackets.

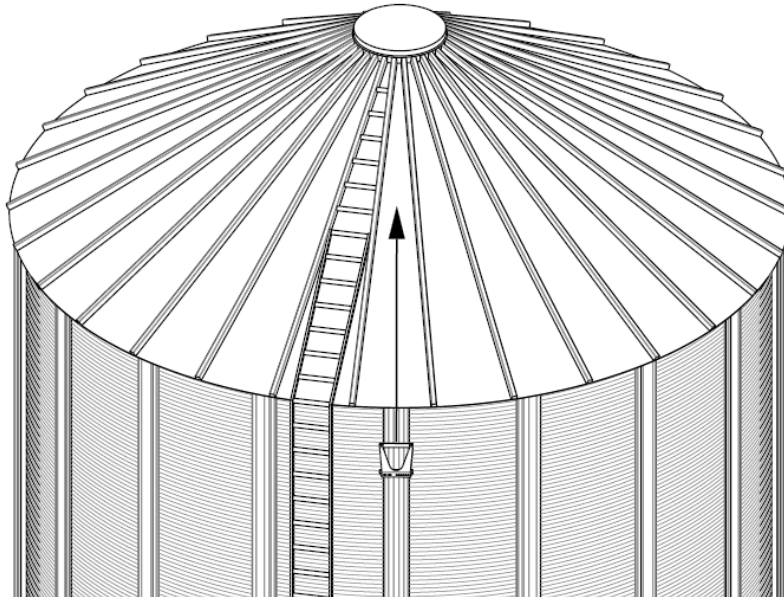


Figure 24: Roof section identification

4. Slide the provided template along the roof section towards the bin peak until it contacts the reinforcements on both sides. It is important the flashing is installed as close to the bin peak as possible to prevent roof deformation.

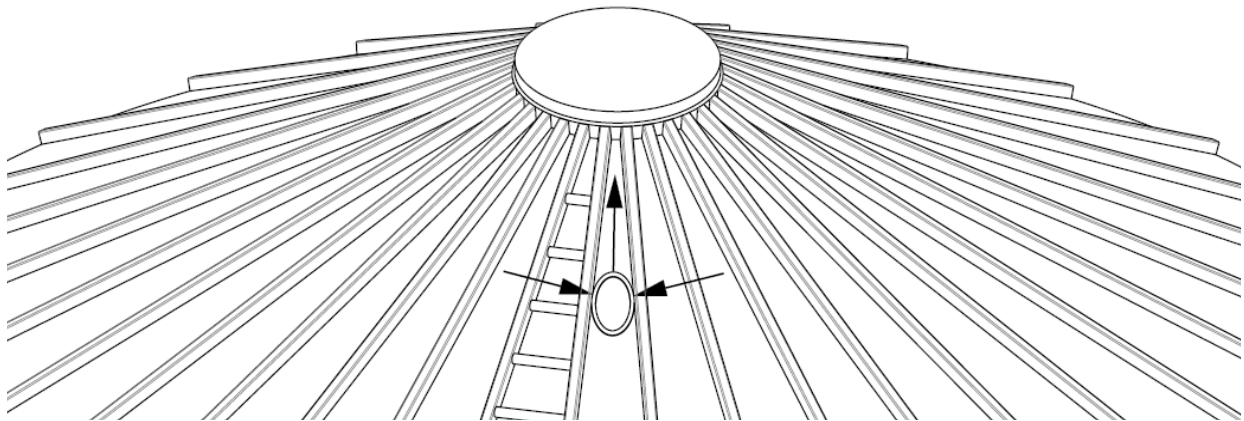


Figure 25: Positioning of template

5. Mark the inner shape of the template on the roof once correctly positioned.

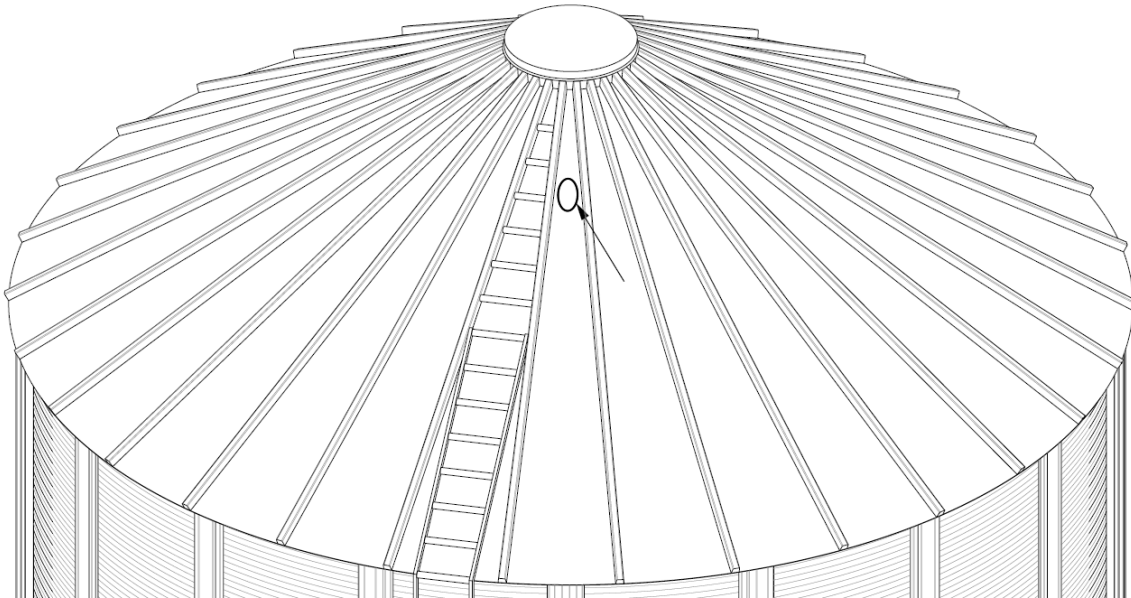


Figure 26: Template profile marking

6. Cut the hole in the bin peak. Do not oversize the hole as this may lead to water ingress.
7. Remove any debris or burrs from the hole to allow the flashing to sit flush on the bin.
8. For galvanized bins, if available, apply a layer of cold galvanizing spray to the edge of the hole to protect the exposed metal from corrosion.
9. Insert the flashing into the hole. Mark the end of the flashing tube at the length required for the installation of the deflector with reference to **Figure 29**. The deflector should be positioned such that the vertical edge of the deflector is just slightly past the edge of the bin opening, as seen in **Figure 27**. This allows sufficient space for an auger to load the bin without contacting the deflector while allowing the deflector to direct conveyed product towards the bin center to prevent side-loading.

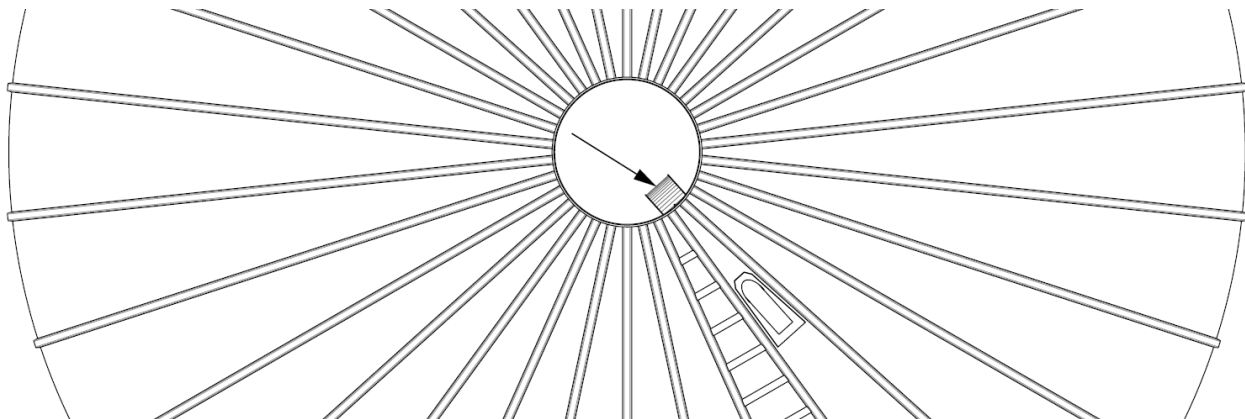


Figure 27: Recommended deflector positioning (top view)

10. Remove the flashing and cut the tube to the required length. Remove any debris or burrs from the tube.
11. Apply a layer of silicone around the edge of the hole to form an effective seal against the bin and flashing to maintain the integrity of the bin.
12. Install the flashing and secure in place with self-tapping screws.
13. Loosely install two saddle clamps onto the top end of the bin deflector.

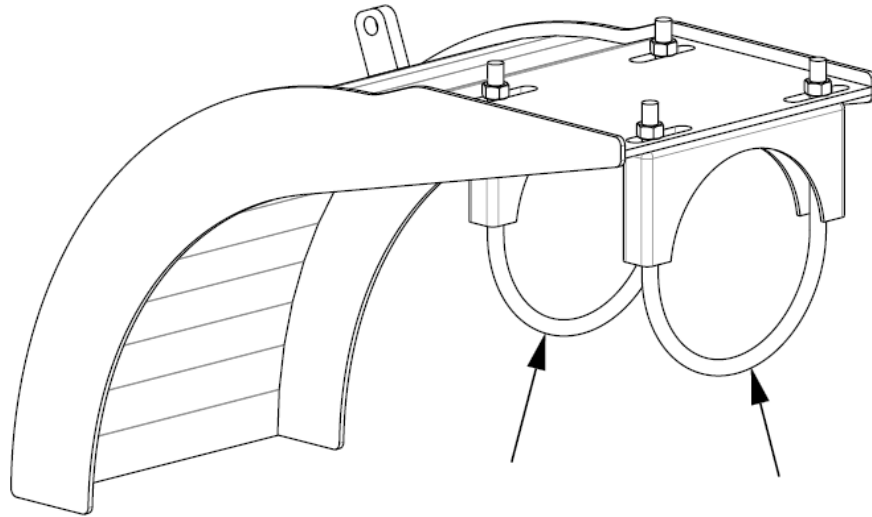


Figure 28: Deflector saddle clamp installation

14. Slide the saddle clamps over the end of the flashing tube until the step of the deflector is flush with the end of the flashing tube.

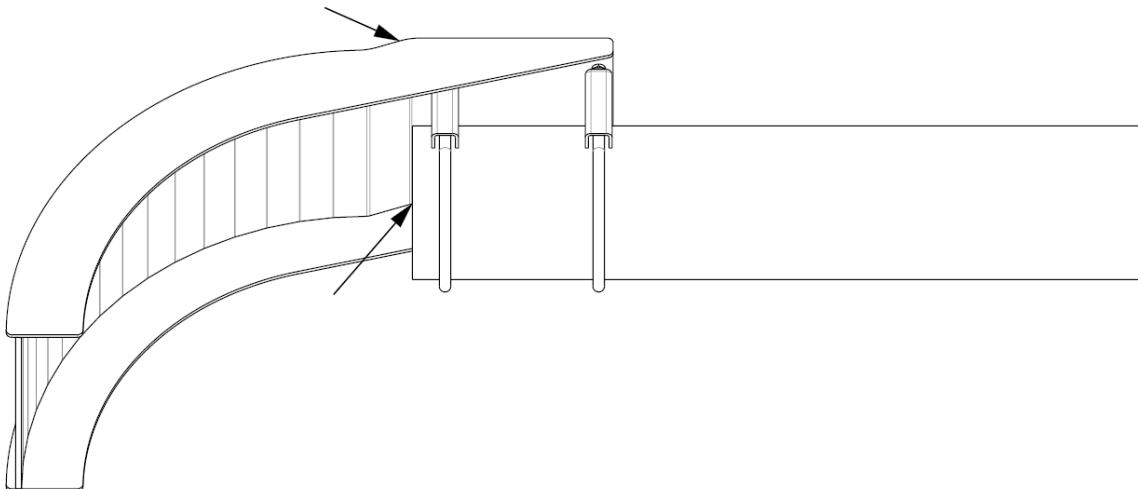


Figure 29: Installation of deflector

15. Ensure the deflector is positioned such that it is level and pointing directly downwards.

16. Connect a length of chain to the hook on the deflector. Attach the chain to the bin and tighten such that the chain holds some of the weight of the deflector; ensure the chain does not pull excessively on the deflector.

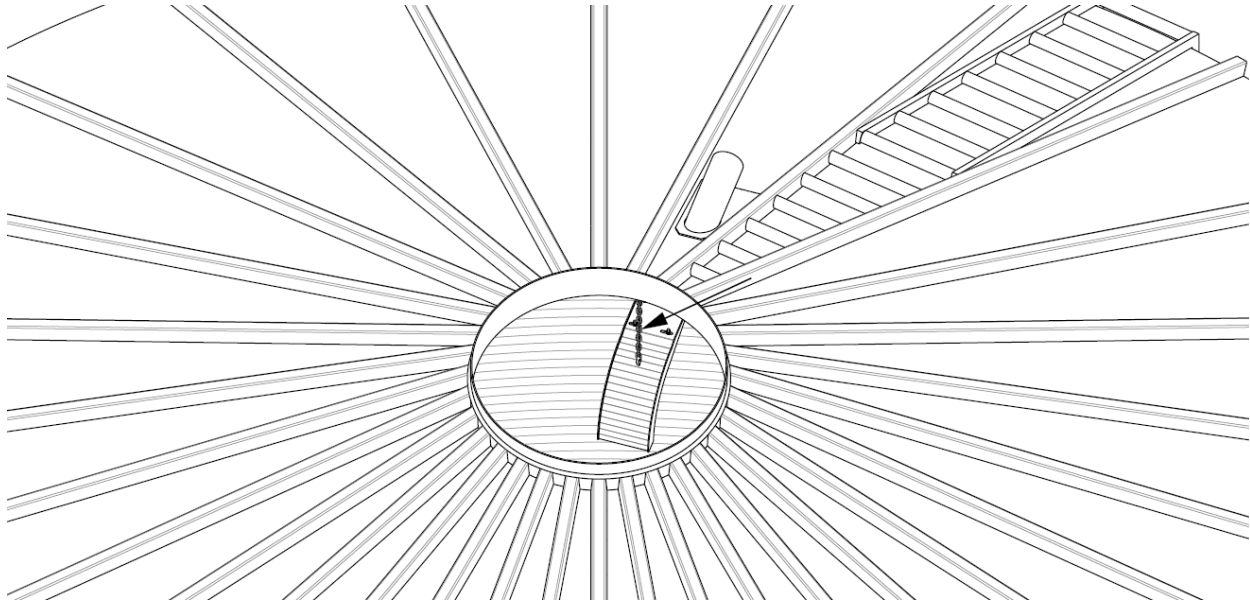


Figure 30: Deflector chain installation

17. Ensure any required support structure is properly installed and secured to the flashing and deflector.

Deadhead Installation

To install a deadhead assembly, proceed as follows:

1. Ensure the area is clear of any bystanders and individuals not involved in the installation of the system, especially small children.
2. Verify the bin roof structure is capable of supporting the loading of the deadhead and lines without compromising the structural integrity of the bin.
3. The deadhead assembly requires an additional support structure to support the load of the deadhead and conveying line near the bin peak. The support structure must be positioned such that it is aligned with the vertical line stand-off brackets, it will allow for the proper positioning of the deadhead assembly to direct product into the center of the bin, and it does not interfere with the operation of the bin cap.

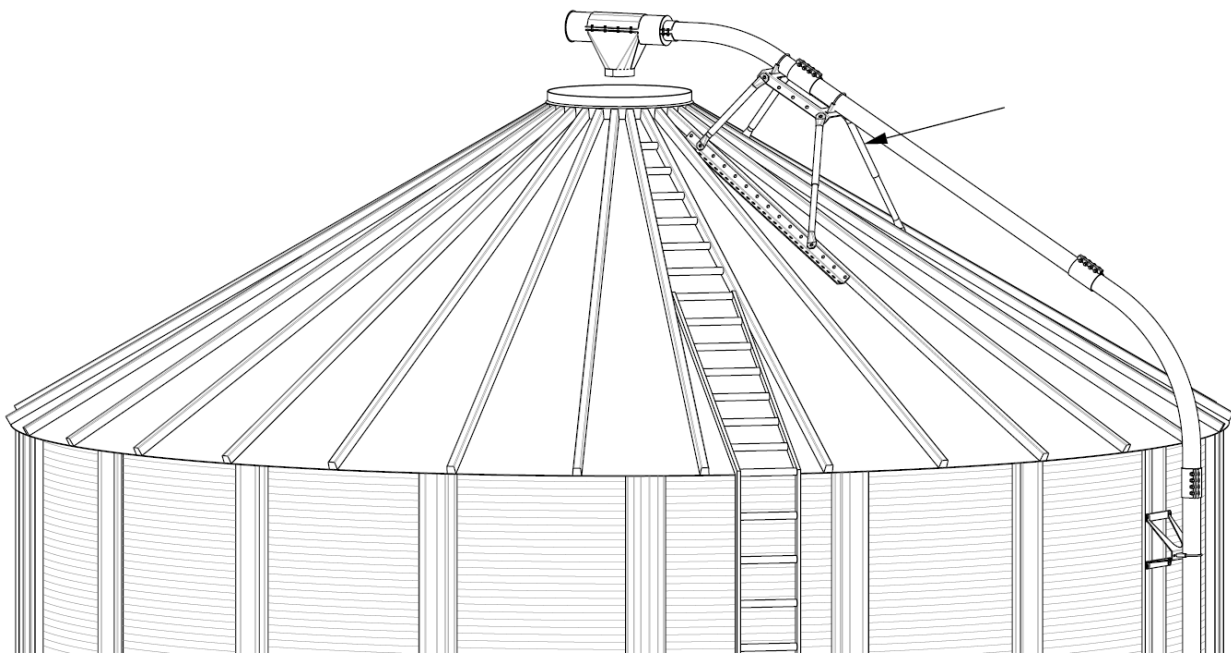


Figure 31: Reference deadhead support

4. Following the procedure outlined in the subsection *Bin Line and Elbow Installation*, install the lower elbow, vertical line and roof elbow(s), observing the following requirements:
 - a. The elbows installed on the roof must allow for the deadhead to discharge product vertically downwards. Discharging product at an angle from the deadhead may result in side-loading potentially leading to bin failure.
 - b. The length of lines and elbows on the roof must allow the discharge point of the deadhead to be centered on the bin opening.
 - c. The configuration of the lines and elbows must allow the deadhead assembly to be supported by the additional support.

5. Install the deadhead assembly on the end of the line or elbow, tightening the fasteners of the clamp to the required torque of 18 ft-lb (24.4 Nm).

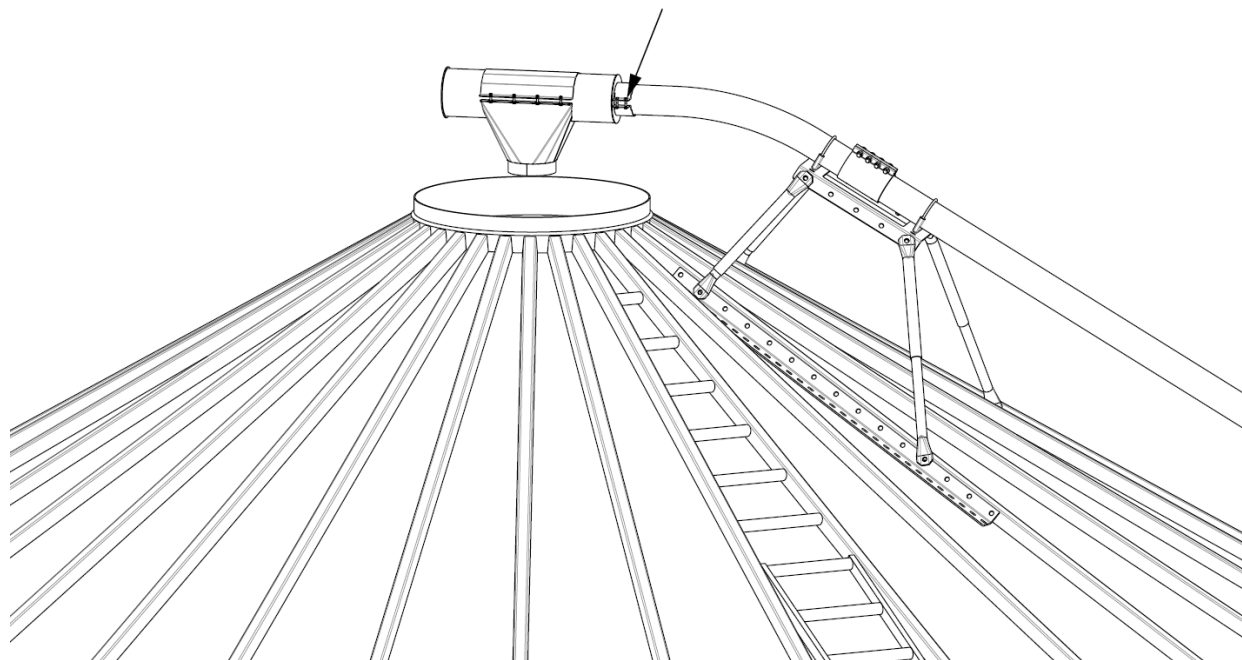


Figure 32: Deadhead installation

6. Ensure any required support structure is properly installed and secured to the deadhead.

Dustless Bin Vent Installation

To install a dustless bin vent (DBV) proceed as follows:

1. Ensure the area is clear of any bystanders and individuals not involved in the assembly and installation of the DBV, especially small children.
2. Verify the bin roof structure is capable of supporting the loading of the DBV without compromising the structural integrity of the bin. Ensure any required reinforcements or additional support structures are or will be installed.
3. Create an opening in the bin roof to allow for the mounting of the DBV. Reference **Figure 33** for the reference dimensions of the DBV mounting surface. All dimensions shown are in inches.

NOTE: If a mounting adapter must be used to ensure the DBV is level when installed, the dimensions provided adjusted accordingly. Use the lower mounting flanges once they have been fit and cut, as described in **Step 5**, to achieve the correct dimensions for the mounting dimensions.

4. The DBV must be installed such that the lower mounting flange is horizontal. Note that the filter access door is angled to assist in preventing water/snow accumulation.

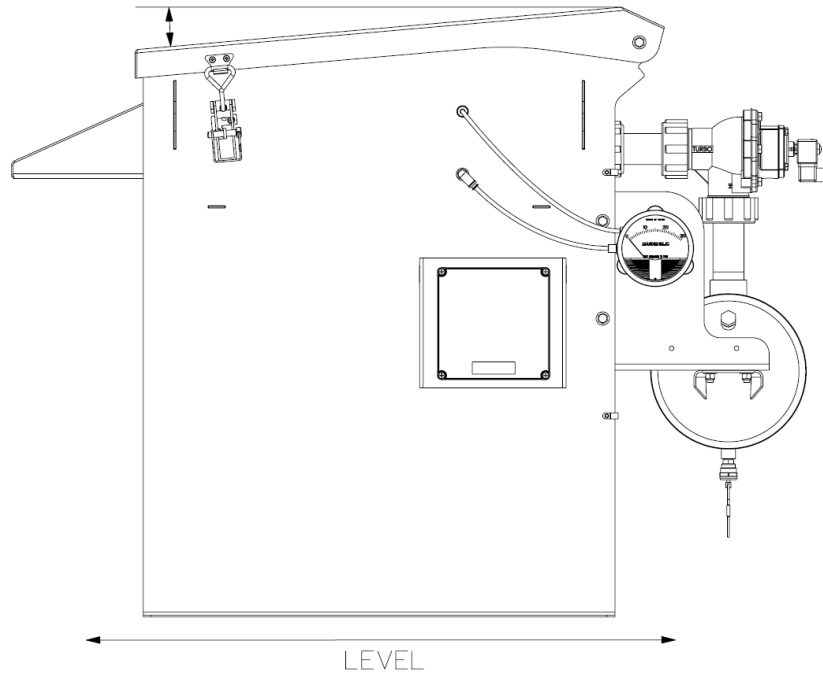


Figure 34: DBV level mounting requirement

5. As necessary, prepare a mounting adapter as follows:
 - a. Use a level to position the mounting adapter on the mounting frame of the bin roof such that the upper mounting flange is horizontal.

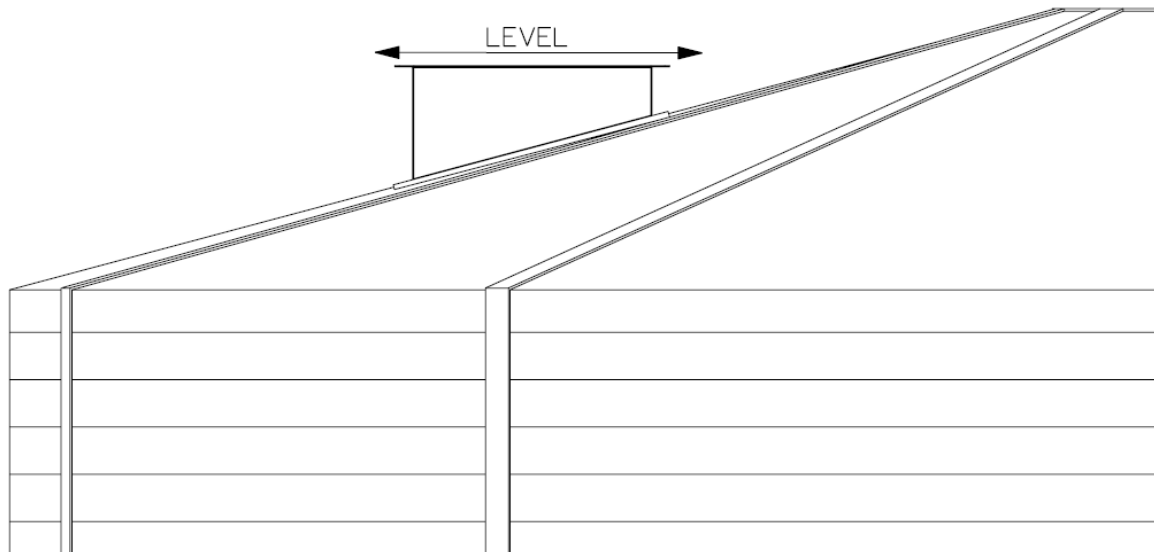


Figure 35: Mounting adapter angle positioning

- b. Mark the angle of the bin roof mounting frame and trim the walls of the mounting adapter to match.

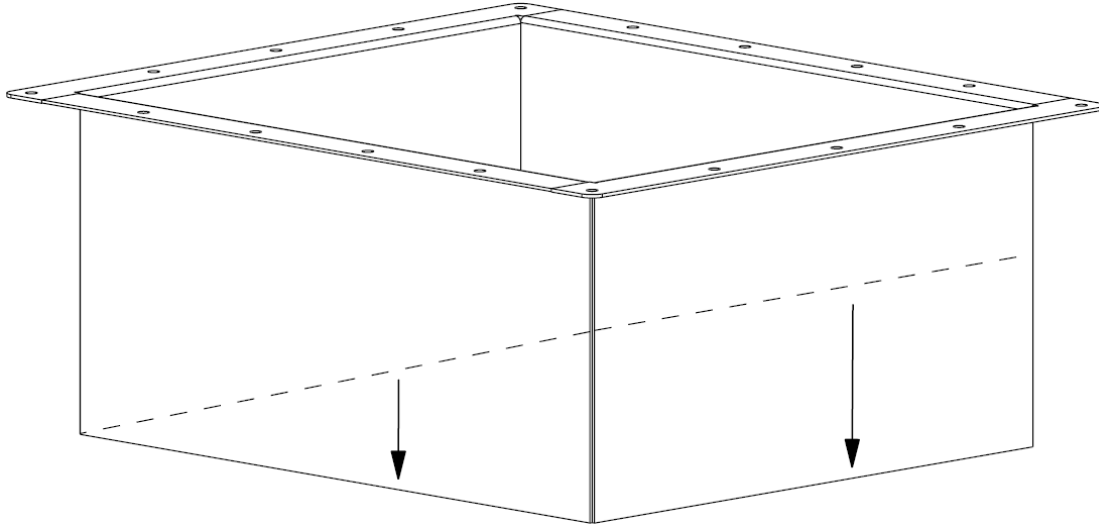


Figure 36: Mounting adapter angle marking

- c. Trim the lower mounting flanges to fit as required.
- d. Install and weld the lower mounting flanges to the trimmed edge of the mounting adapter. The flange must be welded fully to maintain a seal on the inlet side of the DBV. Do not weld in the presence of combustible dust or materials.

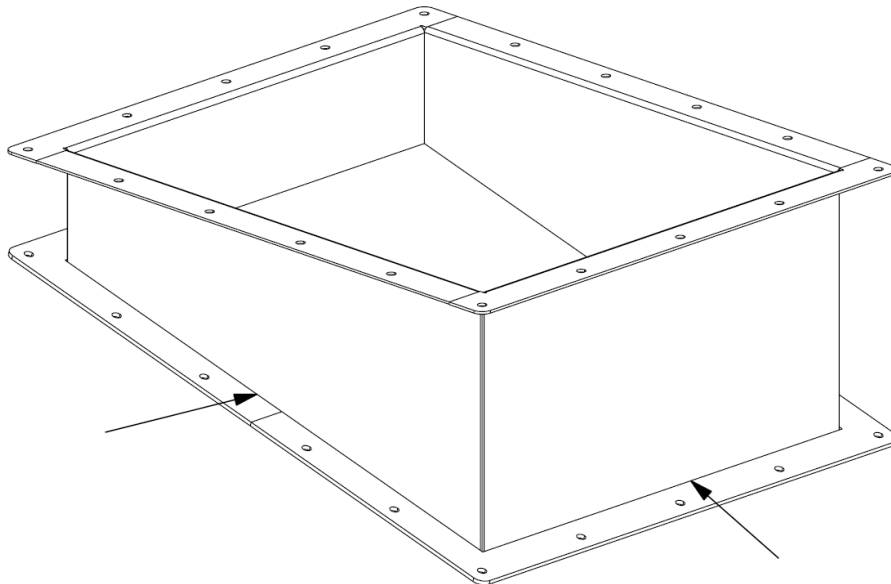


Figure 37: Mounting adapter flanges

- e. Install a mounting gasket on the bin roof mounting frame and position the mounting adapter to align the fastener holes.

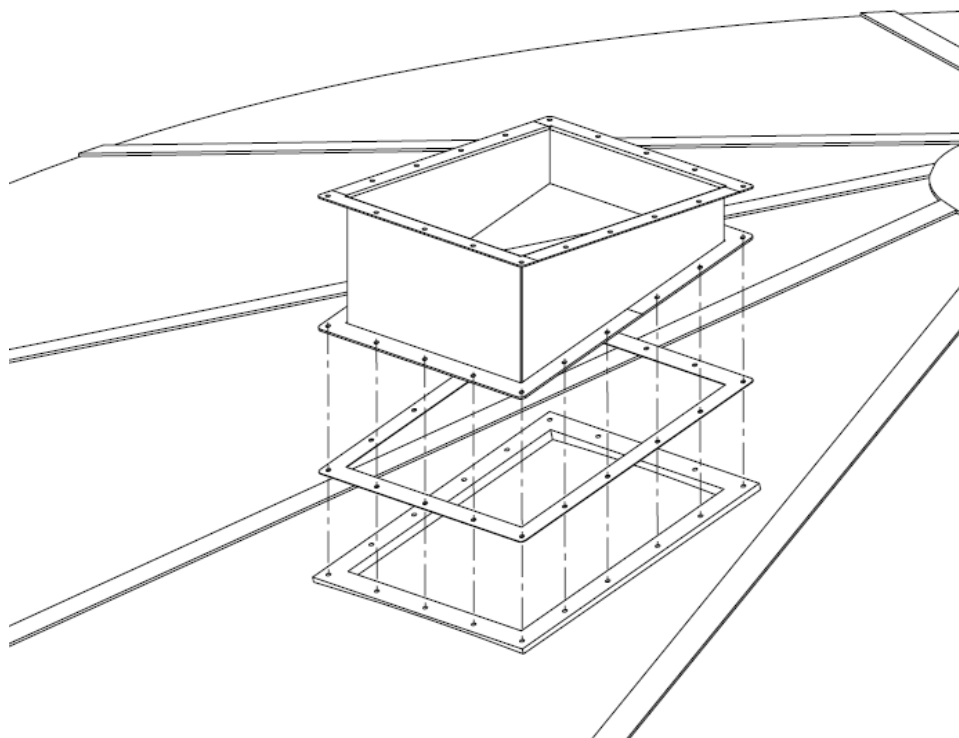


Figure 38: Mounting gasket positioning

- f. Secure the mounting adapter in place, ensuring the required fasteners are installed in each hole and are properly tightened to the required torque.

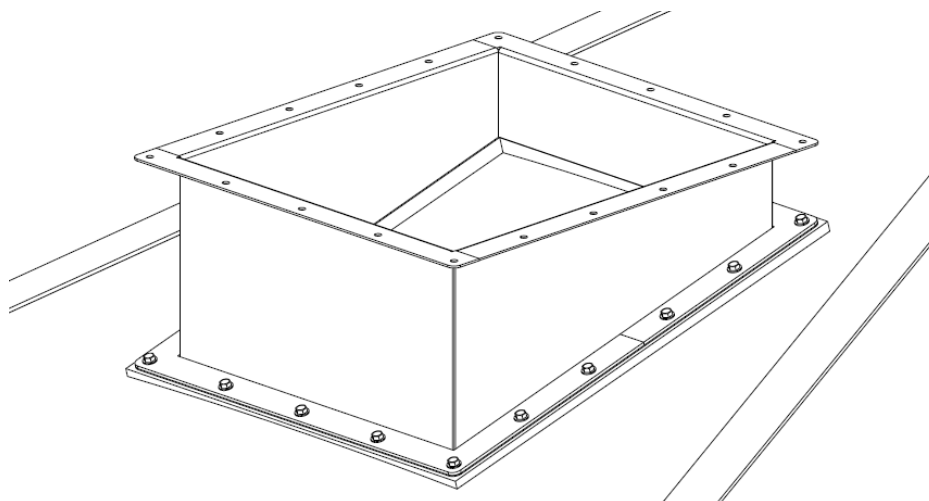


Figure 39: Mounting adapter fasteners

6. Position a mounting gasket on the flange of the bin roof mounting frame or mounting adapter.

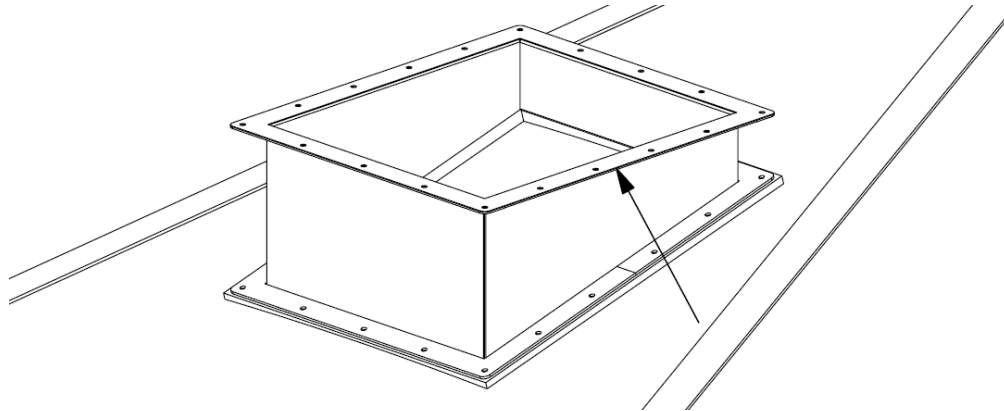


Figure 40: Mounting gasket positioning

7. Lift the DBV into position, aligning the holes of the mounting flanges. Drift pins may be used to assist with alignment.

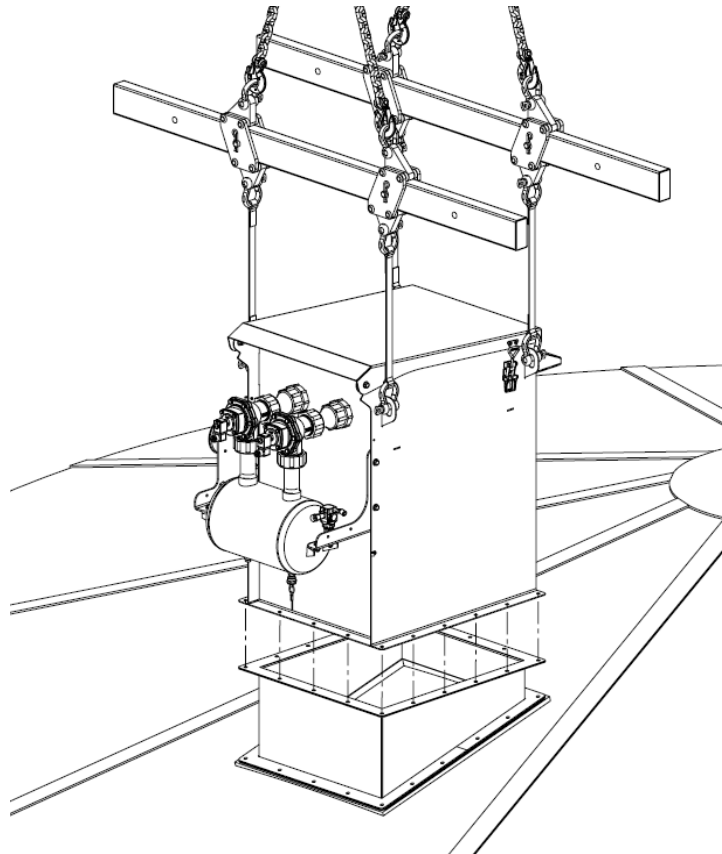


Figure 41: Mounting hole alignment

8. Install and tighten all mounting fasteners to the required torque.

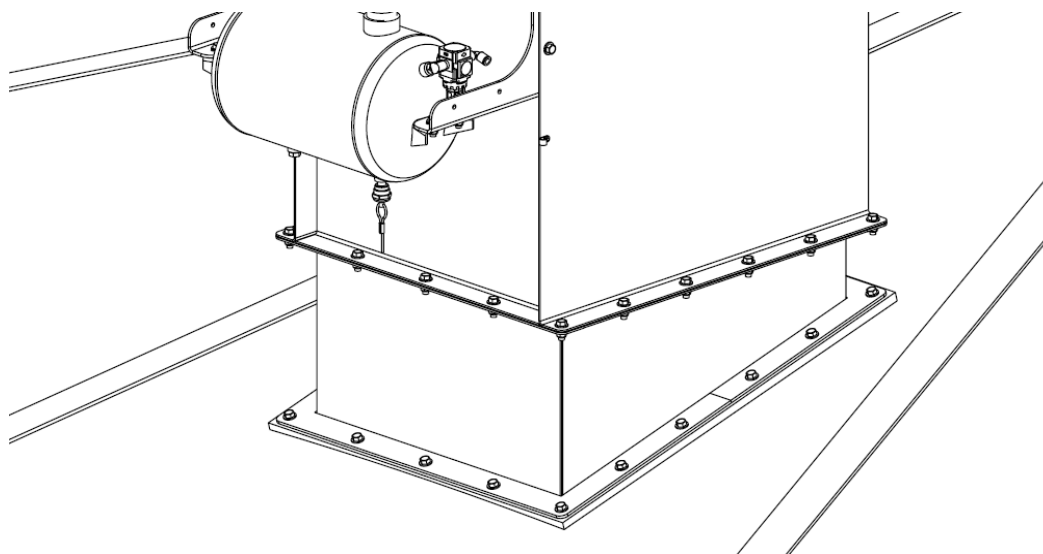


Figure 42: DBV mounting fasteners

9. Ensure the filters are properly grounded by measuring the electrical continuity between the filters and the DBV housing. The resistance must be less than 10 Ω .

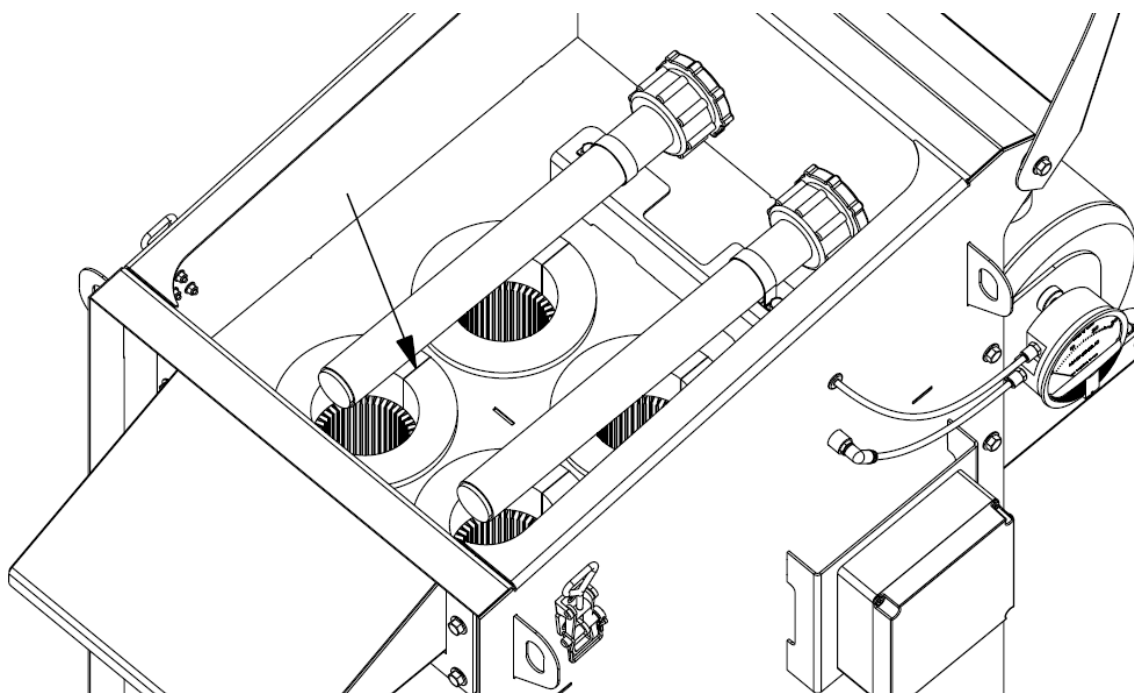


Figure 43: Filter grounding strip

10. Refer to the [operator's manual](#) of the DBV to proceed with initial set-up.

Bin Line and Elbow Installation

To install a deadhead assembly, proceed as follows:

1. Ensure the area is clear of any bystanders and individuals not involved in the installation of the system, especially small children.
2. Verify the bin structure is capable of supporting the loading of the lines and elbows without compromising the structural integrity of the bin.
3. Verify the intended line route and ensure the bin stand-off brackets have been installed.
4. Position the lower elbow such that the vertical portion is aligned with the bin stand-off brackets and the lower portion is aligned and at the correct height for the intended horizontal line route.

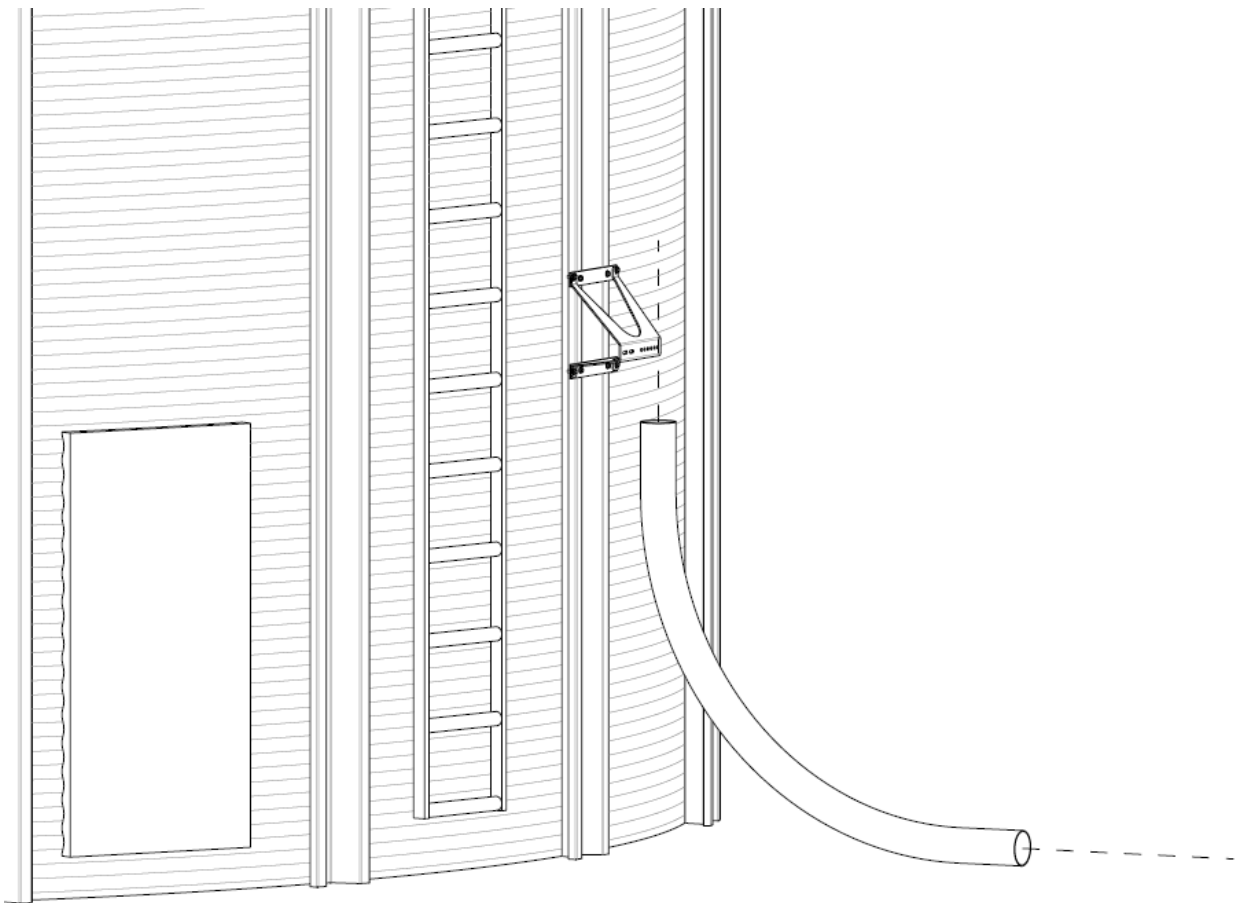


Figure 44: Lower elbow positioning

5. The lower elbow requires an additional load bearing support. This support must be capable of supporting the load of the lower elbow and the entire vertical section of line. Secure the lower elbow in position to the load bearing support.

6. Determine the length of line required to extend from the lower elbow to the elbow positioned at the eave of the bin, keeping in mind the following:
 - a. Bins larger than 24 ft (7.3 m) in diameter will typically use a 60° degree elbow installed at the eave and a 30° elbow connected to the discharge assembly.
 - b. Bins smaller than 24 ft (7.3 m) in diameter will typically use a single 90° elbow installed at the eave.
 - c. The position of the eave elbow must allow for alignment with the inlet of the discharge assembly.

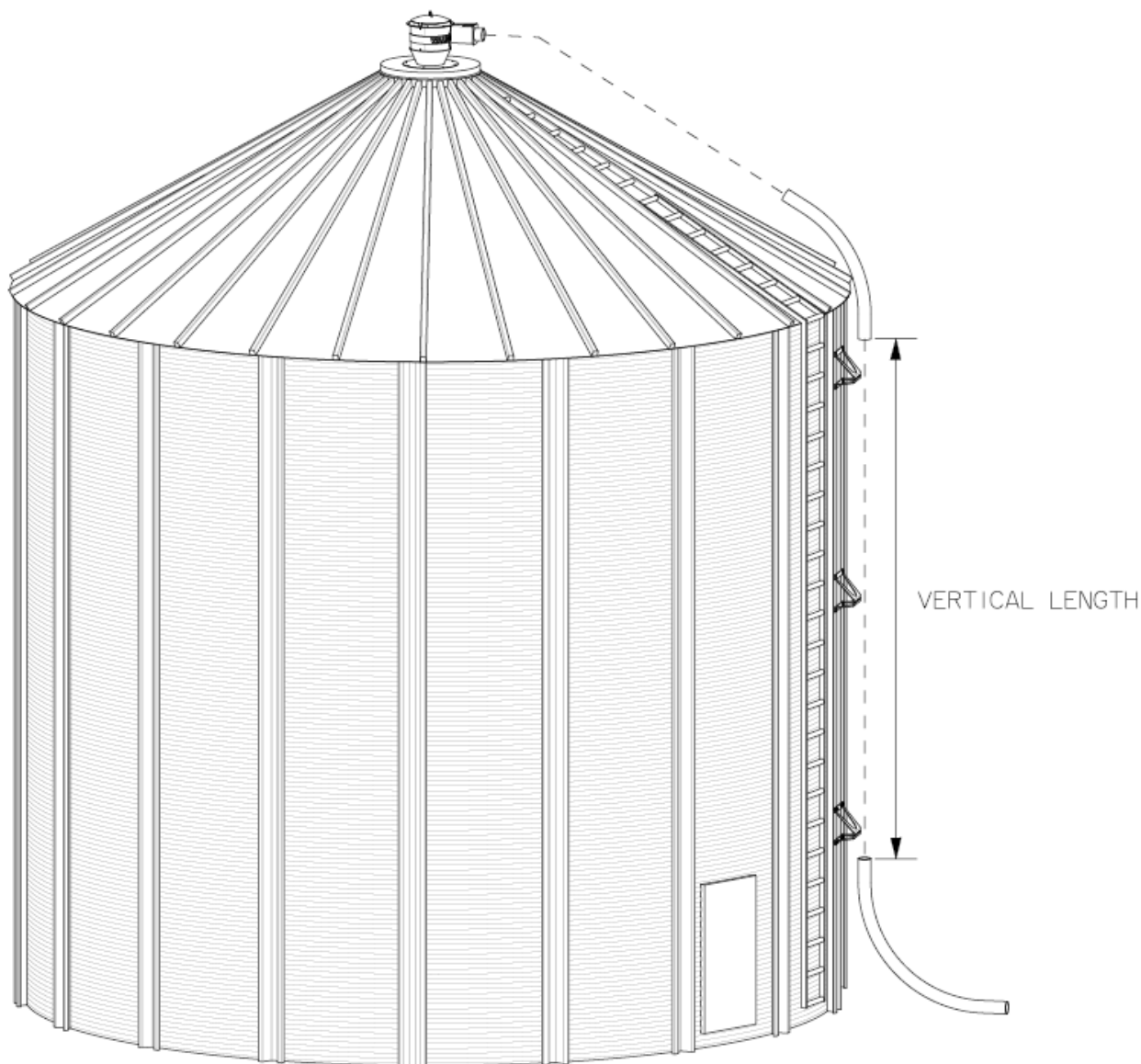


Figure 45: Vertical line length determination

7. Cut the required length of line.

8. Install the vertical length of line with compression couplings at each joint. Secure the vertical line to the bin stand-off brackets with saddle clamps.

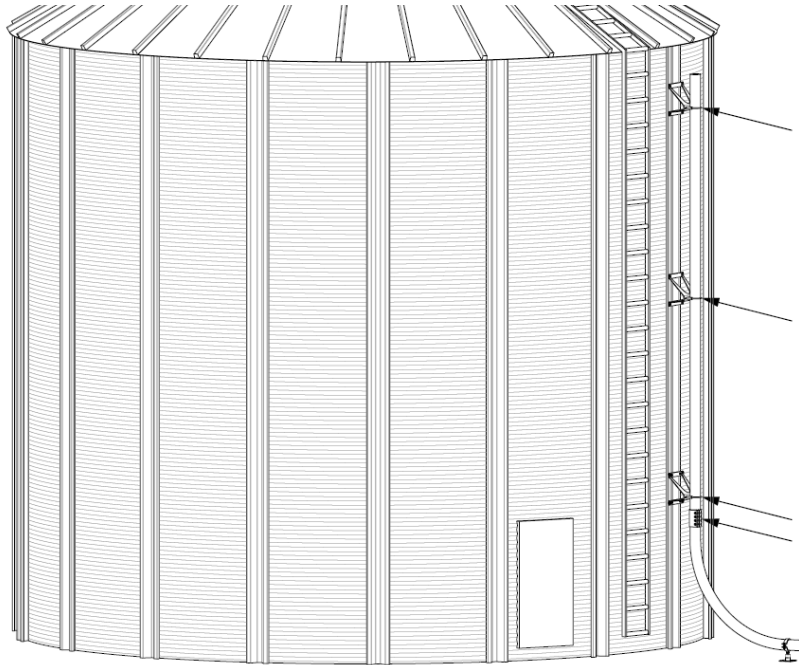


Figure 46: Vertical line securement

9. Install the eave elbow such that it is aligned with the discharge inlet. Secure the elbow to the vertical line with a compression coupling.

NOTE: If the installed elbow only has one straight end, the elbow must be installed with the straight end closer to the discharge point.

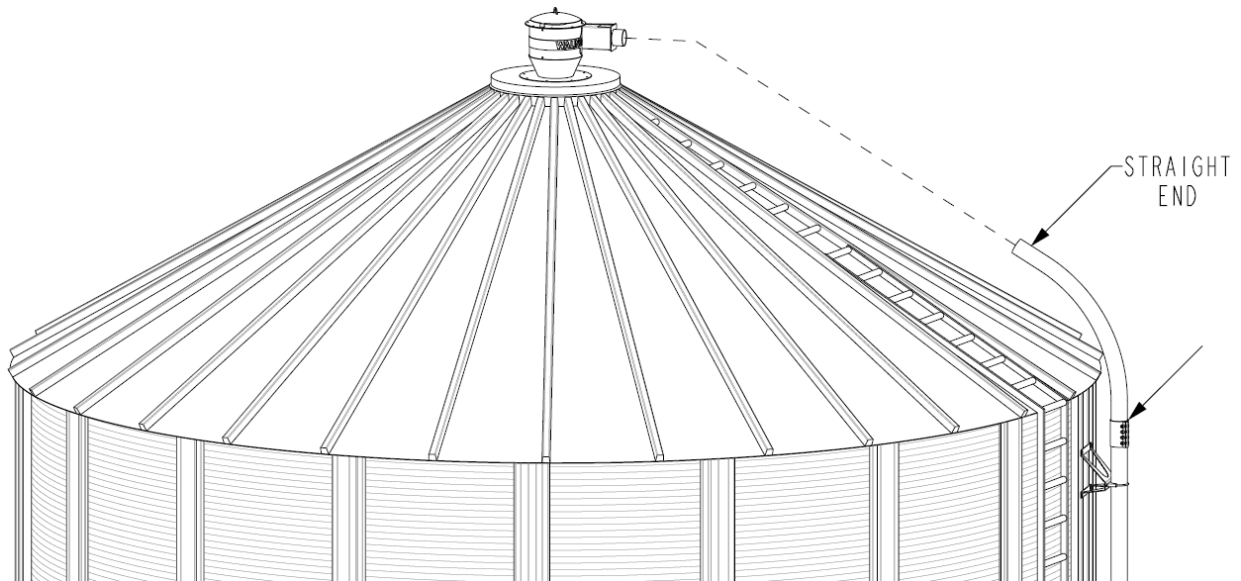


Figure 47: Eave elbow installation

10. For bins with only one roof elbow, proceed as follows:
 - a. Measure the length between the eave elbow and the discharge assembly inlet.
 - b. Cut the required length of line.
 - c. Install the line between the elbow and discharge assembly, securing the joints with compression couplings.

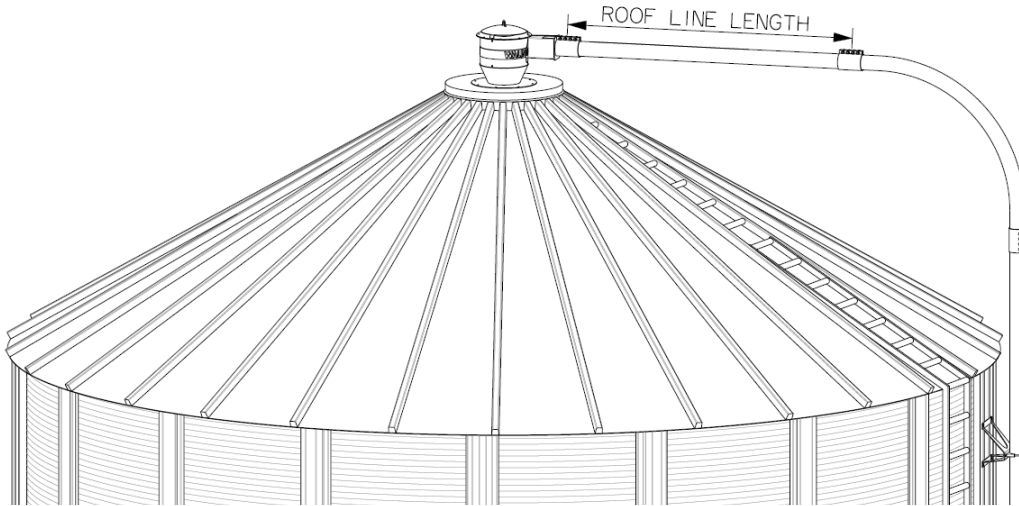


Figure 48: Single elbow roof line installation

- d. It is recommended that a line support be installed on the bin roof when a discharge cyclone, dustless discharge cyclone or deflector and flashing are installed. A bin roof line support is required for a deadhead assembly.

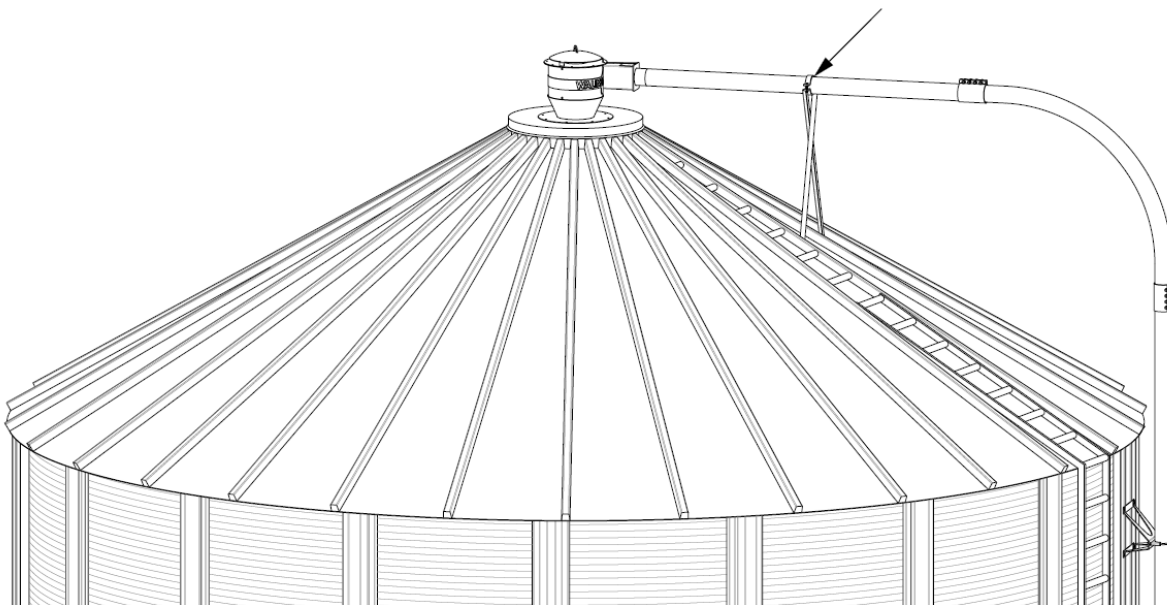


Figure 49: Single elbow roof line support reference

11. For bins with two roof elbows, proceed as follows:

- a. Install the 30° elbow onto the discharge assembly. Ensure it is aligned with the eave elbow and secure in place with a compression coupling.

NOTE: If the installed elbow only has one straight end, the elbow must be installed with the straight end closer to the discharge point.

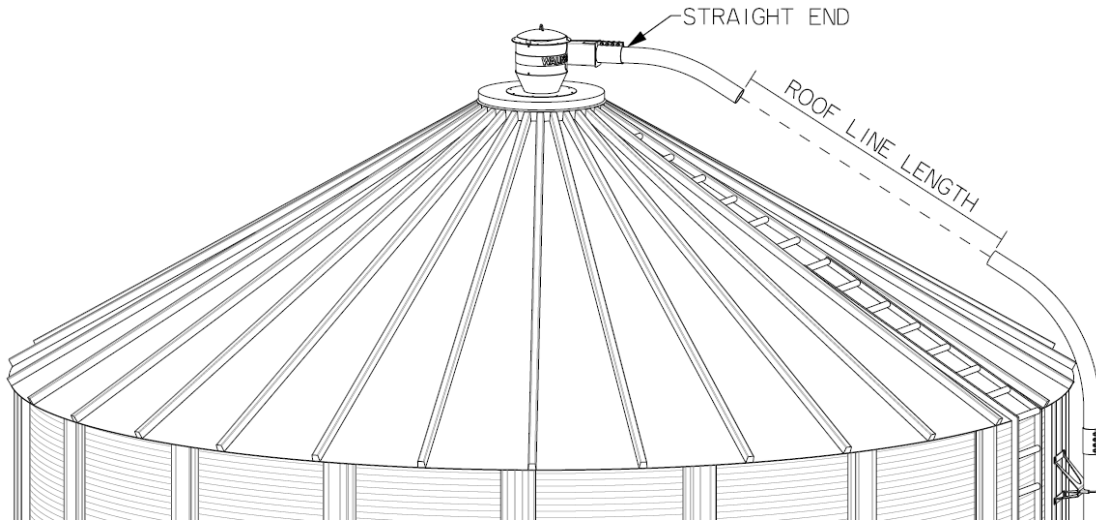


Figure 50: Discharge elbow installation

- b. For discharge cyclones, verify that the elbow is aligned with the inlet. A slight inward angle, reference **Figure 51**, is acceptable. Any outward angle, reference **Figure 51**, will result in premature wear of the cyclone.

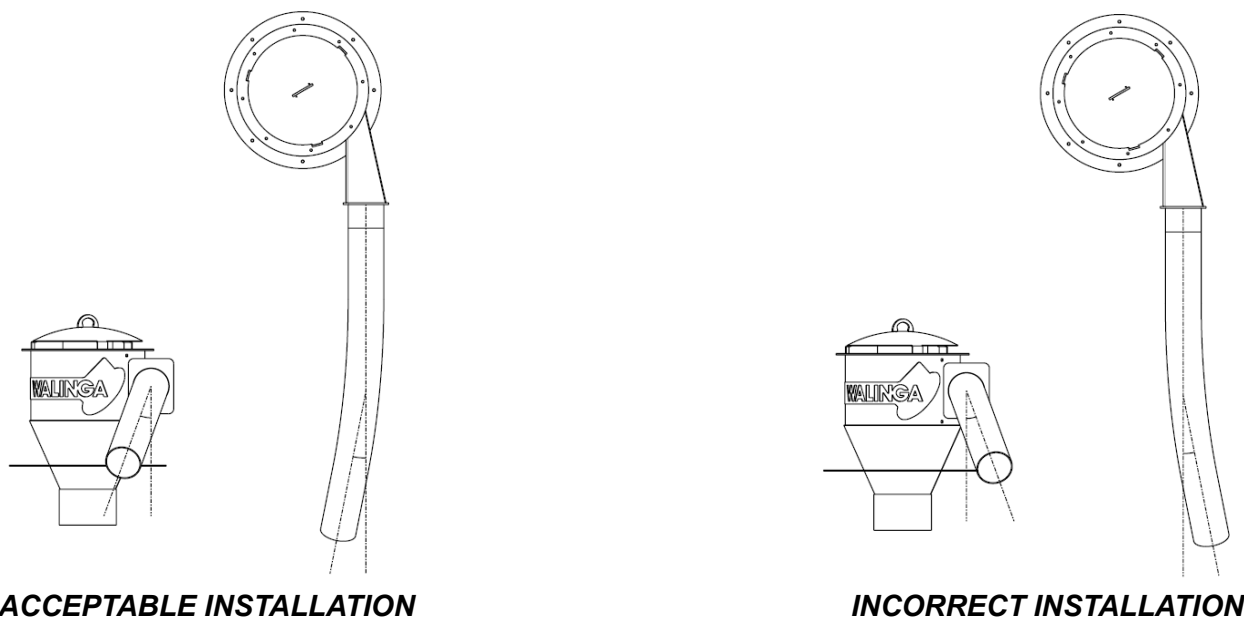


Figure 51: Cyclone elbow installation requirement

- c. Measure the distance between the two elbows and cut the required length of line.
- d. Install the line between the elbows, securing with compression couplings.

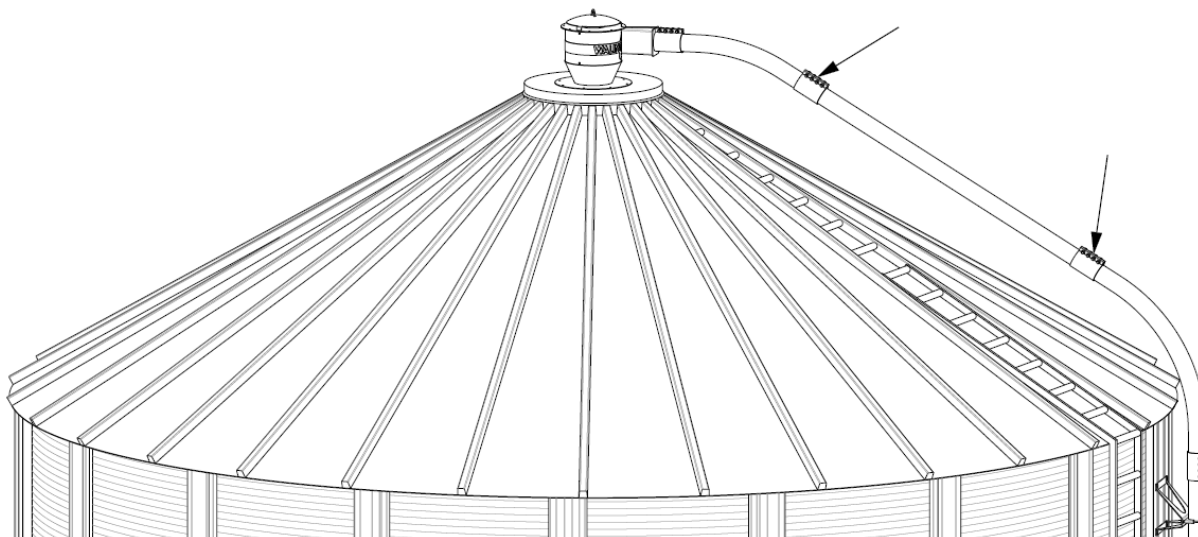


Figure 52: Double elbow roof line installation

- e. It is recommended that a line support be installed on the bin roof when a discharge cyclone, dustless discharge cyclone or deflector and flashing are installed. A bin roof line support is required for a deadhead assembly.

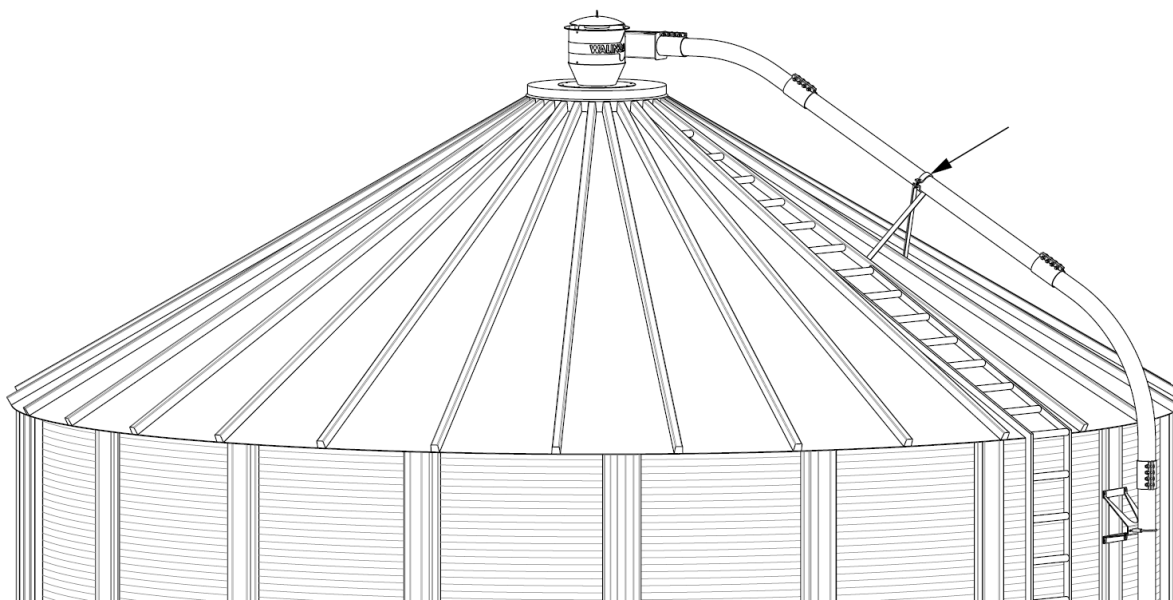


Figure 53: Double elbow roof line support reference

12. Ensure any required support structures are properly installed and secured to the lines and elbows.

Distributor Valve Installation

To install a distributor valve, proceed as follows:

1. Ensure the area is clear of any bystanders and individuals not involved in the installation of the system, especially small children.
2. Verify that the valve rotates freely, shipping may occasionally affect the operation.
3. Identify the intended installation location of the valve. Ensure the location is capable of supporting the load of the valve and that it will allow for the valve to remain level. It is recommended that the valve be installed on a concrete pad, cement blocks or screw piles. A specially designed kit is available to mount the valve in a vertical position.
4. Position the valve in the installation location. For horizontal installations, the operational handle should be positioned to the left when viewed from the inlet end.

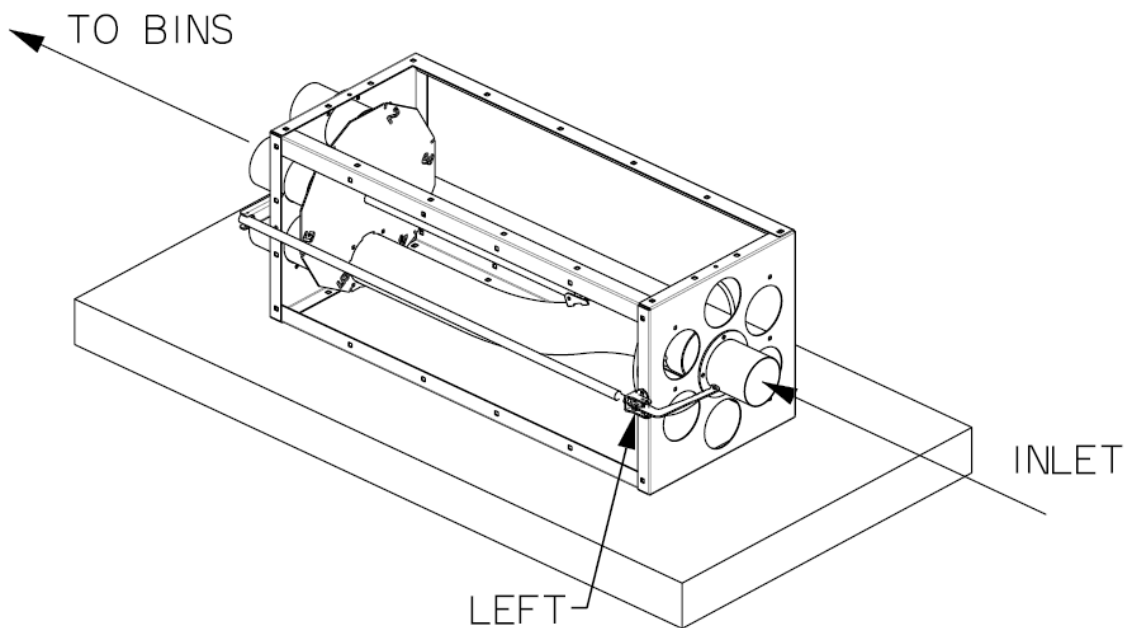


Figure 54: Distributor valve positioning

5. Rotate the valve elbow to ensure it operates freely. As necessary, shims may be used to level the valve to prevent binding of the elbow during operation. Once properly positioned, secure the valve in place.

6. If desired, a sight glass may be installed directly to the inlet of the valve, secured to the valve with the use of a compression coupling.

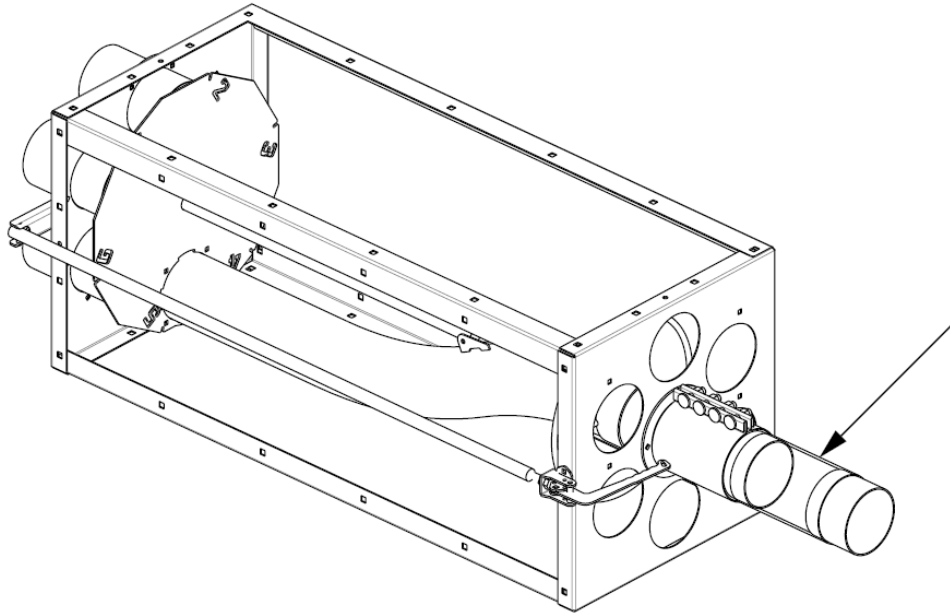


Figure 55: Sight glass installation

7. Measure the required length of line to connect the inlet side of the valve.
8. Cut and install the inlet line, ensuring it is as straight as possible. Secure the line to the valve or sight glass with a compression coupling.

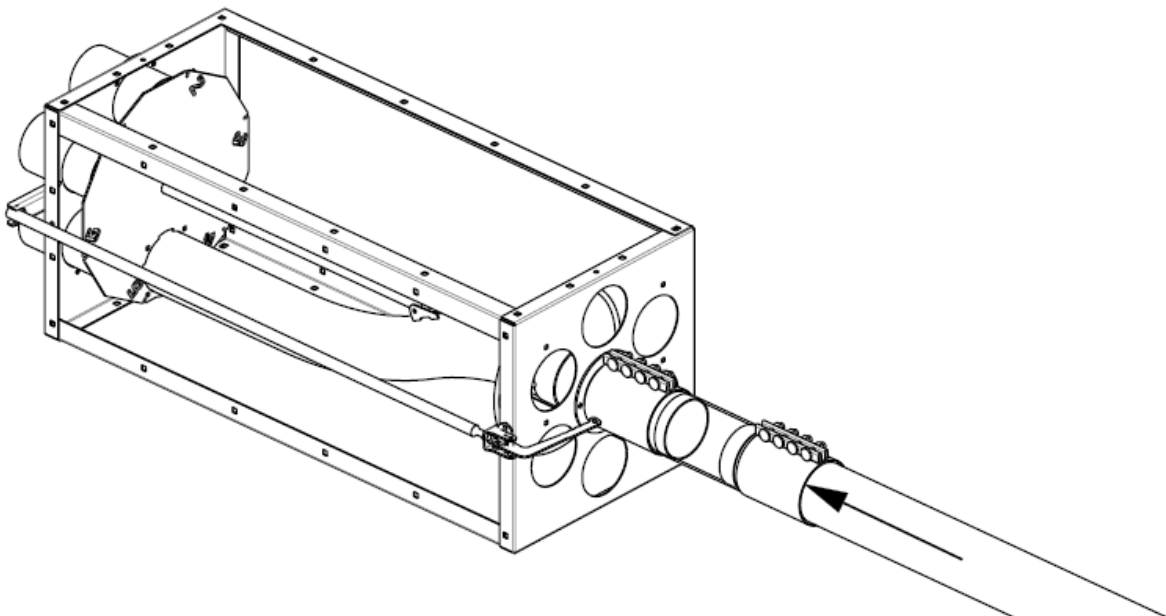


Figure 56: Inlet line connection to distributor valve

9. A support for the inlet line should be installed approximately 10 ft (3.0 m) from the valve to prevent excessive force transmission. Excessive force will cause the valve's mechanism to bind, preventing operation of the valve. Rotate the valve elbow to ensure it moves freely without binding; reposition the line as necessary to relieve any side loading.

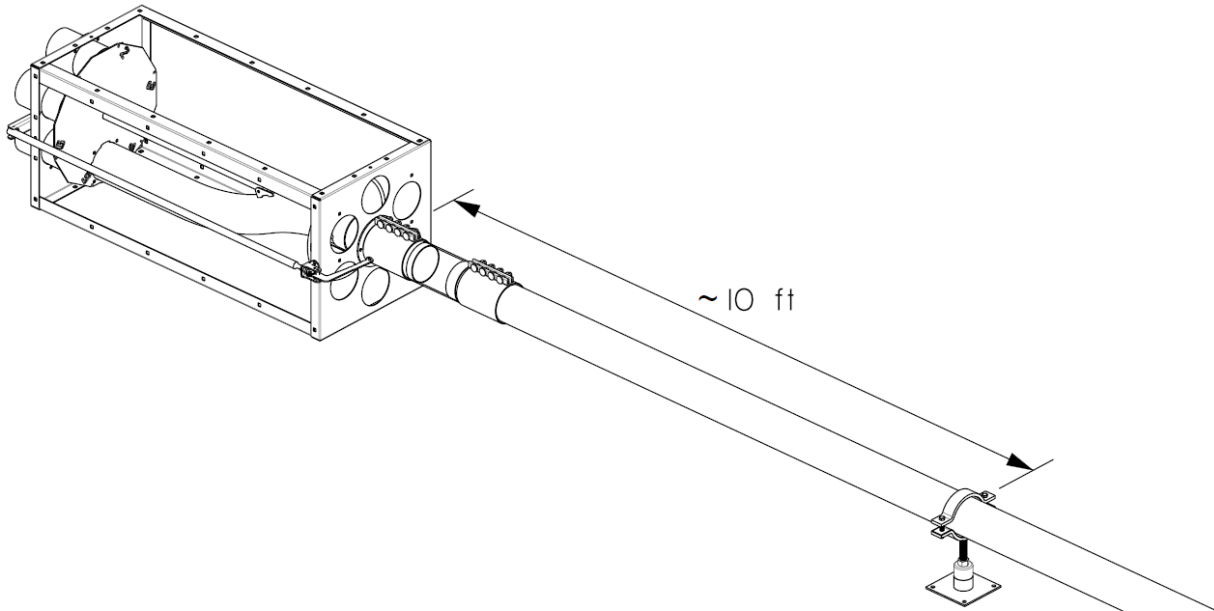


Figure 57: Inlet line support

10. Position a support stand approximately 10 ft (3.0 m) from the outlet end of the valve to provide support to the outlet lines.

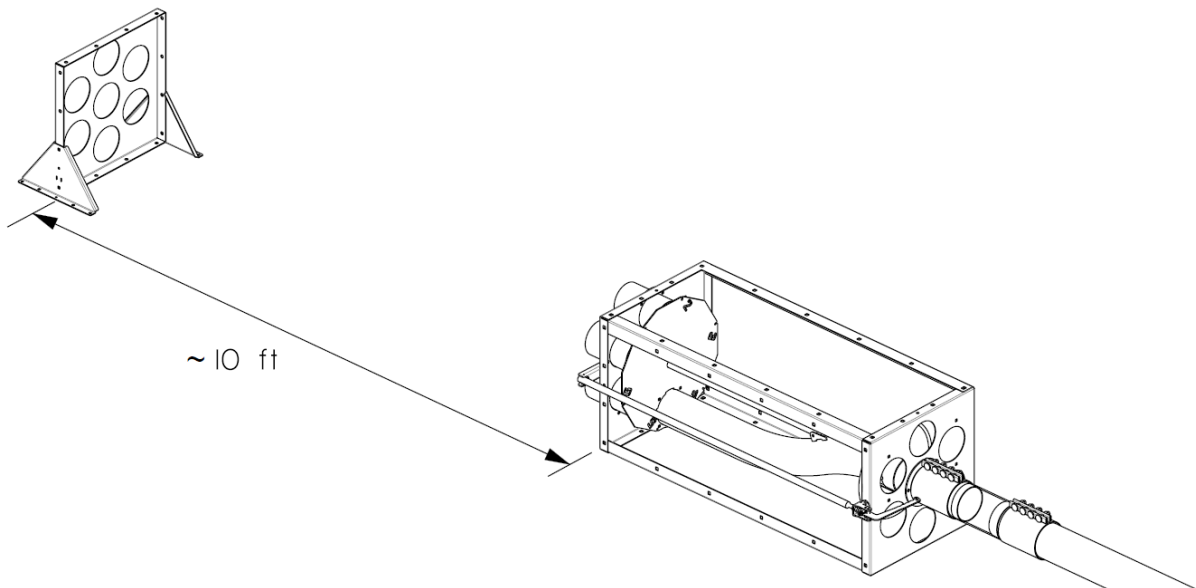


Figure 58: Outlet lines support stand

11. Install the first outlet line, ensuring it is as straight as possible. Secure the line to the valve with a compression coupling.

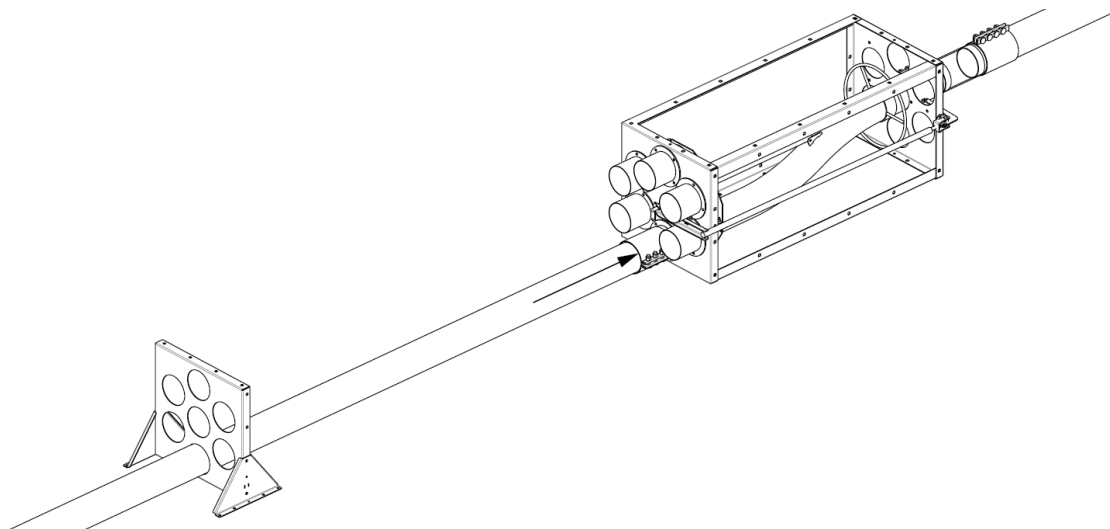


Figure 59: Outlet line installation

12. Rotate the valve elbow to engage the port to which the outlet line was installed. Ensure the elbow moves freely without binding; reposition the line as necessary to relieve any side loading.
13. Repeat **Step 11** and **Step 12** to install all required outlet lines.
14. Operate the valve through each position to verify the mechanism operates smoothly and does not bind. Make any adjustments to the lines or supports as required.

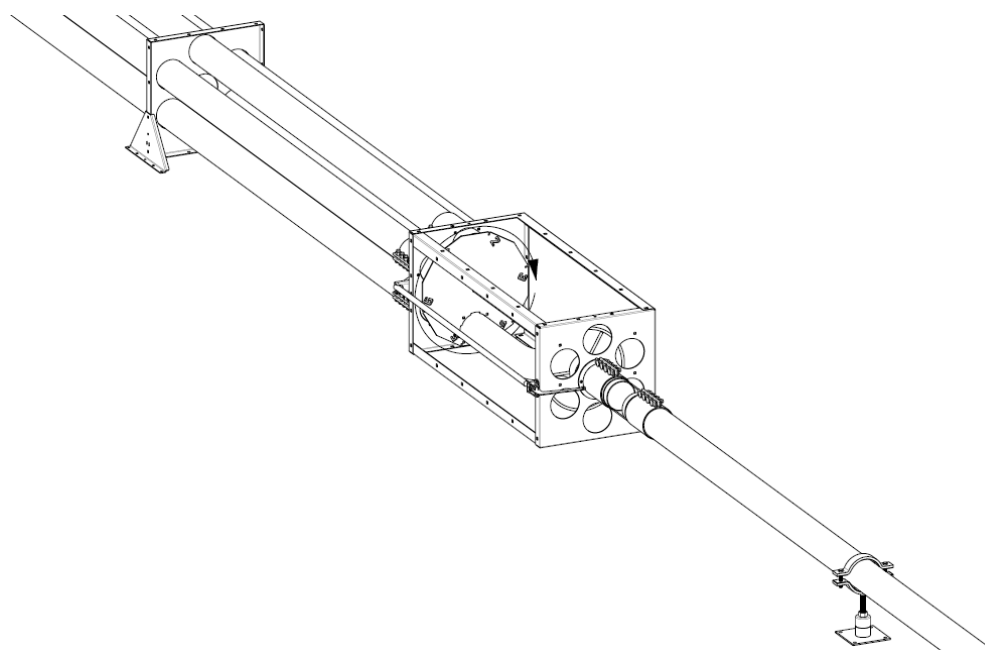


Figure 60: Valve operation

Appendix I: Parts List

	Description	Part Number	Empty Weight (w_e)		Internal Volume (V)		Max. Projected Area (A_p)		Loading Equation(s)
			[lbs]	[kg]	[cu ft]	[L]	[sq ft]	[m ²]	
Straight Piping	TUBE, 2" OD x 16 ga, STEEL	89-03951-1	1.34 /ft	1.99 /m	0.019 /ft	1.76 /m	0.014 /ft	0.004 /m	$F_s, F_m, F_t,$ F_w, F_q
	TUBE, 2" OD x 16 ga, GALV	89-80295-1	1.35 /ft	2.01 /m	0.019 /ft	1.76 /m	0.014 /ft	0.004 /m	
	TUBE, 2" OD x 16 ga, STAINLESS	89-130389-1	1.35 /ft	2.01 /m	0.019 /ft	1.76 /m	0.014 /ft	0.004 /m	
	TUBE, 2" OD x .065" TH, ALUMINUM	89-86409-2	0.46 /ft	0.68 /m	0.019 /ft	1.76 /m	0.014 /ft	0.004 /m	
	TUBE, 2" OD x .125" TH, ALUMINUM	89-16436-2	0.85 /ft	1.26 /m	0.017 /ft	1.58 /m	0.014 /ft	0.004 /m	
	PIPE, 2" ID x SCH40, BLACK	56-01104-1	3.65 /ft	5.43 /m	0.022 /ft	2.04 /m	0.017 /ft	0.005 /m	
	PIPE, 2" ID x SCH40, STAINLESS	56-08713-1	3.66 /ft	5.45 /m	0.022 /ft	2.04 /m	0.017 /ft	0.005 /m	
	PIPE, 2" ID x SCH40, ALUMINUM	89-15928-2	1.26 /ft	1.88 /m	0.016 /ft	1.49 /m	0.017 /ft	0.005 /m	
	TUBE, 3" OD x 16 ga, STEEL	89-08824-1	2.04 /ft	3.04 /m	0.045 /ft	4.18 /m	0.021 /ft	0.006 /m	
	TUBE, 3" OD x 16 ga, GALV	89-80296-1	2.04 /ft	3.04 /m	0.045 /ft	4.18 /m	0.021 /ft	0.006 /m	
	TUBE, 3" OD x 16 ga, STAINLESS	89-80419-1	2.05 /ft	3.05 /m	0.045 /ft	4.18 /m	0.021 /ft	0.006 /m	
	TUBE, 3" OD x 11 ga, STEEL	89-139582-1	3.69 /ft	5.49 /m	0.042 /ft	3.90 /m	0.021 /ft	0.006 /m	
	TUBE, 3" OD x 11 ga, GALV	89-124885-1	3.69 /ft	5.49 /m	0.042 /ft	3.90 /m	0.021 /ft	0.006 /m	
	TUBE, 3" OD x .125" TH, ALUMINUM	89-15203-2	1.33 /ft	1.98 /m	0.042 /ft	3.90 /m	0.021 /ft	0.006 /m	
	PIPE, 3" ID x SCH40, BLACK	56-14292-1	7.77 /ft	11.56 /m	0.049 /ft	4.55 /m	0.024 /ft	0.007 /m	
	PIPE, 3" ID x SCH40, GALV	56-129154-1	7.58 /ft	11.28 /m	0.049 /ft	4.55 /m	0.024 /ft	0.007 /m	
	TUBE, 4" OD x 16 ga, STEEL	89-00299-1	2.73 /ft	4.06 /m	0.082 /ft	7.62 /m	0.028 /ft	0.008 /m	
	TUBE, 4" OD x 16 ga, GALV	89-17452-1	2.74 /ft	4.08 /m	0.082 /ft	7.62 /m	0.028 /ft	0.008 /m	
	TUBE, 4" OD x 11 ga, STEEL	89-16853-1	4.97 /ft	7.40 /m	0.077 /ft	7.15 /m	0.028 /ft	0.008 /m	
	TUBE, 4" OD x 11 ga, GALV	89-124701-1	4.90 /ft	7.29 /m	0.077 /ft	7.15 /m	0.028 /ft	0.008 /m	
	TUBE, 4" OD x 11 ga, STAINLESS	89-80261-1	5.00 /ft	7.44 /m	0.077 /ft	7.15 /m	0.028 /ft	0.008 /m	
	TUBE, 4" OD x .125" TH, ALUMINUM	89-00392-2	1.77 /ft	2.63 /m	0.077 /ft	7.15 /m	0.028 /ft	0.008 /m	
	PIPE, 4" ID x SCH40, BLACK	56-01106-1	10.79 /ft	16.06 /m	0.068 /ft	6.32 /m	0.031 /ft	0.010 /m	
	PIPE, 4" ID x SCH40, STAINLESS	89-83153-1	10.79 /ft	16.06 /m	0.068 /ft	6.32 /m	0.031 /ft	0.010 /m	
	PIPE, 4" ID x SCH40, ALUMINUM	89-80414-2	3.73 /ft	5.55 /m	0.068 /ft	6.32 /m	0.031 /ft	0.010 /m	
	TUBE, 5" OD x 16 ga, STEEL	89-08382-1	3.43 /ft	5.10 /m	0.129 /ft	11.98 /m	0.035 /ft	0.011 /m	
	TUBE, 5" OD x 16 ga, STAINLESS	89-80442-1	3.42 /ft	5.09 /m	0.129 /ft	11.98 /m	0.035 /ft	0.011 /m	
	TUBE, 5" OD x 11 ga, STEEL	89-03591-1	6.25 /ft	9.30 /m	0.124 /ft	11.52 /m	0.035 /ft	0.011 /m	
	TUBE, 5" OD x 11 ga, GALV	89-124702-1	6.25 /ft	9.30 /m	0.124 /ft	11.52 /m	0.035 /ft	0.011 /m	
	TUBE, 5" OD x 11 ga, STAINLESS	89-66051-1	6.26 /ft	9.32 /m	0.124 /ft	11.52 /m	0.035 /ft	0.011 /m	
TUBE, 5" OD x .125" TH, ALUMINUM	89-08073-2	2.2 /ft	3.3 /m	0.124 /ft	11.52 /m	0.035 /ft	0.011 /m		
PIPE, 5" ID x SCH40, BLACK	56-05112-1	14.6 /ft	21.8 /m	0.136 /ft	12.63 /m	0.039 /ft	0.012 /m		

	Description	Part Number	Empty Weight (w_e)		Internal Volume (V_i)		Max. Projected Area (A_f)		Loading Equation(s)
			[lbs]	[kg]	[cu ft]	[L]	[sq ft]	[m ²]	
Straight Piping	PIPE, 5" ID x SCH40, STAINLESS	89-19036-1	14.6 /ft	21.8 /m	0.136 /ft	12.63 /m	0.039 /ft	0.012 /m	$F_s, F_m, F_t,$ F_w, F_q
	PIPE, 5" ID x SCH40, ALUMINUM	89-80422-2	5.1 /ft	7.5 /m	0.136 /ft	12.63 /m	0.039 /ft	0.012 /m	
	TUBE, 6" OD x 11 ga, STEEL	89-08012-1	7.5 /ft	11.2 /m	0.181 /ft	16.82 /m	0.042 /ft	0.013 /m	
	TUBE, 6" OD x 11 ga, GALV	89-124703-1	7.5 /ft	11.2 /m	0.181 /ft	16.82 /m	0.042 /ft	0.013 /m	
	TUBE, 6" OD x 11 ga, STAINLESS	89-17778-1	7.6 /ft	11.3 /m	0.181 /ft	16.82 /m	0.042 /ft	0.013 /m	
	TUBE, 6" OD x .125" TH, ALUMINUM	89-16222-2	2.7 /ft	4.0 /m	0.180 /ft	16.72 /m	0.042 /ft	0.013 /m	
	PIPE, 6" ID x SCH40, BLACK	56-14234-1	19.0 /ft	28.2 /m	0.196 /ft	18.21 /m	0.046 /ft	0.014 /m	
	PIPE, 6" ID x SCH40, STAINLESS	89-18451-1	16.8 /ft	25.0 /m	0.196 /ft	18.21 /m	0.046 /ft	0.014 /m	
	PIPE, 6" ID x SCH40, ALUMINUM	89-14299-2	6.6 /ft	9.8 /m	0.196 /ft	18.21 /m	0.046 /ft	0.014 /m	
	TUBE, 7" OD x 11 ga, STEEL	89-16497-1	8.8 /ft	13.1 /m	0.249 /ft	23.13 /m	0.049 /ft	0.015 /m	
	TUBE, 7" OD x 11 ga, GALV	89-155692-1	8.8 /ft	13.1 /m	0.249 /ft	23.13 /m	0.049 /ft	0.015 /m	
	TUBE, 7" OD x .125" TH, ALUMINUM	89-08897-2	3.2 /ft	4.7 /m	0.248 /ft	23.04 /m	0.049 /ft	0.015 /m	
	TUBE, 8" OD x 11 ga, STEEL	89-16682-1	10.1 /ft	15.0 /m	0.328 /ft	30.47 /m	0.056 /ft	0.017 /m	
	TUBE, 8" OD x 11 ga, GALV	89-155693-1	10.1 /ft	15.0 /m	0.328 /ft	30.47 /m	0.056 /ft	0.017 /m	
	TUBE, 8" OD x 11 ga, STAINLESS	89-87716-1	10.1 /ft	15.1 /m	0.328 /ft	30.47 /m	0.056 /ft	0.017 /m	
	TUBE, 8" OD x .125" TH, ALUMINUM	89-08901-2	2.5 /ft	3.7 /m	0.328 /ft	30.47 /m	0.056 /ft	0.017 /m	
	PIPE, 8" ID x SCH40, BLACK	56-82465-1	28.6 /ft	42.5 /m	0.349 /ft	32.42 /m	0.060 /ft	0.018 /m	
	PIPE, 8" ID x SCH40, STAINLESS	56-87715-1	28.6 /ft	42.5 /m	0.349 /ft	32.42 /m	0.060 /ft	0.018 /m	
	TUBE, 10" OD x 12 ga, STEEL	89-03592-1	11.5 /ft	17.1 /m	0.522 /ft	48.50 /m	0.069 /ft	0.021 /m	
	TUBE, 10" OD x 12 ga, STAINLESS	89-110623-1	11.5 /ft	17.1 /m	0.522 /ft	48.50 /m	0.069 /ft	0.021 /m	
TUBE, 10" OD x .188" TH, ALUMINUM	89-81189-2	6.8 /ft	10.2 /m	0.505 /ft	46.92 /m	0.069 /ft	0.021 /m		
TUBE, 10" OD x 7 ga, STEEL	89-15831-1	19.7 /ft	29.3 /m	0.505 /ft	46.92 /m	0.069 /ft	0.021 /m		
PIPE, 10" ID x SCH40, BLACK	56-75367-1	40.5 /ft	60.3 /m	0.545 /ft	50.63 /m	0.075 /ft	0.023 /m		
Sight Glass	SIGHT GLASS TUBE, 3" OD, 11 ga	51-80912-6	1.5	0.68	0.055	1.56	0.333	0.031	$F_s, F_m, F_t,$ F_w, F_q
	SIGHT GLASS TUBE, 4" OD, 11 ga	51-144346-6	2.0	0.91	0.103	2.92	0.444	0.041	
	SIGHT GLASS TUBE, 5" OD, 11 ga	51-80911-6	2.4	1.1	0.165	4.67	0.556	0.052	
	SIGHT GLASS TUBE, 6" OD, 11 ga	51-144348-6	2.9	1.3	0.241	6.82	0.667	0.062	
Elbows	ELBOW, 2" OD, 16 ga, 45°, 18" CLR, GALV	51-156425-6	2.9	1.3	0.042	1.19	0.363	0.034	$F_s, F_p, F_t, F_c,$ F_w, F_q
	ELBOW, 2" OD, 16 ga, 90°, 18" CLR, GALV	51-80283-6	4.5	2.1	0.064	1.81	0.559	0.052	
	ELBOW, 2" OD, 16 ga, 90°, 24" CLR, GALV	51-80284-6	5.6	2.5	0.079	2.24	0.690	0.064	
	FLAT BACK ELBOW, 2", 16 ga, 22.5°, 18" CLR	11-112358-5	5.7	2.6	0.037	1.05	0.411	0.038	
	FLAT BACK ELBOW, 2", 16 ga, 90°, 24" CLR	11-112239-5	17.4	7.9	0.101	2.86	1.049	0.097	
	ELBOW, 3" OD, 16 ga, 45°, 24" CLR, GALV	51-18933-6	5.2	2.4	0.115	3.26	0.643	0.060	
ELBOW, 3" OD, 16 ga, 45°, 30" CLR, GALV	51-18934-6	6.0	2.7	0.133	3.77	0.741	0.069		

	Description	Part Number	Empty Weight (w_e)		Internal Volume (V_i)		Max. Projected Area (A_f)		Loading Equation(s)
			[lbs]	[kg]	[cu ft]	[L]	[sq ft]	[m ²]	
Elbows	ELBOW, 3" OD, 16 ga, 45°, 36" CLR, GALV	51-18935-6	6.9	3.1	0.151	4.28	0.839	0.078	$F_s, F_p, F_t, F_c,$ F_w, F_q
	ELBOW, 3" OD, 16 ga, 45°, 38" CLR, GALV	51-18936-6	7.1	3.2	0.157	4.44	0.872	0.081	
	ELBOW, 3" OD, 16 ga, 45°, 48" CLR, GALV	51-18937-6	8.4	3.8	0.186	5.27	1.035	0.096	
	ELBOW, 3" OD, 16 ga, 90°, 24" CLR, STAINLESS	51-113577-6	8.5	3.9	0.186	5.27	1.035	0.096	
	ELBOW, 3" OD, 11 ga, 30°, 36" CLR, GALV	51-111689-6	9.7	4.4	0.107	3.03	0.643	0.060	
	ELBOW, 3" OD, 11 ga, 45°, 36" CLR, GALV	51-121898-6	12.6	5.7	0.139	3.94	0.839	0.078	
	ELBOW, 3" OD, 11 ga, 60°, 36" CLR, GALV	51-111690-6	15.6	7.1	0.172	4.87	1.035	0.096	
	ELBOW, 3" OD, 11 ga, 90°, 36" CLR, STEEL	51-18054-6	21.1	9.6	0.237	6.71	1.428	0.133	
	ELBOW, 3" OD, 11 ga, 90°, 36" CLR, GALV	51-111688-6	21.5	9.8	0.237	6.71	1.428	0.133	
	ELBOW, 3" ID, SCH40, 90°, 36" CLR, STEEL	51-106948-6	43.3	19.6	0.293	8.30	1.666	0.155	
	FLAT BACK ELBOW, 3", 11 ga, 45°, 12" CLR	11-130067-5	11.2	5.1	0.101	2.86	0.714	0.066	
	FLAT BACK ELBOW, 3", 11 ga, 90°, 24" CLR	11-129156-5	24.6	11.2	0.232	6.57	1.372	0.127	
	ELBOW, 4" OD, 16 ga, 45°, 24" CLR, GALV	51-18938-6	8.1	3.7	0.237	6.71	0.968	0.090	
	ELBOW, 4" OD, 16 ga, 45°, 30" CLR, GALV	51-18939-6	9.2	4.2	0.269	7.62	1.099	0.102	
	ELBOW, 4" OD, 16 ga, 45°, 36" CLR, GALV	51-18940-6	10.3	4.7	0.301	8.52	1.230	0.114	
	ELBOW, 4" OD, 16 ga, 45°, 48" CLR, GALV	51-18941-6	12.6	5.7	0.366	10.36	1.492	0.139	
	ELBOW, 4" OD, 16 ga, 45°, 60" CLR, GALV	51-18942-6	14.7	6.6	0.430	12.18	1.753	0.163	
	ELBOW, 4" OD, 16 ga, 90°, 24" CLR, GALV	51-18961-6	12.5	5.7	0.366	10.36	1.492	0.139	
	ELBOW, 4" OD, 16 ga, 90°, 30" CLR, GALV	51-18962-6	14.7	6.6	0.427	12.09	1.753	0.163	
	ELBOW, 4" OD, 16 ga, 90°, 36" CLR, GALV	51-18963-6	16.9	7.6	0.494	13.99	2.015	0.187	
	ELBOW, 4" OD, 16 ga, 90°, 48" CLR, GALV	51-18964-6	21.2	9.6	0.622	17.61	2.539	0.236	
	ELBOW, 4" OD, 16 ga, 90°, 60" CLR, GALV	51-18965-6	25.6	11.62	0.750	21.24	3.062	0.285	
	ELBOW, 4" OD, 11 ga, 30°, 30" CLR, STEEL	51-80890-6	13.1	6.0	0.204	5.78	0.881	0.082	
	ELBOW, 4" OD, 11 ga, 30° 36" CLR, GALV	51-111692-6	18.4	8.3	0.275	7.79	0.968	0.090	
	ELBOW, 4" OD, 11 ga, 45° 36" CLR, STEEL	51-108105-6	18.4	8.3	0.285	8.07	1.230	0.114	
	ELBOW, 4" OD, 11 ga, 45°, 36" CLR, GALV	51-121899-6	18.7	8.5	0.285	8.07	1.230	0.114	
	ELBOW, 4" OD, 11 ga, 60° 36" CLR, GALV	51-111693-6	22.7	10.3	0.345	9.77	1.492	0.139	
	ELBOW, 4" OD, 11 ga, 90°, 36" CLR, STEEL	51-13147-6	30.1	13.6	0.466	13.20	2.015	0.187	
	ELBOW, 4" OD, 11 ga, 90° 36" CLR, GALV	51-111691-6	30.7	13.9	0.466	13.20	2.015	0.187	
	ELBOW, 4" ID, SCH 40, 90°, 48" CLR, STEEL	51-113420-6	82.3	37.3	0.673	19.06	2.856	0.265	
	FLAT BACK ELBOW, 4", 11 ga, 90°, 18" CLR	11-75788-5	45.9	20.8	0.376	10.64	1.662	0.154	
	FLAT BACK ELBOW, 4", 11 ga, 90°, 24" CLR	11-75500-5	56.3	25.5	0.467	13.22	2.075	0.193	
	FLAT BACK ELBOW, 4", 11 ga, 90°, 36" CLR	11-152707-5	77.8	35.3	0.578	16.37	2.723	0.253	
	FLAT BACK ELBOW, 4", SCH 40, 45° 24" CLR	11-138018-5	38.7	17.6	0.305	8.64	1.439	0.134	
FLAT BACK ELBOW, 4", SCH 40, 90°, 24" CLR	11-117651-5	60.3	27.4	0.490	13.88	2.107	0.196		

	Description	Part Number	Empty Weight (w_e)		Internal Volume (V_i)		Max. Projected Area (A_f)		Loading Equation(s)
			[lbs]	[kg]	[cu ft]	[L]	[sq ft]	[m ²]	
Elbows	ELBOW, 5" OD, 11 ga, 30°, 48" CLR, GALV	51-111695-6	24.0	10.9	0.465	13.17	1.567	0.146	$F_s, F_p, F_t, F_c,$ F_w, F_q
	ELBOW, 5" OD, 11 ga, 45°, 36" CLR, STEEL	51-108669-6	25.2	11.4	0.497	14.07	1.742	0.162	
	ELBOW, 5" OD, 11 ga, 45°, 48" CLR, GALV	51-121900-6	30.7	13.9	0.596	16.88	2.003	0.186	
	ELBOW, 5" OD, 11 ga, 60°, 30" CLR, STEEL	51-17628-6	28.3	12.8	0.529	14.98	2.480	0.166	
	ELBOW, 5" OD, 11 ga, 60°, 48" CLR, GALV	51-111696-6	37.4	20.0	0.724	20.50	2.440	0.227	
	ELBOW, 5" OD, 11 ga, 90°, 48" CLR, STEEL	51-08753-6	49.8	22.6	0.982	27.81	3.312	0.308	
	ELBOW, 5" OD, 11 ga, 90°, 48" CLR, GALV	51-111694-6	50.8	23.0	0.982	27.81	3.312	0.308	
	ELBOW, 5" ID, SCH 40, 90°, 48" CLR, STEEL	51-86212-6	116.3	52.8	1.104	31.26	3.607	0.335	
	FLAT BACK ELBOW, 5", 11 ga, 90°, 48" CLR	11-86365-5	126.0	57.2	1.390	39.36	4.504	0.418	
	ELBOW, 6" OD, 11 ga, 30°, 30" CLR, STEEL	51-17631-6	25.0	11.3	0.599	16.96	1.655	0.154	
	ELBOW, 6" OD, 11 ga, 30°, 48" CLR, GALV	51-111698-6	31.5	14.3	0.741	20.98	2.047	0.190	
	ELBOW, 6" OD, 11 ga, 45°, 30" CLR, STEEL	51-17633-6	29.9	13.6	0.717	20.30	1.982	0.184	
	ELBOW, 6" OD, 11 ga, 45°, 48" CLR, GALV	51-121901-6	39.6	17.9	0.930	26.33	2.571	0.239	
	ELBOW, 6" OD, 11 ga, 60°, 48" CLR, GALV	51-111699-6	47.6	21.6	1.120	31.71	3.094	0.287	
	ELBOW, 6" OD, 11 ga, 90°, 48" CLR, STEEL	51-07287-6	62.5	28.3	1.499	42.45	4.142	0.385	
	ELBOW, 6" OD, 11 ga, 90°, 48" CLR, GALV	51-11697-6	63.7	28.9	1.499	42.45	4.142	0.385	
	FLAT BACK ELBOW, 6", 11 ga, 45°, 48" CLR	11-128486-5	86.8	39.4	1.211	34.29	3.366	0.313	
	FLAT BACK ELBOW, 6", 11 ga, 60°, 48" CLR	11-94017-5	106.7	48.4	1.475	41.77	4.006	0.372	
	FLAT BACK ELBOW, 6", 11 ga, 90°, 48" CLR	11-76195-5	143.7	65.2	1.989	56.32	4.981	0.463	
	ELBOW, 7" OD, 11 ga, 30°, 60" CLR, STEEL	51-133421-6	43.7	19.8	1.234	34.94	2.888	0.268	
	ELBOW, 7" OD, 11 ga, 30°, 60" CLR, GALV	51-133278-6	44.6	20.2	1.234	34.94	2.888	0.268	
	ELBOW, 7" OD, 11 ga, 45°, 60" CLR, STEEL	51-133420-6	55.3	25.1	1.560	44.17	3.652	0.339	
	ELBOW, 7" OD, 11 ga, 45°, 60" CLR, GALV	51-133277-6	56.4	25.6	1.560	44.17	3.652	0.339	
	ELBOW, 7" OD, 11 ga, 60°, 60" CLR, STEEL	51-133419-6	66.8	30.3	1.887	53.43	4.415	0.410	
	ELBOW, 7" OD, 11 ga, 60°, 60" CLR, GALV	51-133276-6	68.2	30.9	1.887	53.43	4.415	0.410	
	ELBOW, 7" OD, 11 ga, 90°, 60" CLR, STEEL	51-133418-6	89.9	40.8	2.539	71.90	5.943	0.552	
	ELBOW, 7" OD, 11 ga, 90°, 60" CLR, GALV	51-133275-6	91.7	41.2	2.539	71.90	5.943	0.552	
	FLAT BACK ELBOW, 7", 11 ga, 30°, 48" CLR	11-78829-5	78.7	35.7	1.317	37.29	3.115	0.289	
	FLAT BACK ELBOW, 7", 11 ga, 60°, 48" CLR	11-78822-5	124.1	56.3	2.015	57.06	4.648	0.432	
	FLAT BACK ELBOW, 7", 11 ga, 90°, 48" CLR	11-78633-5	169.9	77.2	2.757	78.07	5.844	0.543	
	ELBOW, 8" OD, 11 ga, 30°, 48" CLR, GALV	51-132628-6	49.1	22.3	1.564	44.29	3.174	0.295	
	ELBOW, 8" OD, 11 ga, 45°, 48" CLR, GALV	51-159296-6	59.9	27.2	1.908	54.03	3.872	0.360	
	ELBOW, 8" OD, 11 ga, 60°, 48" CLR, GALV	51-132627-6	70.7	32.1	2.252	63.77	4.570	0.425	
	ELBOW, 8" OD, 11 ga, 90°, 32" CLR, STEEL	51-106743-6	69.2	31.4	2.252	63.77	4.570	0.425	

	Description	Part Number	Empty Weight (w_e)		Internal Volume (V_i)		Max. Projected Area (A_i)		Loading Equation(s)
			[lbs]	[kg]	[cu ft]	[L]	[sq ft]	[m ²]	
Elbows	ELBOW, 8" OD, 11 ga, 90°, 48" CLR, STEEL	51-111174-6	90.5	41.0	2.939	83.22	5.967	0.554	$F_s, F_p, F_t, F_c,$ F_w, F_q
	ELBOW, 8" OD, 11 ga, 90°, 48" CLR, GALV	51-132626-6	92.3	41.9	2.939	83.22	5.967	0.554	
	ELBOW, 8" OD, 11 ga, 90°, 60" CLR, STEEL	51-111176-6	106.4	48.2	3.455	97.83	7.014	0.652	
	FLAT BACK ELBOW, 8", 11 ga, 90°, 30" CLR	11-86570-5	148.9	67.5	2.943	83.34	5.312	0.494	
	FLAT BACK ELBOW, 8", 11 ga, 90°, 48" CLR	11-110912-5	194.1	88.0	3.633	102.9	6.545	0.608	
	FLAT BACK ELBOW, 8", 11 ga, 90°, 60" CLR	11-110934-5	232.0	105.2	4.331	122.6	7.797	0.724	
	ELBOW, 10" OD, 12 ga, 90°, 32" CLR, STEEL	51-70666-6	77.1	35.0	3.491	98.85	6.546	0.608	
	ELBOW, 10" ID, SCH 40, 45°, 72" CLR, STEEL	11-164146-5	247.1	112.1	3.315	93.87	5.541	0.515	
	ELBOW, 10" ID, SCH 40, 90°, 72" CLR, STEEL	11-164143-5	440.3	199.8	5.901	167.098	9.890	0.919	
Diverter Valves	DISTRIBUTOR, 2", 2-WAY, 11 ga, SHORT	11-156445-6	90.9	41.2	0.063	1.78	2.783	0.259	$F_s, F_p, F_t,$ F_w, F_q
	DISTRIBUTOR, 2", 3-WAY, 11 ga	11-156446-6	113.4	51.4	0.096	2.72	4.558	0.423	
	DISTRIBUTOR, 2", 3-WAY, SCH 40	11-159053-6	121.9	55.3	0.133	3.77	4.728	0.439	
	DISTRIBUTOR, 2", 6-WAY, 11 ga	11-156447-6	119.5	54.2	0.096	2.72	4.556	0.423	
	DISTRIBUTOR, 2", 6-WAY, SCH 40	11-159059-6	129.1	58.6	0.133	3.77	4.726	0.439	
	DIVERTER, 3", Y, HD	38-111317-5	57.6	26.1	0.317	8.98	1.964	0.182	
	DISTRIBUTOR, 3", 2-WAY, 11 ga, SHORT	11-156448-6	104.1	47.2	0.155	4.39	3.051	0.283	
	DISTRIBUTOR, 3", 2-WAY, 11 ga, AUTO	11-156790-6	251.1	113.9	0.236	6.68	7.573	0.704	
	DISTRIBUTOR, 3", 2-WAY, 11 ga, AUTO/AIR	11-159032-6	251.1	113.9	0.236	6.68	7.573	0.704	
	DISTRIBUTOR, 3", 3-WAY, 11 ga	11-137640-6	122.2	55.4	0.236	6.68	5.011	0.466	
	DISTRIBUTOR, 3", 3-WAY, 11 ga, AUTO	11-156794-6	296.1	134.3	0.236	6.68	10.20	0.947	
	DISTRIBUTOR, 3", 3-WAY, 11 ga, AUTO/AIR	11-159036-6	296.1	134.3	0.236	6.68	10.20	0.947	
	DISTRIBUTOR, 3", 3-WAY, SCH 40	11-159054-6	150.1	68.1	0.292	8.27	5.153	0.479	
	DISTRIBUTOR, 3", 6-WAY, 11 ga	11-128635-6	169.4	76.8	0.236	6.68	5.009	0.465	
	DISTRIBUTOR, 3", 6-WAY, 11 ga, AUTO	11-156797-6	329.4	149.4	0.236	6.68	10.14	0.942	
	DISTRIBUTOR, 3", 6-WAY, 11 ga, AUTO/AIR	11-156040-6	329.4	149.4	0.236	6.68	10.14	0.942	
	DISTRIBUTOR, 3", 6-WAY, SCH 40	11-159060-6	160.9	73.0	0.292	8.27	5.284	0.491	
	DIVERTER, 4", Y, HD	38-79450-5	94.8	43.0	0.548	15.52	2.349	0.218	
	DISTRIBUTOR, 4", 2-WAY, 11 ga, SHORT	11-156449-6	102.6	46.5	0.287	8.13	3.375	0.314	
	DISTRIBUTOR, 4", 2-WAY, 11 ga, AUTO	11-156791-6	357.7	162.3	0.438	12.40	7.583	0.705	
	DISTRIBUTOR, 4", 2-WAY, 11 ga, AUTO/AIR	11-159033-6	357.7	162.3	0.438	12.40	7.583	0.705	
	DISTRIBUTOR, 4", 2-WAY, SCH 40, AUTO	11-156800-6	397.6	180.3	0.503	14.24	7.594	0.705	
	DISTRIBUTOR, 4", 2-WAY, SCH 40, AUTO/AIR	11-159044-6	397.6	180.3	0.503	14.24	7.594	0.705	
	DISTRIBUTOR, 4", 3-WAY, 11 ga	11-126837-6	130.9	59.4	0.438	12.40	5.519	0.513	
DISTRIBUTOR, 4", 3-WAY, 11 ga, AUTO	11-132658-6	365.9	166.0	0.438	12.40	10.50	0.976		

	Description	Part Number	Empty Weight (w_e)		Internal Volume (V_i)		Max. Projected Area (A_f)		Loading Equation(s)
			[lbs]	[kg]	[cu ft]	[L]	[sq ft]	[m ²]	
Diverter Valves	DISTRIBUTOR, 4", 3-WAY, 11 ga, AUTO/AIR	111-159037-6	365.9	166.0	0.438	12.40	10.50	0.976	$F_s, F_p, F_t,$ F_w, F_q
	DISTRIBUTOR, 4", 3-WAY, SCH 40	11-159055-6	170.7	77.4	0.503	14.24	5.746	0.534	
	DISTRIBUTOR, 4", 3-WAY, SCH 40, AUTO	11-156823-6	405.7	184.0	0.503	14.24	10.55	0.980	
	DISTRIBUTOR, 4", 3-WAY, SCH 40, AUTO/AIR	11-159047-6	405.7	184.0	0.503	14.24	10.55	0.980	
	DISTRIBUTOR, 4", 6-WAY, 11 ga	11-113345-6	139.3	63.2	0.438	12.40	5.517	0.513	
	DISTRIBUTOR, 4", 6-WAY, 11 ga, AUTO	11-132659-6	399.3	181.1	0.438	12.40	10.45	0.971	
	DISTRIBUTOR, 4", 6-WAY, 11 ga, AUTO/AIR	11-159041-6	399.3	181.1	0.438	12.40	10.45	0.971	
	DISTRIBUTOR, 4", 6-WAY, SCH 40	11-159061-6	184.2	83.6	0.503	14.24	5.744	0.534	
	DISTRIBUTOR, 4", 6-WAY, SCH 40, AUTO	11-156826-6	444.2	200.6	0.503	14.24	10.50	0.975	
	DISTRIBUTOR, 4", 6-WAY, SCH 40, AUTO/AIR	11-159050-6	444.2	200.6	0.503	14.24	10.50	0.975	
	DIVERTER, 5", Y, HD	38-68309-5	105.1	47.7	0.833	23.59	2.719	0.253	
	DIVERTER, 5", Y, 45°, HD	38-93480-5	49.2	22.3	0.410	11.61	1.423	0.132	
	DISTRIBUTOR, 5", 2-WAY, 11 ga, SHORT	11-156450-6	108.4	49.2	0.460	13.03	3.657	0.340	
	DISTRIBUTOR, 5", 2-WAY, 11 ga, AUTO	11-156792-6	355.4	161.2	0.703	19.91	7.865	0.731	
	DISTRIBUTOR, 5", 2-WAY, 11 ga, AUTO/AIR	11-159034-6	355.4	161.2	0.703	19.91	7.865	0.731	
	DISTRIBUTOR, 5", 2-WAY, SCH 40, AUTO	11-156801-6	422.8	191.8	0.790	22.37	7.906	0.734	
	DISTRIBUTOR, 5", 2-WAY, SCH 40, AUTO/AIR	11-159045-6	422.8	191.8	0.790	22.37	7.906	0.734	
	DISTRIBUTOR, 5", 3-WAY, 11 ga	11-126538-6	139.7	63.4	0.703	19.91	5.986	0.556	
	DISTRIBUTOR, 5", 3-WAY, 11 ga, AUTO	11-156795-6	374.7	169.9	0.703	19.91	10.60	0.985	
	DISTRIBUTOR, 5", 3-WAY, 11 ga, AUTO/AIR	11-159038-6	374.7	169.9	0.703	19.91	10.60	0.985	
	DISTRIBUTOR, 5", 3-WAY, SCH 40	11-159056-6	197.0	89.4	0.790	22.37	6.256	0.581	
	DISTRIBUTOR, 5", 3-WAY, SCH 40, AUTO	11-156824-6	432.0	195.9	0.790	22.37	10.65	0.990	
	DISTRIBUTOR, 5", 3-WAY, SCH 40, AUTO/AIR	11-159048-6	432.0	195.5	0.790	22.37	10.65	0.990	
	DISTRIBUTOR, 5", 6-WAY, 11 ga	11-113346-6	149.2	67.7	0.703	19.91	5.984	0.556	
	DISTRIBUTOR, 5", 6-WAY, 11 ga, AUTO	11-156798-6	409.2	185.6	0.703	19.91	10.54	0.980	
	DISTRIBUTOR, 5", 6-WAY, 11 ga, AUTO/AIR	11-159042-6	409.2	185.6	0.703	19.91	10.54	0.980	
	DISTRIBUTOR, 5", 6-WAY, SCH 40	11-159062-6	213.9	97.0	0.790	22.37	6.239	0.580	
	DISTRIBUTOR, 5", 6-WAY, SCH 40, AUTO	11-156827-6	473.9	215.0	0.790	22.37	10.60	0.985	
	DISTRIBUTOR, 5", 6-WAY, SCH 40, AUTO/AIR	11-159051-6	473.9	215.0	0.790	22.37	10.60	0.985	
	DISTRIBUTOR, 5", 8-WAY, 11 ga	11-161945-6	147.2	66.8	0.703	19.91	6.106	0.567	
	DIVERTER, 6", Y, HD	38-98558-5	121.6	55.2	1.197	33.90	3.099	0.288	
	DISTRIBUTOR, 6", 2-WAY, 11 ga, SHORT	11-156451-6	114.1	51.8	0.673	19.06	3.940	0.366	
	DISTRIBUTOR, 6", 2-WAY, 11 ga, AUTO	11-156793-6	361.1	163.8	1.029	29.14	7.938	0.737	
	DISTRIBUTOR, 6", 2-WAY, 11 ga, AUTO/AIR	11-159035-6	361.1	163.8	1.029	29.14	7.938	0.737	

	Description	Part Number	Empty Weight (w_e)		Internal Volume (V_i)		Max. Projected Area (A_i)		Loading Equation(s)
			[lbs]	[kg]	[cu ft]	[L]	[sq ft]	[m ²]	
Diverter Valves	DISTRIBUTOR, 6", 2-WAY, SCH 40, AUTO	11-156822-6	451.0	204.6	1.141	32.31	7.983	0.742	$F_s, F_p, F_t,$ F_w, F_q
	DISTRIBUTOR, 6", 2-WAY, SCH 40, AUTO/AIR	11-159046-6	451.0	204.6	1.141	32.31	7.983	0.742	
	DISTRIBUTOR, 6", 3-WAY, 11 ga	11-126539-6	148.3	67.3	1.029	29.14	6.453	0.599	
	DISTRIBUTOR, 6", 3-WAY, 11 ga, AUTO	11-156796-6	383.3	173.9	1.029	29.14	10.70	0.994	
	DISTRIBUTOR, 6", 3-WAY, 11 ga, AUTO/AIR	11-159039-6	383.3	173.9	1.029	29.14	10.70	0.994	
	DISTRIBUTOR, 6", 3-WAY, SCH 40	11-159057-6	226.6	102.8	1.141	32.31	6.735	0.626	
	DISTRIBUTOR, 6", 3-WAY, SCH 40, AUTO	11-156825-6	461.6	209.4	1.141	32.31	10.76	0.999	
	DISTRIBUTOR, 6", 3-WAY, SCH 40, AUTO/AIR	11-159049-6	461.6	209.4	1.141	32.31	10.76	0.999	
	DISTRIBUTOR, 6", 6-WAY, 11 ga	11-113347-6	158.8	72.0	1.029	29.14	6.451	0.599	
	DISTRIBUTOR, 6", 6-WAY, 11 ga, AUTO	11-156799-6	393.8	178.6	1.029	29.14	10.64	0.989	
	DISTRIBUTOR, 6", 6-WAY, 11 ga, AUTO/AIR	11-159043-6	393.8	178.6	1.029	29.14	10.64	0.989	
	DISTRIBUTOR, 6", 6-WAY, SCH 40	11-159063-6	247.2	112.1	1.141	32.31	6.733	0.626	
	DISTRIBUTOR, 6", 6-WAY, SCH 40, AUTO	11-156828-6	507.2	230.1	1.141	32.31	10.70	0.994	
	DISTRIBUTOR, 6", 6-WAY, SCH 40, AUTO/AIR	11-159052-6	507.2	230.1	1.141	32.31	10.70	0.994	
	DISTRIBUTOR, 6", 8-WAY, 11 ga	11-161946-6	156.8	71.1	1.029	29.14	6.597	0.613	
	DISTRIBUTOR, 7", 2-WAY, 11 ga, SHORT	11-156452-6	124.0	56.2	0.945	26.76	4.649	0.432	
	DISTRIBUTOR, 7", 2-WAY, 11 ga, AUTO	11-162226-6	443.3	201.1	1.431	40.52	9.260	0.860	
	DISTRIBUTOR, 7", 3-WAY, 11 ga	11-132045-6	163.8	74.3	1.431	40.52	7.272	0.676	
	DISTRIBUTOR, 7", 6-WAY, 11 ga	11-132044-6	180.5	81.9	1.431	40.52	7.269	0.675	
	DISTRIBUTOR, 8", 2-WAY, 11 ga, SHORT	11-156453-6	130.2	59.1	1.245	35.25	4.747	0.441	
DISTRIBUTOR, 8", 3-WAY, 11 ga	11-156454-6	186.8	84.7	1.885	53.38	7.742	0.719		
DISTRIBUTOR, 8", 3-WAY, SCH 40	11-159058-6	300.5	136.3	1.994	56.46	8.027	0.745		
DISTRIBUTOR, 8", 6-WAY, 11 ga	11-156455-6	190.7	86.5	1.885	53.38	7.739	0.719		
DISTRIBUTOR, 8", 6-WAY, SCH 40	11-159064-6	334.5	151.7	1.994	56.46	8.025	0.746		
Couplings	COMPRESSION CPLG, 2", 3 BOLT, BLACK	38-80276-6	2.8	1.3	—	—	—	—	F_s
	COMPRESSION CPLG, 3", 3 BOLT, BLACK	38-80279-6	3.9	1.8	—	—	—	—	
	COMPRESSION CPLG, 4", 3 BOLT, BLACK	38-13084-6	5.3	2.4	—	—	—	—	
	COMPRESSION CPLG, 5", 4 BOLT, BLACK	38-08787-6	8.9	4.0	—	—	—	—	
	COMPRESSION CPLG, 6", 4 BOLT, BLACK	38-08785-6	11.2	5.1	—	—	—	—	
	COMPRESSION CPLG, 7", 4 BOLT, BLACK	38-08848-6	14.4	6.5	—	—	—	—	
	COMPRESSION CPLG, 8", 3 BOLT, BLACK	38-97092-6	12.3	5.6	—	—	—	—	
	COMPRESSION CPLG, 10", 5 BOLT, BLACK	38-72422-6	26.8	12.2	—	—	—	—	

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			[lbs]	[kg]	[cu ft]	[L]	[sq ft]	[m ²]	
Piping Supports	BIN CLAMP BRKT, 2" - 6"	38-07612-4	0.39	0.18	—	—	—	—	F_s
	BIN STAND OFF BRKT, 4" - 6"	38-07989-4	0.80	0.36	—	—	—	—	
	BIN STAND OFF BRKT, 7"	38-83700-4	0.46	0.21	—	—	—	—	
	BIN STAND OFF ASSEMBLY, 8"	38-111166-5	1.90	0.86	—	—	—	—	
	BIN BRKT SUPPORT	38-09466-4	0.52	0.24	—	—	—	—	
	BIN STAND OFF BRKT, HD, 3" - 6"	38-39510-4	2.7	1.2	—	—	—	—	
	BIN STAND OFF BRKT, HD, 3" - 6", WIDE	38-142981-4	4.6	2.1	—	—	—	—	
	BIN STAND OFF BRKT, HD, 8"	38-111168-4	3.3	1.5	—	—	—	—	
	BN STAND OFF BRKT, HD, 10"	38-75635-4	3.1	1.4	—	—	—	—	
	SADDLE CLAMP, 2", PLTD	28-16800-6	0.38	0.17	—	—	—	—	
	SADDLE CLAMP, 3", PLTD	28-04673-6	0.58	0.26	—	—	—	—	
	SADDLE CLAMP, 4", PLTD	28-02074-6	0.81	0.37	—	—	—	—	
	SADDLE CLAMP, 4", STAINLESS	28-129392-6	0.91	0.41	—	—	—	—	
	SADDLE CLAMP, 5", PLTD	28-04675-6	1.0	0.46	—	—	—	—	
	SADDLE CLAMP, 5", STAINLESS	28-134077-6	0.98	0.44	—	—	—	—	
	SADDLE CLAMP, 6", PLTD	28-08698-6	1.4	0.63	—	—	—	—	
	SADDLE CLAMP, 7", PLTD	28-18432-6	1.8	0.81	—	—	—	—	
	SADDLE CLAMP, 8", PLTD	11-120197-5	1.4	0.64	—	—	—	—	
	SADDLE CLAMP BAND, 10",	11-125318-5	2.7	1.2	—	—	—	—	
	SADDLE CLAMP BRKT, 10"	11-125399-4	3.5	1.6	—	—	—	—	
	TUBE HANGER, 2", GALV	28-80399-6	0.12	0.05	—	—	—	—	
	TUBE HANGER, 3", GALV	28-65182-6	0.28	0.12	—	—	—	—	
TUBE HANGER, 4", GALV	28-65183-6	0.34	0.15	—	—	—	—		
TUBE HANGER, 5", GALV	28-19041-6	0.83	0.38	—	—	—	—		
BEAM CLAMP, SMALL THROAT, 3/8"-16	28-72148-6	0.29	0.13	—	—	—	—		
BIN ROOF SUPPORT ASSY, 8"	11-163966-6	72.4	32.9	—	—	—	—		
BIN ROOF SUPPORT ASSY, 8", ADJUSTABLE	11-138281-5	54.3	24.6	—	—	—	—		
Bin Vents	DUSTLESS BIN VENT, 500 CFM	11-139370-5	268.0	121.6	11.32	320.5	8.860	0.823	F_s, F_w, F_q
	PEDESTAL, BIN VENT 500 CFM	11-139374-5	54.9	24.9	3.733	105.7	2.101	0.195	
	DUSTLESS BIN VENT, 1200 CFM	11-139519-5	389.1	176.5	22.13	626.7	11.12	1.033	
	PEDESTAL, BIN VENT 1200 CFM	11-139523-5	77.8	35.3	7.212	204.2	2.809	0.261	
	DUSTLESS BIN VENT, 2000 CFM	11-163995-5	619.5	281.0	35.97	1018.6	12.88	1.196	
	PEDESTAL, BIN VENT 2000 CFM	11-163991-5	114.5	51.9	12.46	352.8	4.217	0.392	
	DUSTLESS BIN VENT, 2000 CFM, STAINLESS	11-159707-5	554.4	251.5	35.97	1018.6	12.88	1.196	
	PEDESTAL, BIN VENT 2000 CFM, STAINLESS	11-159708-5	104.9	47.6	12.46	352.8	4.217	0.392	

	Description	Part Number	Empty Weight (w_e)		Internal Volume (V_i)		Max. Projected Area (A_f)		Loading Equation(s)
			[lbs]	[kg]	[cu ft]	[L]	[sq ft]	[m ²]	
Discharge Assemblies	BIN FLASHING, 4", 30°	38-132100-5	8.8	4.0	0.462	13.08	1.570	0.146	$F_s, F_m,$ F_w, F_q
	BIN FLASHING, 5", 30°	38-132102-5	15.9	7.2	0.702	19.88	1.933	0.180	
	BIN FLASHING, 6", 30°	38-132104-5	18.8	8.5	1.027	29.08	2.285	0.212	
	BIN FLASHING, 7", 30°	38-139216-5	21.9	9.9	1.450	41.06	2.704	0.251	
	BIN FLASHING, 8", 30°	38-157070-5	23.1	10.5	1.876	53.12	2.964	0.275	
	BIN DEFLECTOR, 4" - 6"	38-106900-5	15.2	6.9	—	—	1.311	0.122	
	BIN DEFLECTOR, 7" - 8"	38-132047-5	26.5	12.0	—	—	2.377	0.221	
	DEADHEAD DEFLECTOR, 4", 45°	38-116155-5	21.0	9.5	0.370	10.48	1.395	0.130	
	DEADHEAD DEFLECTOR, 4", 90°	38-115299-5	30.9	14.0	0.533	15.09	1.346	0.125	
	DEADHEAD DEFLECTOR, 5", 45°	38-116156-5	32.8	14.9	1.304	36.93	2.624	0.244	
	DEADHEAD DEFLECTOR, 5", 90°	38-112683-5	48.8	22.1	1.222	34.60	2.403	0.223	
	DEADHEAD DEFLECTOR, 6", 45°	38-116157-5	53.0	24.0	2.443	69.18	3.781	0.351	
	DEADHEAD DEFLECTOR, 6", 90°	38-115779-5	79.2	35.9	2.218	62.81	3.477	0.323	
	CYCLONE, 3"	38-137178-5	57.7	26.2	1.041	29.48	1.562	0.145	$F_s, F_c,$ F_w, F_q
	CYCLONE, 3", WP	38-110838-5	56.8	25.8	1.041	29.48	1.679	0.156	
	CYCLONE, 4"	38-142991-5	86.4	39.2	2.088	59.13	2.575	0.239	
	CYCLONE, 4", HIGH EFFICIENCY	38-126883-5	83.6	37.9	1.985	56.21	2.170	0.202	
	CYCLONE, 4", WP	38-114268-5	90.0	40.8	2.088	59.13	2.558	0.238	
	CYCLONE, 4", WP, HINGED	38-112697-5	98.9	44.9	2.084	59.01	2.412	0.224	
	CYCLONE, 4", WP, HIGH EFFICIENCY	38-126740-5	86.6	39.3	2.009	59.89	2.214	0.206	
	CYCLONE, 4", WP, REVERSIBLE	38-137046-5	94.0	42.6	2.134	60.43	2.609	0.242	
	CYCLONE, 4", WP, PLASTIC	38-45315-5	31.0	14.1	1.772	50.18	2.553	0.237	
	CYCLONE, 5"	38-142994-5	86.6	39.3	2.099	59.44	2.596	0.241	
	CYCLONE, 5", HIGH EFFICIENCY	38-126884-5	115.7	52.5	3.751	106.2	3.267	0.304	
	CYCLONE, 5", WP	38-114270-5	92.0	41.7	2.111	59.78	2.580	0.240	
	CYCLONE, 5", WP, HINGED	38-112694-5	98.9	44.9	2.095	59.32	2.433	0.226	
	CYCLONE, 5", WP, HIGH EFFICIENCY	38-126741-5	120.0	54.4	3.707	105.0	3.349	0.311	
	CYCLONE, 5", WP, REVERSIBLE	38-137119-5	93.9	42.6	2.145	60.74	2.632	0.245	
	CYCLONE, 5", WP, PLASTIC	38-45314-5	31.0	14.1	1.899	53.77	2.092	0.194	
	CYCLONE, 6"	38-142997-5	114.5	51.9	3.553	100.6	3.339	0.310	
CYCLONE, 6", HIGH EFFICIENCY	38-126885-5	154.4	70.0	6.372	180.4	5.269	0.490		
CYCLONE, 6", WP	38-114272-5	114.5	51.9	3.445	97.55	3.369	0.313		
CYCLONE, 6", WP, HINGED	38-112690-5	128.1	58.1	3.412	96.62	3.556	0.330		
CYCLONE, 6", WP, HIGH EFFICIENCY	38-126742-5	161.3	73.2	6.310	178.7	5.384	0.500		

	Description	Part Number	Empty Weight (w_e)		Internal Volume (V_i)		Max. Projected Area (A_i)		Loading Equation(s)
			[lbs]	[kg]	[cu ft]	[L]	[sq ft]	[m ²]	
Discharge Assemblies	CYCLONE, 6", WP, REVERSIBLE	38-137107-5	120.1	54.5	3.414	96.67	3.439	0.319	$F_s, F_c,$ F_w, F_q
	CYCLONE, 6", WP, TALL	38-75774-5	158.5	71.9	7.098	201.0	5.477	0.509	
	CYCLONE, 7", HIGH EFFICIENCY	38-126886-5	227.8	103.3	11.87	336.1	8.768	0.815	
	CYCLONE, 7", WP	38-114274-5	132.3	60.0	4.779	135.3	4.385	0.407	
	CYCLONE, 7", WP, HINGED	38-144390-5	142.3	64.5	4.807	136.1	4.422	0.411	
	CYCLONE, 7", WP, HIGH EFFICIENCY	38-126547-5	235.0	106.6	11.83	335.0	8.908	0.828	
	CYCLONE, 8", HIGH EFFICIENCY, STAINLESS, L	38-126858-5	277.0	125.6	14.90	421.9	13.35	1.241	
	CYCLONE, 8", HIGH EFFICIENCY, STAINLESS, R	38-127997-5	275.0	124.7	14.90	421.9	13.35	1.241	
	CYCLONE, 8", WP	38-114276-5	150.0	68.0	6.086	172.3	4.863	0.452	
	CYCLONE, 10", WP, REVERSIBLE	38-164058-5	292.0	132.4	14.43	408.6	8.504	0.790	
	CYCLONE, 4", 5", 6", WP, STAINLESS	38-136594-5	168.0	76.2	6.649	188.3	7.078	0.658	
	DUSTLESS CYCLONE, 3"	11-138699-5	560.7	254.3	10.58	299.6	11.92	1.107	
	DUSTLESS CYCLONE, 5"	11-139465-5	906.3	411.1	31.00	877.8	23.86	2.216	$F_s, F_c, F_r,$ F_w, F_q

Appendix II: Loading Equations

STATIC LOAD

IMPERIAL EQUATION

$$F_s = w_e + (V_i \times \rho_p)$$

F_s	Static Load	[lb-f]	—
w_e	Empty Weight*	[lbs]	<i>Parts List</i>
V_i	Internal Volume*	[cu ft]	<i>Parts List</i>
ρ_p	Product Density	[lb/cu ft]	<i>Table 5</i>

METRIC EQUATION

$$F_s = 9.81 \times (0.001 \times w_e + (V_i \times \rho_p))$$

F_s	Static Load	[N]	—
w_e	Empty Weight*	[kg]	<i>Parts List</i>
V_i	Internal Volume*	[L]	<i>Parts List</i>
ρ_p	Product Density	[kg/m ³]	<i>Table 5</i>

* For the static load of tube or pipe, the listed empty weight and internal volume in Appendix I must be multiplied by the total length of the section of line.

MOMENTUM LOAD

IMPERIAL EQUATION

$$F_m = 0.031 \times \left(\left[(Q_s \times 0.016) + (q_a \times 0.253) \right] \times \frac{q_a \times 2.4}{A_i} \right)$$

F_m	Momentum Load	[lb-f]	—
Q_s	Solid Flow Rate	[bushels/hr]	Table 6
q_a	Blower Capacity	[cfm]	Table 7
A_i	Pipe/Tube Internal Cross-Sectional Area	[sq in]	Table 8

METRIC EQUATION

$$F_m = \left[(Q_s \times 0.278) + (q_a \times 0.000041) \right] \times \frac{q_a \times 0.167}{A_i}$$

F_m	Momentum Load	[N]	—
Q_s	Solid Flow Rate	[tonnes/hr]	Table 6
q_a	Blower Capacity	[Lpm]	Table 7
A_i	Pipe/Tube Internal Cross-Sectional Area	[cm ²]	Table 8

THERMAL LOAD

IMPERIAL EQUATION

$$F_t = \alpha \times \Delta T \times E \times A_w$$

F_t	Thermal Expansion Load	[lb-f]	—
α	Coefficient of Thermal Expansion	[in/in·°F]	<i>Table 9</i>
ΔT	Temperature Difference	[°F]	<i>Measured</i>
E	Young's Modulus	[psi]	<i>Table 9</i>
A_w	Pipe Wall Cross-Sectional Area	[sq in]	<i>Table 8</i>

METRIC EQUATION

$$F_t = 100,000 \times (\alpha \times \Delta T \times E \times A_w)$$

F_t	Thermal Expansion Load	[N]	—
α	Coefficient of Thermal Expansion	[m/m·°C]	<i>Table 9</i>
ΔT	Temperature Difference	[°C]	<i>Measured??</i>
E	Young's Modulus	[GPa]	<i>Table 9</i>
A_w	Pipe Wall Cross-Sectional Area	[cm ²]	<i>Table 8</i>

PRESSURE THRUST LOAD

IMPERIAL EQUATION

$$F_p = P \times A_i \times k_b$$

F_p	Pressure Thrust Load	[lb-f]	—
P	Maximum System Pressure*	[psi]	<i>Application-Specific</i>
A_i	Pipe/Tube Internal Cross-Sectional Area	[sq in]	<i>Table 8</i>
k_b	Bend Factor	—	<i>Table 10</i>

METRIC EQUATION

$$F_p = 0.1 \times (P \times A_i \times k_b)$$

F_p	Pressure Thrust Load	[N]	—
P	Maximum System Pressure*	[kPa]	<i>Application-Specific</i>
A_i	Pipe/Tube Internal Cross-Sectional Area	[cm ²]	<i>Table 8</i>
k_b	Bend Factor	—	<i>Table 10</i>

* The maximum allowable pressure for standard Walinga blowers is 15 psi (103.4 kPa).

CENTRIFUGAL LOAD
IMPERIAL EQUATION

$$F_c = \frac{0.3587}{r} \times \left[\left(Q_s \times \frac{V_{eff}}{q_a} \right) \times \left(\frac{q_a}{A_i} \right)^2 \right]$$

F_c	Centrifugal Load	[lb-f]	—
r	Cyclonic Radius	[in]	<i>Table 11</i>
Q_s	Solid Flow Rate	[bushels/hr]	<i>Table 6</i>
V_{eff}	Cyclonic Effective Volume	[cu ft]	<i>Table 11</i>
q_a	Blower Capacity	[cfm]	<i>Table 7</i>
A_i	Pipe/Tube Internal Cross-Sectional Area	[sq in]	<i>Table 8</i>

METRIC EQUATION

$$F_c = \frac{46.246}{r} \times \left[\left(Q_s \times \frac{V_{eff}}{q_a} \right) \times \left(\frac{q_a}{A_i} \right)^2 \right]$$

F_c	Centrifugal Load	[N]	—
r	Cyclonic Radius	[cm]	<i>Table 11</i>
Q_s	Solid Flow Rate	[tonnes/hr]	<i>Table 6</i>
V_{eff}	Cyclonic Effective Volume	[L]	<i>Table 11</i>
q_a	Blower Capacity	[Lpm]	<i>Table 7</i>
A_i	Pipe/Tube Internal Cross-Sectional Area	[cm ²]	<i>Table 8</i>

WIND LOAD

IMPERIAL EQUATION

$$F_w = 0.0064 \times (v_w)^2 \times C_f \times A_f$$

F_w	Wind Load	[lb-f]	—
v_w	Wind Speed	[mph]	<i>Location-Specific</i>
C_f	Force Coefficient	—	<i>Table 12</i>
A_p	Projected Area	[sq ft]	<i>Parts List</i>

METRIC EQUATION

$$F_w = 0.0946 \times (v_w)^2 \times C_f \times A_f$$

F_w	Wind Load	[N]	—
v_w	Wind Speed	[km/h]	<i>Location-Specific</i>
C_f	Force Coefficient	—	<i>Table 12</i>
A_p	Projected Area	[m ²]	<i>Parts List</i>

SEISMIC LOAD

IMPERIAL EQUATION

$$F_q = 0.60 \times C_h \times S_{DS} \times V_i \times \rho_p$$

F_q	Seismic Load	[lb-f]	—
C_h	Mounting Height Coefficient	—	<i>Table 13</i>
S_{DS}	Design Spectral Response Acceleration	—	<i>Location-Specific</i>
V_i	Internal Volume	[cu ft]	<i>Parts List</i>
ρ_p	Product Density	[lb/cu ft]	<i>Table 5</i>

METRIC EQUATION

$$F_q = 0.0059 \times C_h \times S_{DS} \times V_i \times \rho_p$$

F_q	Seismic Load	[N]	—
C_h	Mounting Height Coefficient	—	<i>Table 13</i>
S_{DS}	Design Spectral Response Acceleration	—	<i>Location-Specific</i>
V_i	Internal Volume	[L]	<i>Parts List</i>
ρ_p	Product Density	[kg/m ³]	<i>Table 5</i>

RECOIL LOAD

IMPERIAL EQUATION

$$F_r = 1.2 \times (P_{red} \times A_v)$$

F_r	Recoil Load	[lb-f]	—
P_{red}	Reduced Pressure	[psi]	<i>Table 14</i>
A_v	Vent Area	[sq in]	<i>Table 14</i>

METRIC EQUATION

$$F_r = 0.12 \times (P_{red} \times A_v)$$

F_r	Recoil Load	[N]	—
P_{red}	Reduced Pressure	[kPa]	<i>Table 14</i>
A_v	Vent Area	[cm ²]	<i>Table 14</i>

HORIZONTAL LINE SUPPORT SPACING

IMPERIAL EQUATION

$$L = 0.1853 \times \sqrt[4]{\frac{E \times \delta \times (A_w^2 + 2 \times A_w \times A_i)}{w_e + (0.0069 \times \rho_p \times A_i)}}$$

L	Support Spacing	[ft]	—
E	Young's Modulus	[psi]	<i>Table 9</i>
A_w	Pipe Wall Cross-Sectional Area	[sq in]	<i>Table 8</i>
A_i	Pipe/Tube Internal Cross-Sectional Area	[sq in]	<i>Table 8</i>
δ	Allowable Deflection	[in]	*
w_e	Empty Weight	[lb/ft]	<i>Parts List</i>
ρ_p	Product Density	[lb/cu ft]	<i>Table 5</i>

METRIC EQUATION

$$L = 0.3796 \times \sqrt[4]{\frac{E \times \delta \times (A_w^2 + 2 \times A_w \times A_i)}{w_e + (0.0001 \times \rho_p \times A_i)}}$$

L	Support Spacing	[m]	—
E	Young's Modulus	[GPa]	<i>Table 9</i>
A_w	Pipe Wall Cross-Sectional Area	[cm ²]	<i>Table 8</i>
A_i	Pipe/Tube Internal Cross-Sectional Area	[cm ²]	<i>Table 8</i>
δ	Allowable Deflection	[cm]	*
w_e	Empty Weight	[kg/m]	<i>Parts List</i>
ρ_p	Product Density	[kg/m ³]	<i>Table 5</i>

- * For the recommended spacing use an allowable deflection of 0.10 in (0.25 cm).
 For the maximum spacing use an allowable deflection of 0.25 in (0.64 cm).

Appendix III: Supplemental Data

Data provided assumes a system moving dry corn approximately 100 ft at standard atmospheric temperature, pressure and humidity.

Table 5: Average bulk density of commonly conveyed materials

	Bulk Density (ρ_p)		
	[lbs/cu ft]	[lbs/bu]	[kg/m ³]
Barley	38.7	49.7	619.9
Beans	48.1	61.8	770.5
Calcium Powder	99.9	128.3	1600.2
Canola	48.1	61.8	770.5
Cement Powder	94.0	120.7	1505.7
Corn	44.9	57.7	719.2
Feed, Mash	44.9	57.7	719.2
Feed, Minerals	37.5 – 81.2	48.2 – 104.3	600.7 – 1300.7
Feed, Pellet	48.0	61.6	768.9
Fertilizer, Pelleted	81.2	104.3	1300.7
Flax	43.7	56.1	700.0
Flour, Corn	51.2	65.8	820.1
Flour, Wheat	41.8	53.7	669.6
Grain Dust	18.5	23.8	296.3
Groats	46.2	59.3	740.1
Lime Stone	84.3	108.3	1350.4
Oats	26.8	34.4	429.3
Palmit 80	37.5	48.2	600.7
Plastic, PE Pellets	38.7	49.7	796.1
Plastic, PET Pellets	53.1	68.2	850.6
Plastic, PVC Resin	38.1	48.9	610.3
Potash, White	74.9	96.2	1199.8
Rice, Hulled	46.8	60.1	749.7
Sawdust Bedding	18.7	24.0	299.5
Soybeans	46.2	59.3	740.1
Specialty Silica	12.5	16.1	200.2
Urea	48.7	62.5	1001.2
Wheat	48.1	61.8	770.5

Table 6: Capacity of common system configurations

Line Size [in]	Blower		Airlock Model	System Capacity* (Q _s)	
	Model	Motor [hp]		[bushels/hr]	[tonnes/hr]
2	506	7.5	1008	65	1.6
3	506	7.5	1008	150	3.8
		10		175	4.4
		15		250	6.4
	510	10	1210	220	5.6
		15		300	7.6
		20		350	8.9
4	506	10	1210	425	10.8
		15		525	13.3
	510	10		600	15.2
		15		700	17.8
		20		800	20.3
		10		1314	600
	20	800	20.3		
	5	510	20	1314	1000
30			1300		33.0
40			1600		40.7
614		40	1675		42.6
		50	1725		43.8
		40	1314		1800
50	1900	48.3			
60	2100	53.4			
75	2300	58.4			
7	614	100	2018	2600	66.0
	816	100		3300	83.8
		125		3750	95.3
		150		3950	100.3
8	816	125	2224	4100	104.2
		150		4600	116.9
10	1020	250	2224	7000	177.8

* Capacities based on moving dry corn approximately 100 feet. Barometric pressure, humidity, and condition of product will affect capacities.

Table 7: Standard target blower speeds and air flow capacities

Line Size	506			510			614			816			1020		
	Speed [rpm]	Capacity (q _a) [cfm] ([Lpm])		Speed [rpm]	Capacity (q _a) [cfm] ([Lpm])		Speed [rpm]	Capacity (q _a) [cfm] ([Lpm])		Speed [rpm]	Capacity (q _a) [cfm] ([Lpm])		Speed [rpm]	Capacity (q _a) [cfm] ([Lpm])	
2"	585	117	(3 313)	—			—			—			—		
3"	1425	285	(8 070)	865	288	(8 155)	—			—			—		
4"	2665	533	(15 093)	1600	533	(15 093)	—			—			—		
5"	—			2565	854	(24 183)	1245	853	(24 154)	—			—		
6"	—			—			1825	1250	(35 396)	895	1253	(35 481)	—		
7"	—			—			2515	1723	(48 790)	1230	1722	(48 762)	—		
8"	—			—			—			1620	2268	(64 223)	—		
10"	—			—			—			—			1350	3615	(102 365)

Table 8: Tube / pipe cross-sectional areas

		16 ga		12 ga		11 ga		7 ga		SCH 40	
		[sq in]	([cm ²])	[sq in]	([cm ²])	[sq in]	([cm ²])	[sq in]	([cm ²])	[sq in]	([cm ²])
2"	Internal (A _i)	2.75	(17.74)	—	—	2.43	(15.68)	—	—	3.36	(21.68)
	Wall (A _w)	0.40	(2.55)			0.71	(4.57)			1.07	(6.93)
3"	Internal (A _i)	6.47	(41.74)	—	—	5.98	(38.58)	—	—	7.39	(47.68)
	Wall (A _w)	0.60	(3.87)			1.09	(7.01)			2.23	(14.38)
4"	Internal (A _i)	11.76	(75.87)	—	—	11.10	(71.61)	—	—	12.73	(82.13)
	Wall (A _w)	0.80	(5.18)			1.46	(9.44)			3.17	(20.48)
5"	Internal (A _i)	18.63	(120.19)	—	—	17.80	(114.84)	—	—	20.01	(129.10)
	Wall (A _w)	1.01	(6.50)			1.84	(11.87)			4.30	(27.74)
6"	Internal (A _i)	—	—	—	—	26.06	(168.13)	—	—	28.89	(186.39)
	Wall (A _w)					2.22	(14.30)			5.58	(36.01)
7"	Internal (A _i)	—	—	—	—	35.89	(231.55)	—	—	—	—
	Wall (A _w)					2.59	(16.73)				
8"	Internal (A _i)	—	—	—	—	47.29	(305.10)	—	—	50.03	(322.77)
	Wall (A _w)					2.97	(19.17)			8.40	(54.19)
10"	Internal (A _i)	—	—	75.15	(484.84)	—	—	72.74	(469.29)	78.85	(508.71)
	Wall (A _w)			3.39	(21.85)			5.80	(37.39)	11.91	(76.83)

Table 9: Properties of common tube / pipe materials

	Coefficient of Thermal Expansion (α)		Young's Modulus (E)	
	[in/in·°F]	([m/m·°C])	[psi]	([GPa])
Steel	6.5×10^{-6}	(11.7×10^{-6})	29.0×10^6	(200)
Galvanized Steel	6.7×10^{-6}	(12.0×10^{-6})	29.0×10^6	(200)
Stainless Steel	9.6×10^{-6}	(17.3×10^{-6})	27.6×10^6	(190)
Aluminum	13.1×10^{-6}	(23.5×10^{-6})	10.0×10^6	(68.9)
Acrylic (Sight Glass)	40×10^{-6}	(80×10^{-6})	0.46×10^6	(3.2)

Table 10: Elbow bend factor (k_b)

Bend Angle	Bend Factor (k_b)
18.5° (Short Distributor Valves)	0.321
20.5° (Distributor Valves)	0.356
30°	0.518
45°	0.765
60°	1.000
90°	1.414

Table 11: Cyclone assembly critical parameters

Cyclone Model		Cyclonic Radius (r)		Effective Volume (V_{eff})	
		[in]	([cm])	[cu ft]	([L])
3"	Standard	5.82	(14.78)	0.41	(11.73)
	High Efficiency	7.82	(19.86)	0.81	(23.06)
4"	Standard	5.50	(13.97)	1.03	(29.12)
	Plastic	9.00	(22.86)	0.71	(20.22)
5"	Standard	7.82	(19.86)	0.81	(22.88)
	High Efficiency	7.02	(17.83)	2.19	(61.90)
	Plastic	9.00	(22.86)	0.71	(20.22)
6"	Standard	9.30	(23.62)	1.34	(37.93)
	High Efficiency	8.41	(21.36)	4.08	(115.54)
7"	Standard	10.28	(26.11)	1.79	(50.78)
	High Efficiency	9.88	(25.10)	7.57	(214.34)
8"	Standard	11.82	(30.02)	2.42	(68.54)
	High Efficiency	11.09	(28.17)	8.07	(228.44)
10"	Standard	14.82	(37.64)	5.56	(157.55)

Table 12: Wind force coefficient reference

Components	Recommended Force Coefficient (C_f)
Pipes, Tubes, Round Elbows, Flashing	0.8
Discharge Cyclones, Deadhead Deflectors	1.3
Diverter Valves, Distributor Valves, Flat Back Elbows, Bin Deflectors, Dustless Cyclones	1.5
Dustless Bin Vents	2.0

Table 13: Mounting height coefficient reference

Mounting Location	Height Coefficient (C_h)
In direct contact with the ground	1.0
COG* is in the lower third of the bin but above the ground	1.5
COG* is around the midpoint of the bin, in the middle third	2.0
COG* is in the upper third of the bin but below the roof	2.5
On or above the roof of the bin	3.0

* The COG (Center of Gravity) can be approximated as the midpoint of the total height of the component.

Table 14: Walinga-supplied explosion vent data

Application	Part Number	Reduced Pressure (P_{red})		Vent Area (A_v)	
		[psi]	([kPa])	[sq in]	([cm ²])
Dustless Cyclone, 5"	11-145603-6	26.1	(180.0)	189.1	(1220.0)