

2025 Service School

- Vari-Air Systems
- VFD's
- Grain Dryer Controls



Design – Application – Troubleshooting



2025 SEMINAR OUTLINE

1. 2024 Review
2. Post Harvest Review of Problems and Solutions
3. New products for 2024 performance
4. Outdoor Blower Upgrade
5. Types of Grain Conveying
6. Blower System Sizing
7. Main Components of Vari-Air Blower System
8. Piping Vs Performance
9. Common Rotary Blower Problems
10. Troubleshooting Vari-Air systems
11. Recommended Maintenance
12. VFD's for other Farm Applications
13. Trouble shooting VFD's
14. New Services, Stickers, and Products for 2025
15. Questions - Feedback



Every year we learn more to help us make changes to have a better product next year!

2024 Recap

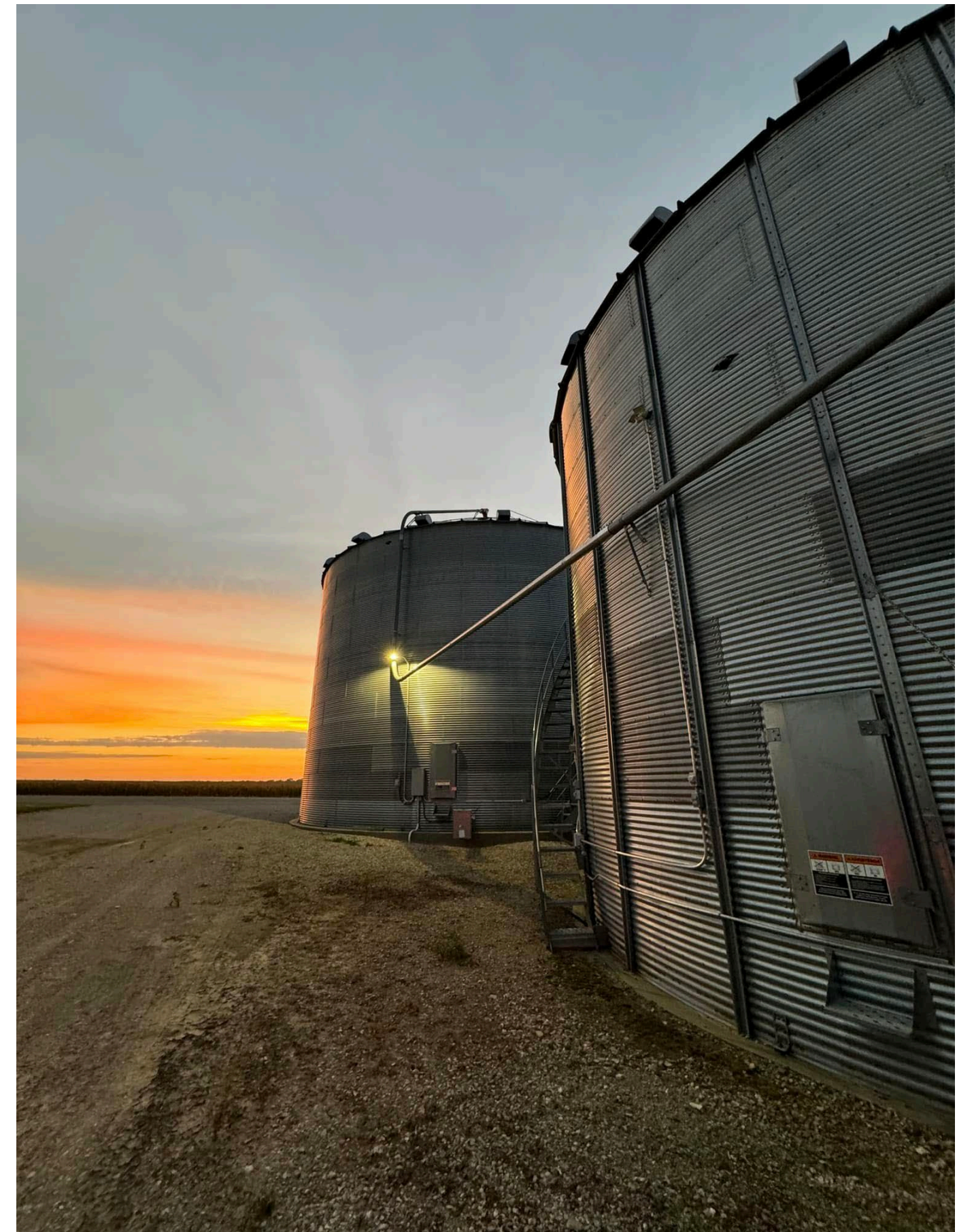
Dry conditions give us two major problems to contend with:

1. Excessive dirt and debris on the intake air side of the system.
2. Lower system performance due to harvesting 15% mc or lower

This dry year also contributed to a quicker harvest with no delays.

In a yearly review with our support staff, we discussed this year's service calls. They mention that calls were down compared to previous years. We believe this is due to recent changes we made to our quality control improvements, and increased testing we started doing in 2023.

This also marks another year without a blower failure making this the 14th year of selling our Tri-lobe Rotary Blower without a single failure.



Every year we learn more to help us make changes to have a better product next year!

2024 NEW VARI-AIR PRODUCTS PERFORMANCE

Advanced POWERHOUSE



POWERHOUSE
ADVANCED
Pre-Built & Pre-Wired system with integrated Grain Dryer Fan Controls



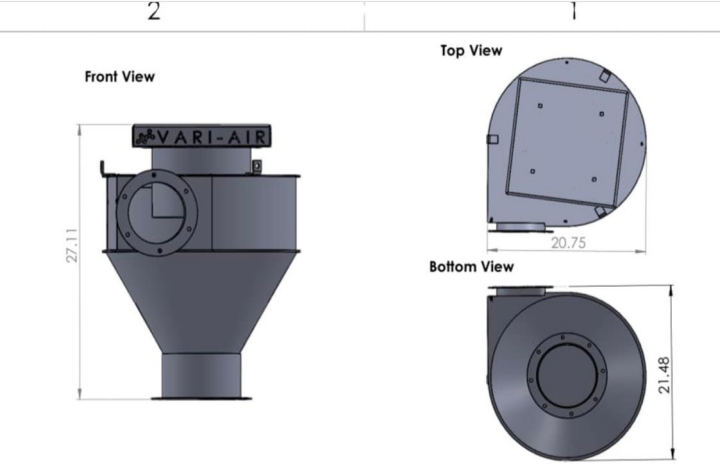
VARI-AIR—POWERHOUSE

- Prefab shed with Blower and Controls
- HEAVY DUTY Galvanized Enclosure-8'x8'x8'
- All items pre-wired—minimal field wiring
- All control interface is mounted on exterior.
- Red=System Off / Green=System On
- Warranty doubles from 2 to 4 years on blower, motors, and VFDs.
- Factory Designed, Assembled, Wired, and tested
- Complete Turn Key System

**VARI-AIR BENEFITS**



Cyclones





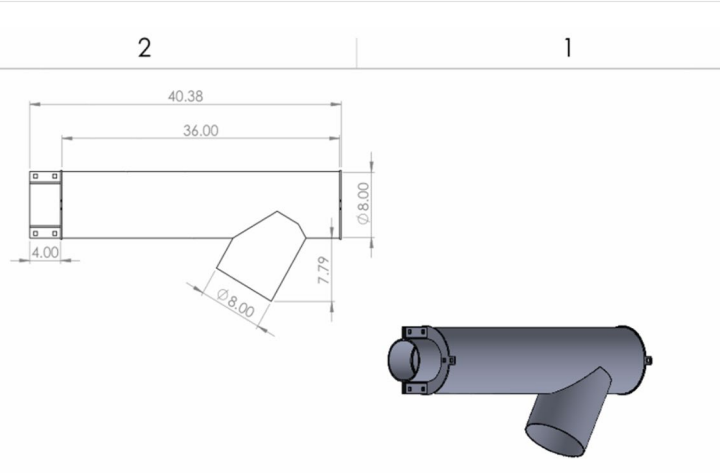
JOHNSON POWER SYSTEMS

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES
TOLERANCES:
FRACTIONS ANGULAR MATCHES BENDS
THREE PLACE DECIMALS
MATERIAL:
FINISH:
DO NOT SCALE DRAWING

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SCALE: 1:8-10 SHEET 1 OF 1

Deadheads





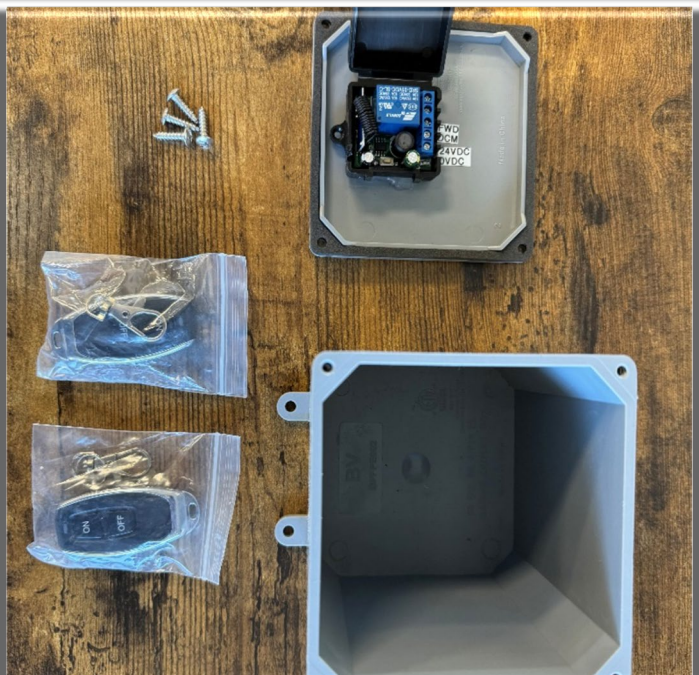
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SCALE: 1:10 SHEET 1 OF 1

Radio Frequency Remote start kit



6"-100HP VARI-AIR



OUR RECOMMENDATIONS AND FIXES

DEBRIS IN THE INTAKE FILTER

- Issue happens mostly when a blower is installed close to the grain dryer..
- We have added a WHIRLEY FILTER AND REMOTE AIRBOX to every system where the blower will be outdoors.

Power issues (Solar)

- Solar systems use Voltage regulation that can send voltage spikes through transformer to VFD – Isolate Solar from drying setup.

VFD/transducer failures

- Transducers that show either 100% Or 0% on VFD keypad have failed and need to be replaced.
- 0% = System will not raise speed with raise in PSI / 100% = System runs at full speed all the time.

Loose/mis-connections

- Jumpers and small wire connections were loose in some cases, and would cause issues to come and go, tugging on wires individually was required to find loose connection.

Overheat issues from higher ambient harvest conditions

- Ambient conditions during 2024 harvest were warmer than usual, causing overheating issues with systems in confined spaces. Increased ventilation is required.

Piping problems

- Sending pictures of piping systems to our support staff helps us identify potential piping in-efficiencies and suggest potential changes.

Input Power Conductor Size

- Found a handful of systems that had too small of wire feeding the Single-phase side of the VFD, and needed to be upsized. We are putting a new sticker on the front of all VFD's with required input amps.

Belt Issues

- We had a few belts from our suppliers that were larger than they should have been. We have been sending out new belts to these systems as we are made aware of the problem.

INDOOR AND OUTDOOR BLOWER OPTIONS

VFD INDOOR / BLOWER INDOOR

- Will have a **1** after the **system size** on the part number (PART NUMBER EXAMPLE: VAT5**1**-20-1-1)
- This is the previous standard INDOOR unit (VAT5-20-1-1)
- Use when ALL parts of the system will be housed INDOORS

VFD INDOOR / BLOWER OUTDOOR

- Will have a **2** after the **system size** on the part number (PART NUMBER EXAMPLE: VAT5**2**-20-1-1)
- This is a NEW OPTION for Indoor Systems that will include a REMOTE AIRBOX and WHIRLEY INTAKE FILTER
- Use this when the VFD control will be housed INDOOR and the blower will be placed OUTDOOR.

VFD OUTDOOR / BLOWER INDOOR

- Will have a **1** after the **system size** on the part number (PART NUMBER EXAMPLE: VAT5**1**-20-1-3R)
- Although this is the same setup as our previous OUTDOOR system but does not include a REMOTE AIRBOX and WHIRLEY INTAKE FILTER.
- Use this when the VFD control will be housed OUTDOOR and the blower will be housed INDOOR.

VFD OUTDOOR / BLOWER OUTDOOR

- Will have a **2** after the **system size** on the part number (PART NUMBER EXAMPLE: VAT5**2**-20-1-3R)
- This is a NEW OPTION for Indoor Systems that will include a REMOTE AIRBOX and WHIRLEY INTAKE FILTER
- Use when ALL parts of the system will be housed OUTDOORS.



Pneumatic vs. Mechanical Systems

Grain Conveying is typically segmented into two main categories:

- Pneumatic grain conveying
- Mechanical grain conveying



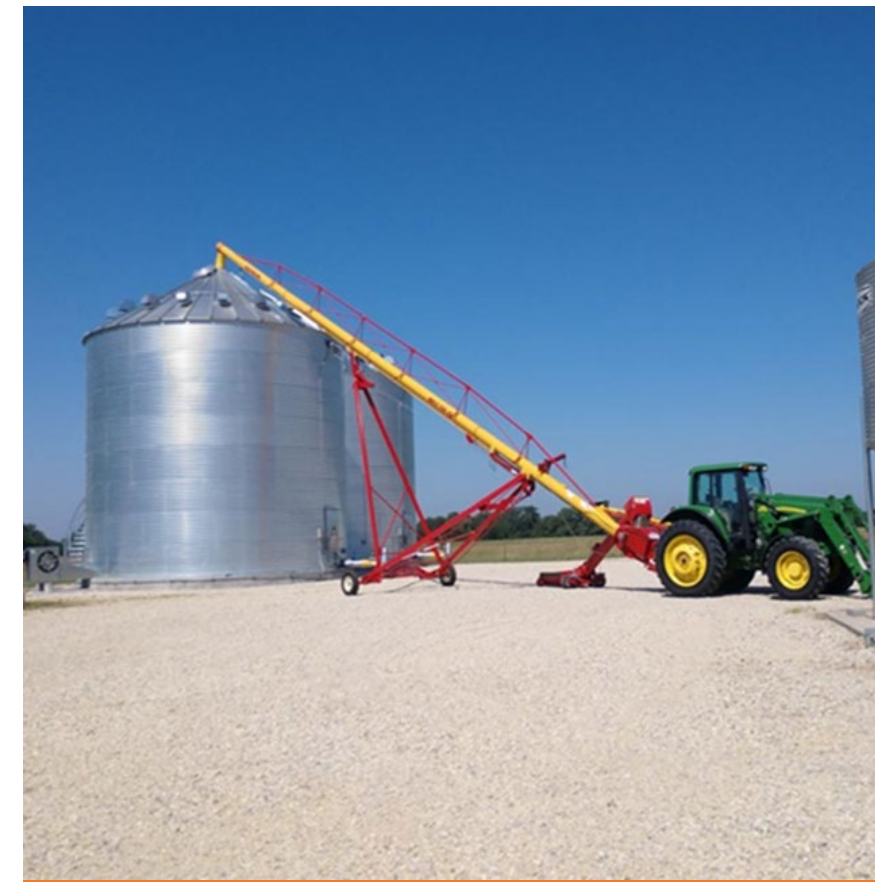
Air Systems

Pneumatic Conveying



Grain Legs

Mechanical Conveying



Screw Augers

Mechanical Conveying



Belt Augers

Mechanical Conveying

Pneumatic conveying systems are more cost-effective than mechanical conveying systems and are far easier to maintain due to the lack of moving parts.

System Capacity

The following is a Bu/Hr chart is based on conveying #2 yellow corn.

- If you are running other commodities through the Vair-Air system please call to confirm what kind of capacities you should be seeing.

5" Vari-Air Bushel/Hour Ratings			
Length	5"-20hp	5"-30hp	5"-40hp
50	1177	1712	1926
100	1150	1685	1899
150	1123	1658	1872
200	1070	1605	1819
250	989	1498	1712
300	882	1364	1551
350	749	1177	1364
400	588	963	1123
450	374	695	829
500			428

6" Vari-Air Bushel/Hour Ratings				
Length	6"-50hp	6"-60hp	6"-75hp	6"-100hp
50	2354	2514	2675	2912
100	2327	2487	2648	2885
150	2300	2461	2621	2860
200	2247	2407	2568	2803
250	2140	2300	2461	2706
300	1979	2140	2300	2535
350	1792	1952	2113	2362
400	1551	1712	1872	2032
450	1257	1417	1578	1740
500	856	1016	1177	1342

5" Electric Motor Power Requirements				
HP	Phase	Volts	Input Amps	Frame size
20	1	230	99	256T
30	1	230	143	286T
40	1	230	211	324T
20	3	230	48.2	256T
30	3	230	70.2	286T
40	3	230	94.2	324T
20	3	460	24.1	256T
30	3	460	35.1	286T
40	3	460	47.1	324T
50	3	460	59.2	326T
60	3	460	68.3	364T
75	3	460	84.1	365T

These capacities are estimates based on conveying #2 dry corn. Grain test weight, moisture content, Grain temperature, and outside temp and humidity can all contribute to system performance.

We recommend to call with any vertical distances over 100ft, and any horizontal distances over 300 ft to discuss proper system sizing.

1 horizontal ft = 1 effective ft
1 vertical ft = 2 effective ft.
Every elbow = 20 effective ft

Sizing Your System

We recommend the piping system to be as simple and direct as possible, with the least amount of system elbows and vertical runs.

Information needed to size air system:

Grain Dryer bu/hr

Maximum piping distance

1 horizontal ft = 1 effective ft
1 vertical ft = 2 effective ft.
Every elbow = 20 effective ft

Example 1
SuperB – SQ 32
Full Heat (20.5 to 15.5) = 1601 bu/hr
Furthest bin is 250 ft away
4 elbows @ 20ft per elbow = 80 ft
Total Effective feet = 330 ft away
Requires – 6” – 50 Hp

Example 2
MC – D900h
Full Heat (20 to 15) = 2200 bu/hr
Furthest bin is 150 ft away max
5 elbows @ 20 ft per elbow = 100 ft
Total Effective feet = 250 ft
Requires – 6” – 60 Hp

Example 3
Grain Handler – 1610
Full Heat (5 points removal) = 1085 bu/hr
Furthest bin is 250 ft away max
4 Elbows @ 20 ft per elbow = 80 feet
Total Effective Feet = 320 ft
Requires – 5” – 30 Hp

Example 4
Deluxe – DPSL15
Maximum Unload Rate = 900 bu/hr
Furthest bin is 150 ft away max
4 Elbows @ 20 ft per elbow = 80 feet
Total Effective Feet = 230 ft
Requires – 5” – 20 Hp

Sizing Your System

Turbulent changes in the air flow pattern in the piping is the root cause to damage to grain and loss in system performance.

How to derate for different grains conveyed through system

Corn	Soybean	Wheat	Oats
0% of Capacity Loss	15% of Capacity Loss	20% of Capacity Loss	20% of Capacity Loss
Example Grain Handler – 1610 Full Heat (5 points removal) = 1085 bu/hr Furthest bin is 250 ft away max 4 Elbows @ 20 ft per elbow = 80 feet Total Effective Feet = 320 ft 0% Derate for Corn Requires 1085 bu/hr x 1 @ 320 ft Requires – 5” – 30 Hp	Example Grain Handler – 1610 Full Heat (5 points removal) = 1085 bu/hr Furthest bin is 250 ft away max 4 Elbows @ 20 ft per elbow = 80 feet 15% Derate for Soybean Total Effective Feet = 320 ft 15% derate for corn Requires 1085 x .85 = 922 bu/hr Requires – 5” – 40 Hp	Example Grain Handler – 1610 Full Heat (5 points removal) = 1085 bu/hr Furthest bin is 250 ft away max 4 Elbows @ 20 ft per elbow = 80 feet 15% Derate for Soybean Total Effective Feet = 320 ft 20% derate for corn Requires 1085 x .80 = 868 bu/hr Requires – 5” – 40 Hp	Example Grain Handler – 1610 Full Heat (5 points removal) = 1085 bu/hr Furthest bin is 250 ft away max 4 Elbows @ 20 ft per elbow = 80 feet 15% Derate for Soybean Total Effective Feet = 320 ft 15% derate for corn Requires 1085 x .85 = 868 bu/hr Requires – 5” – 40 Hp

Main Components of an Air System

Blowers



Compressor air systems are sized by air end rpm, and the physical size of compression chamber, and rotors of an air end.

Airlocks



Air Locks let material flow from the inlet to outlet without letting any air escape from the pressure side of rotary valve.

Controls



- We are a UL panel shop.
- We have been doing our psi control since 2007. We have learned from experience what works best with all types of systems in the market.

Piping



Piping is what makes air system very flexible to be able to make deliveries other systems could not. However, piping is also one of the largest limiting factors of performance.

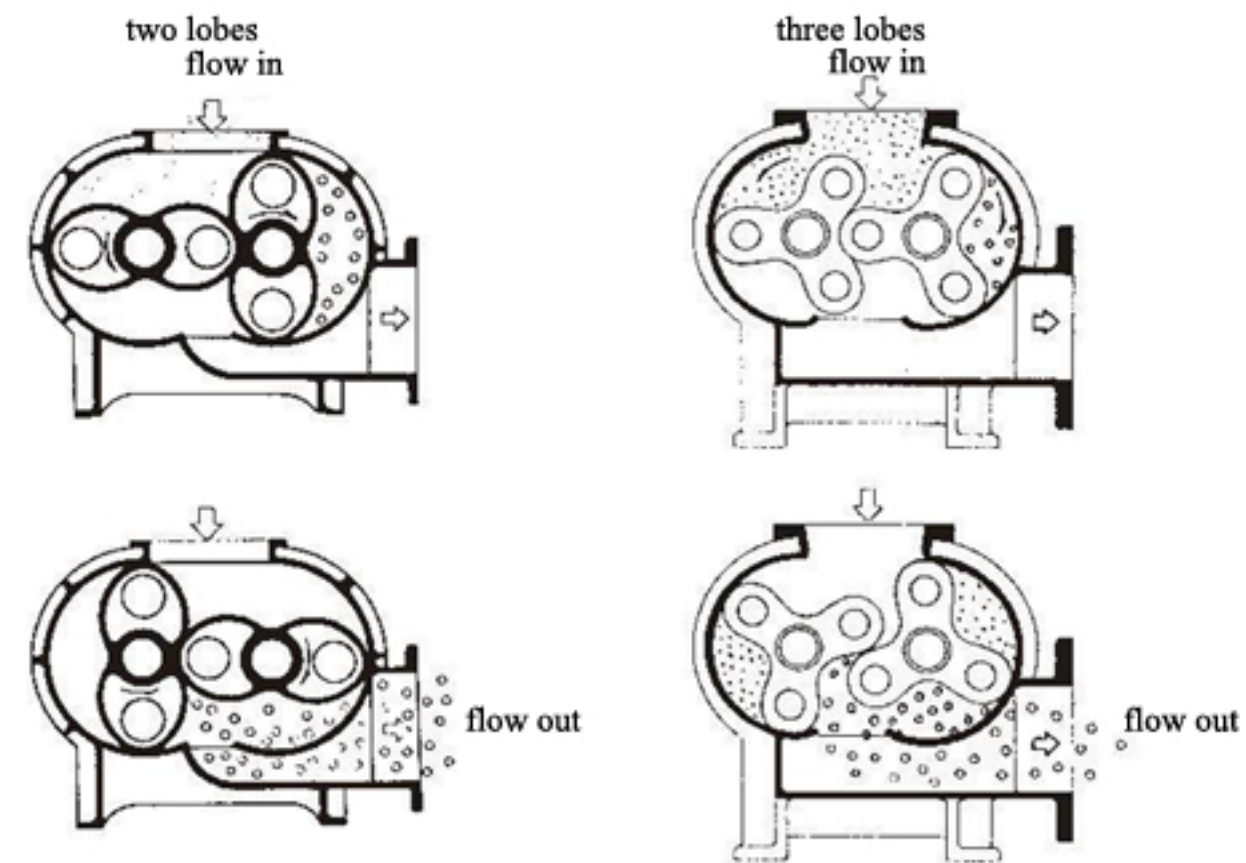
Main Components

The Blower



Two Lobe Blowers struggle with varying pressure performance, where Tri-Lobe Blowers excel at varying pressures, making them the preferred choice for various applications with consistently changing pressures.

Twin lobe conveys 4 large pockets of air from suction to discharge in one revolution whereas Tri lobe conveys 6 small pockets of air due to which pressure pulsations in Tri-Lobe blowers is comparatively less than that of Twin-Lobe blowers which in turn reduces the noise level of Tri-Lobe Blowers.



There are different styles of air compressor systems that differ in design. The pressure and flow requirements vary and are determined by the application you will be using it for.

The Blower

PLANNING YOUR BLOWER INSTALLATION

- Our systems are designed to be installed either inside or outside
- Whether you choose inside or outside - be aware of the intake air quality.
- When installing next to a grain dryer, the amount of debris in the air would limit filtration lifetime.
- When indoor, try to install an intake air window or louver.
- Ensure you have enough room around the air system for system serviceability in the future.
- There will be a significant amount of vibration from the blower, so a sufficient base is required. It is recommended to anchor the blower down to prevent movement.

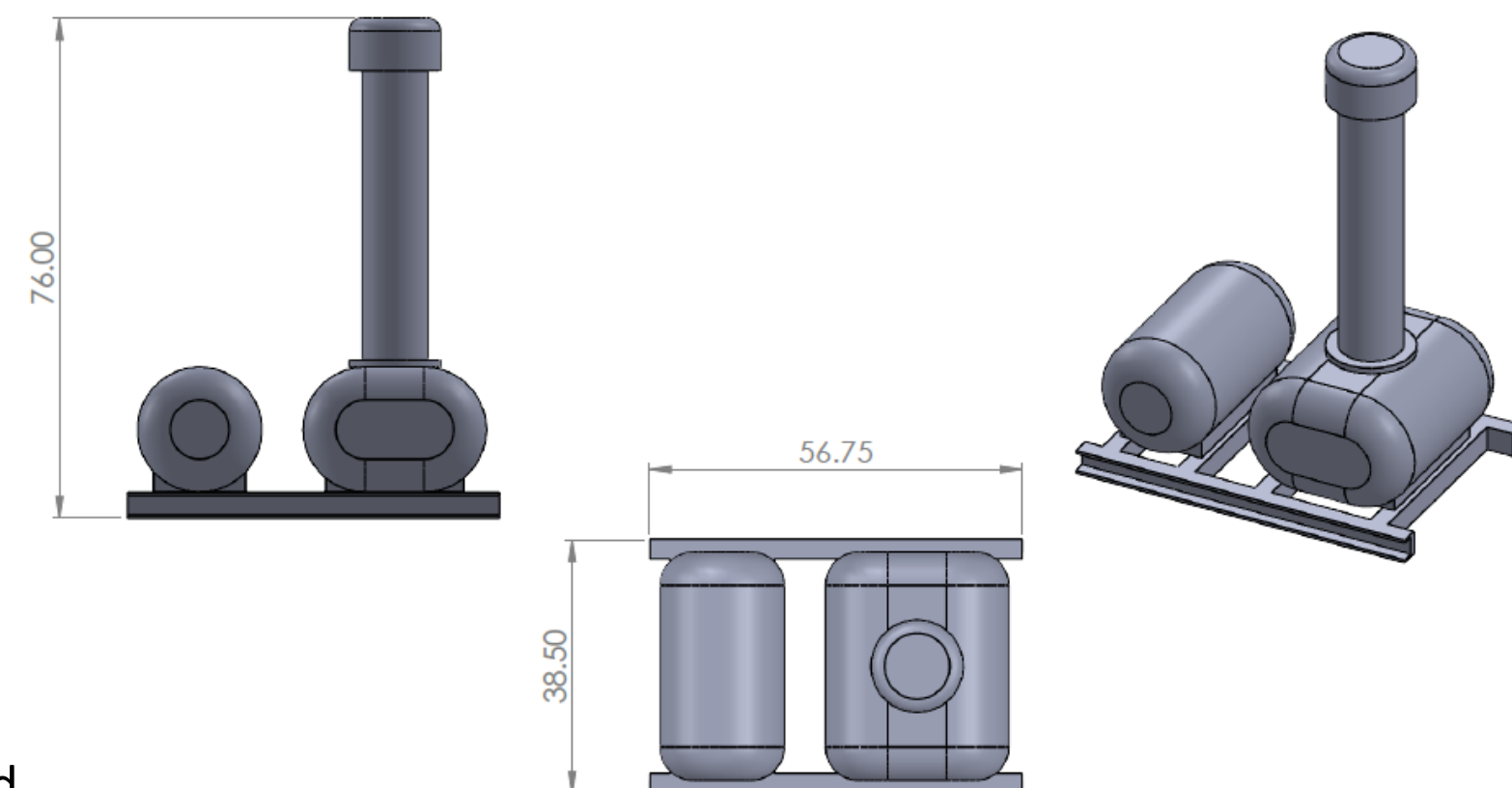


Inside

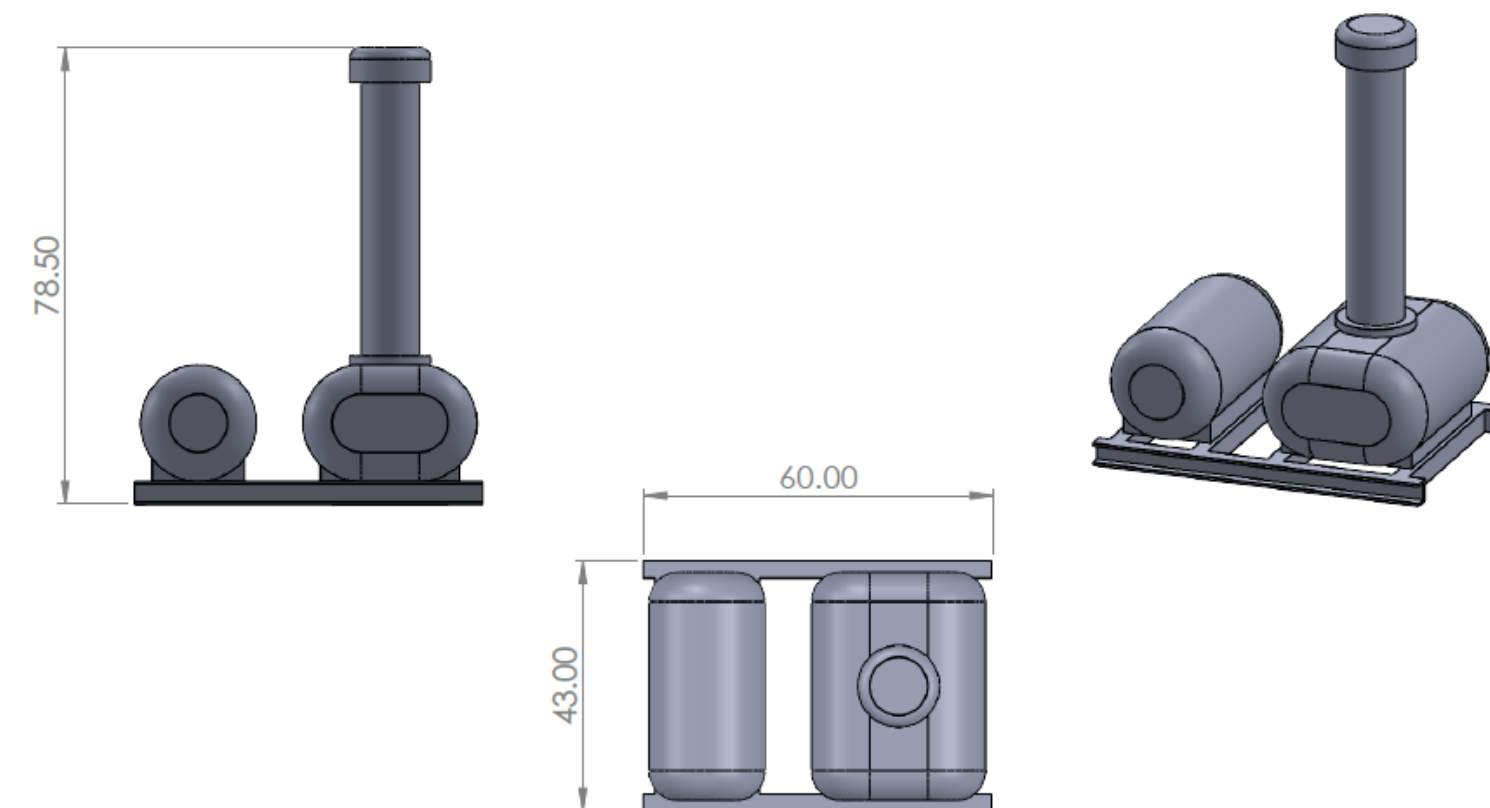


Outside

40 HP Blower Dimensions

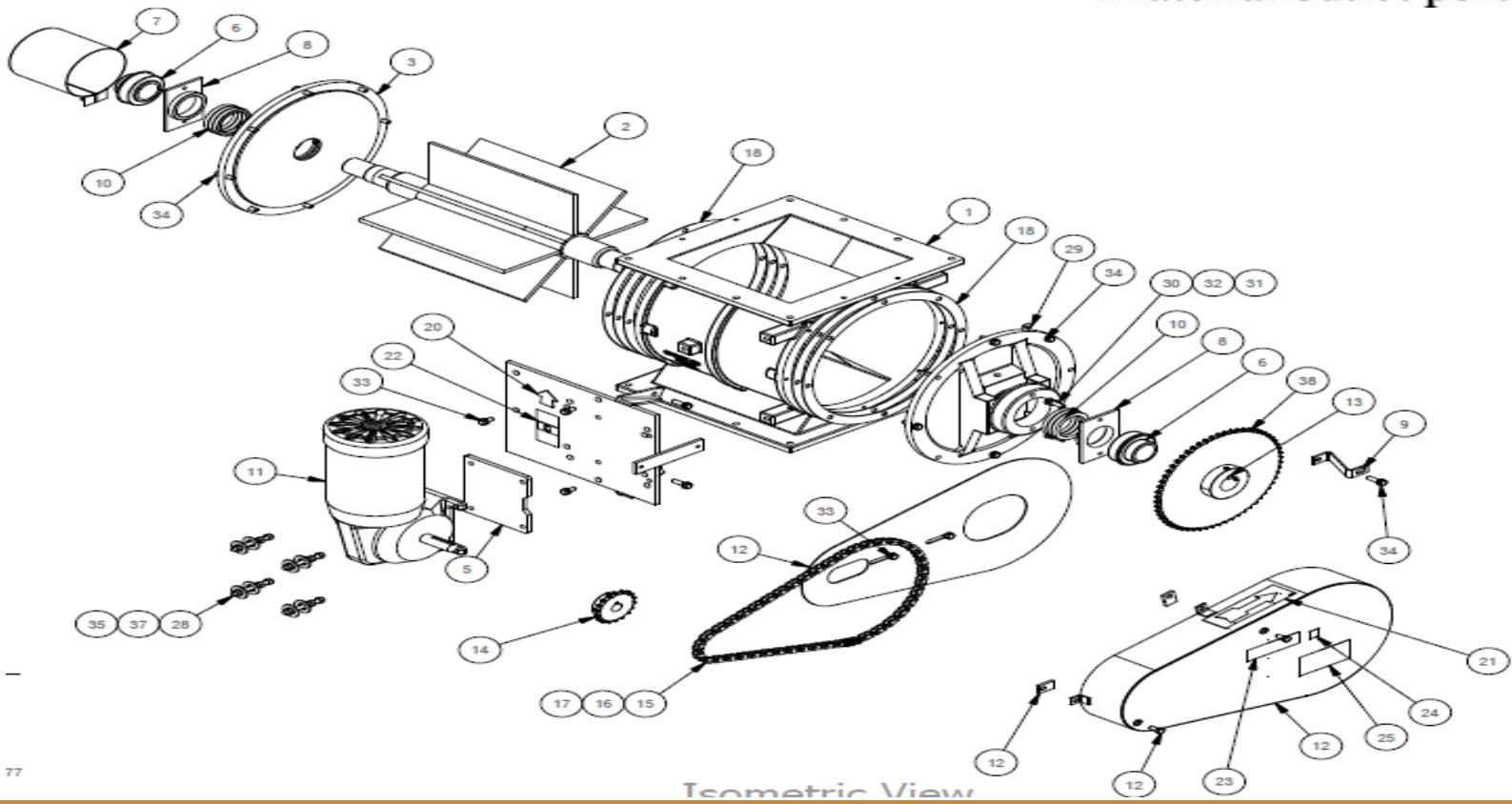
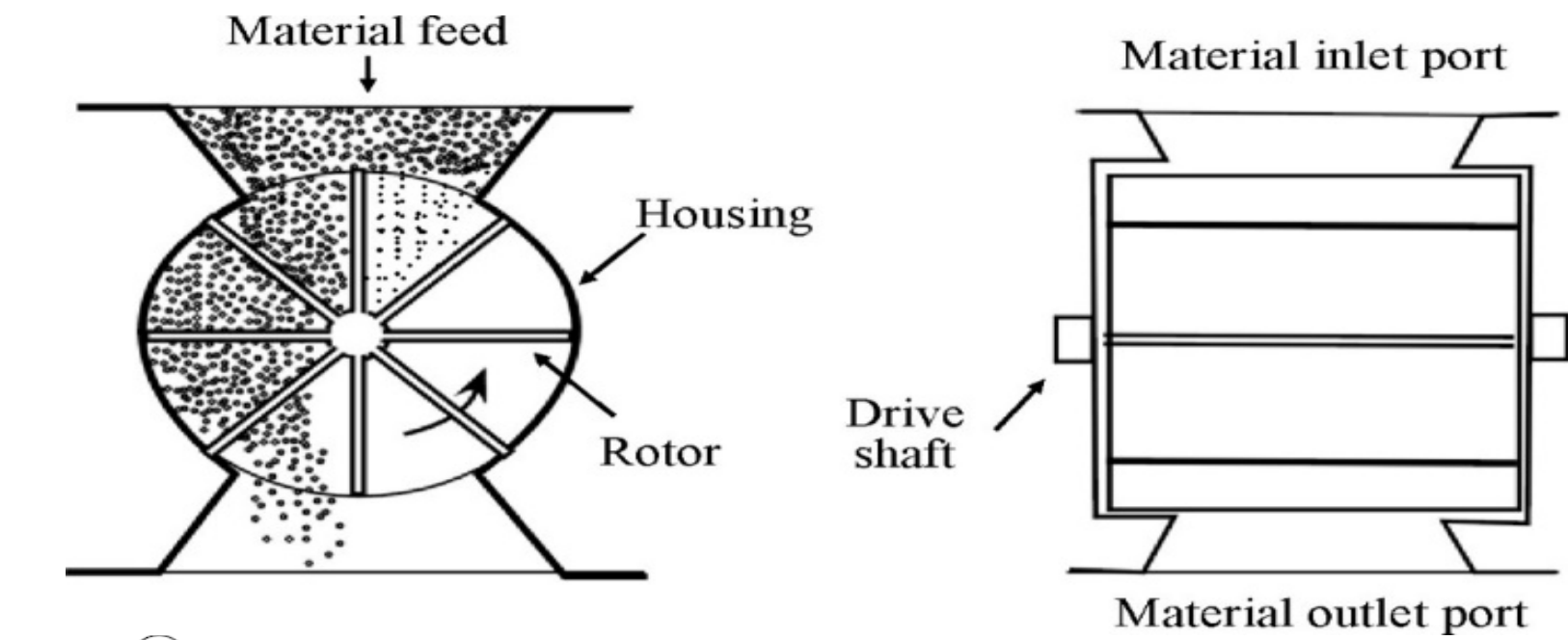


75HP Blower Dimensions

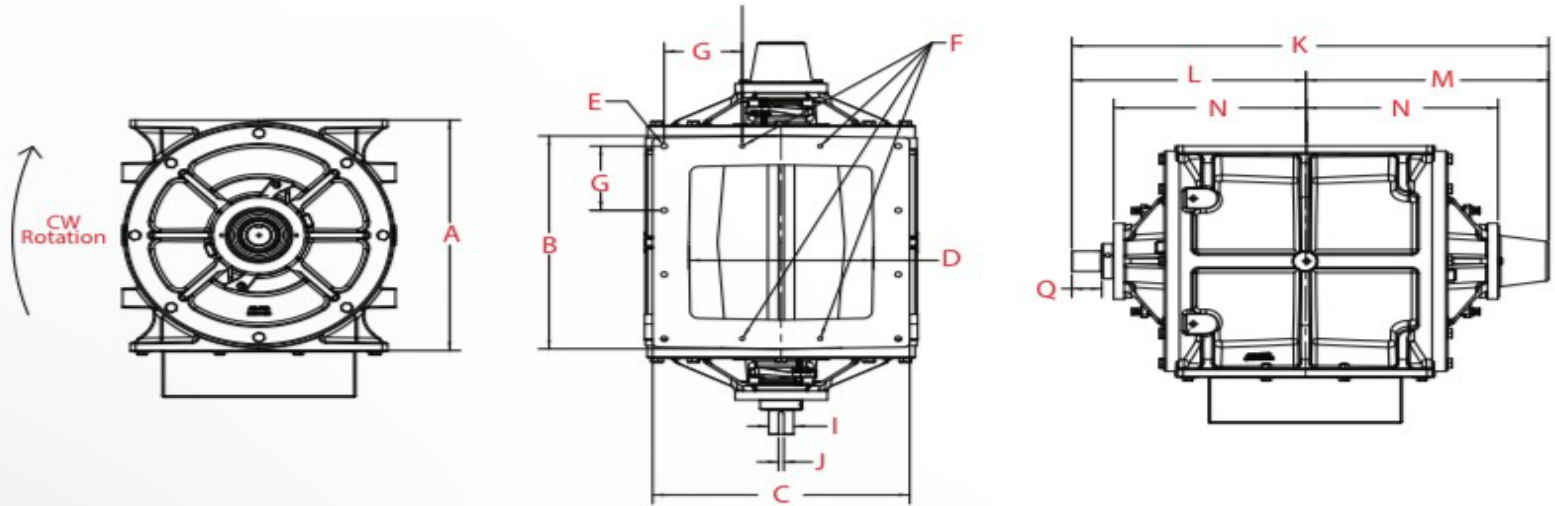


Main Components

The Airlock



FT ROTARY AIRLOCK VALVES



SIZE	CFR**	A	B	C	D	E**	F**	G	I*	J*	K	L	M	N	Q	WT***
12	0.75	15-3/4	15-1/8	15	10 sq	(6) 7/16	(2) 3/8-16	6-1/2	1-1/2	3/8	29	14-3/16	14-13/16	11-1/4	2-3/16	315 lbs.
14	1.05	17-5/8	17-1/8	17	12 sq	(8) 7/16	(4) 3/8-16	5-1/4	1-3/4	3/8	29-15/16	14-13/16	15-1/8	11-9/16	2-5/16	400 lbs.
16	1.77	19-3/4	18-1/4	18-1/8	13 sq	(8) 7/16	(4) 3/8-16	5-1/2	1-3/4	3/8	33-5/8	16-1/2	17-1/8	13-9/16	2-1/8	635 lbs.

Dimensions are in inches and not for construction purposes. *Rotor Shaft Diameter. ** Number of holes in flange. *** Bare valve.
+ Keyway. ++ CFR based on an 8 vane rotor.

"Fully Interchangeable" with the Smoot Valve

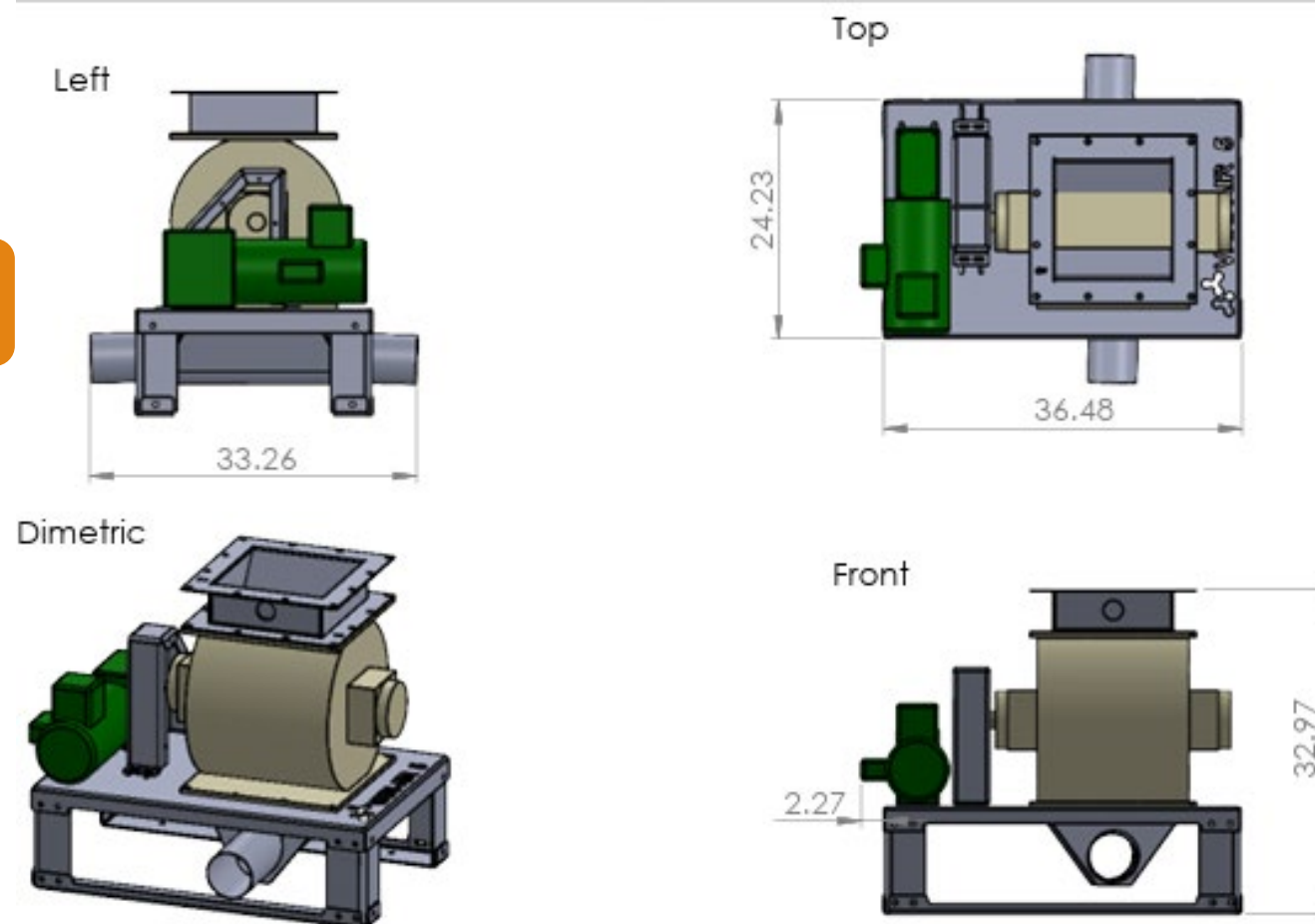
The Airlock

PLANNING YOUR AIRLOCK INSTALLATION

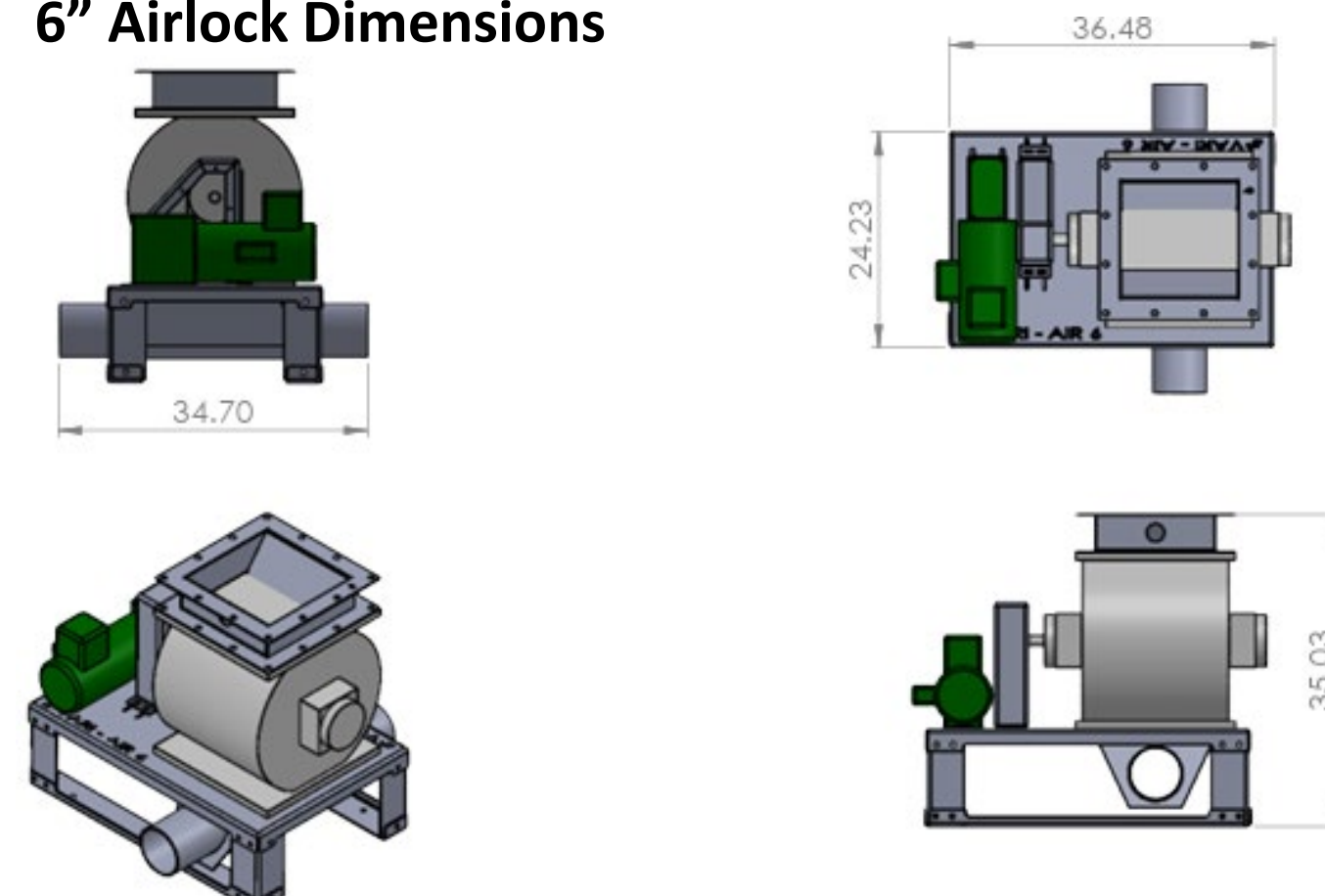
- Air Lock clearance from paddles to body when brand new = .004
- Air Locks close tolerances cause systems to rust easily - so any anti-rust maintenance is strongly recommended.
- All Vari-Air Air Lock systems are powered by 1 Hp motors 1ph or 3 ph.
- Air Lock has over 1 million bushels passed through needs to be checked with a feeler gauge, and if .012 or greater – the Air Lock needs to be rebuild/replaced.
- The best location for air lock installation is on the discharge of the dryer.
- When installing try to leave enough room for servicing in the future.
- System rotation should be done according to air input/output. If air is coming in from the left and leaving out to the right the Air Lock rotation should be Counter-Clockwise to throw the corn in with the air.
- It is recommended to bring Air Lock inside when not being used. We recommend using a plug and receptacle for electrical installation.



5" Airlock Dimensions

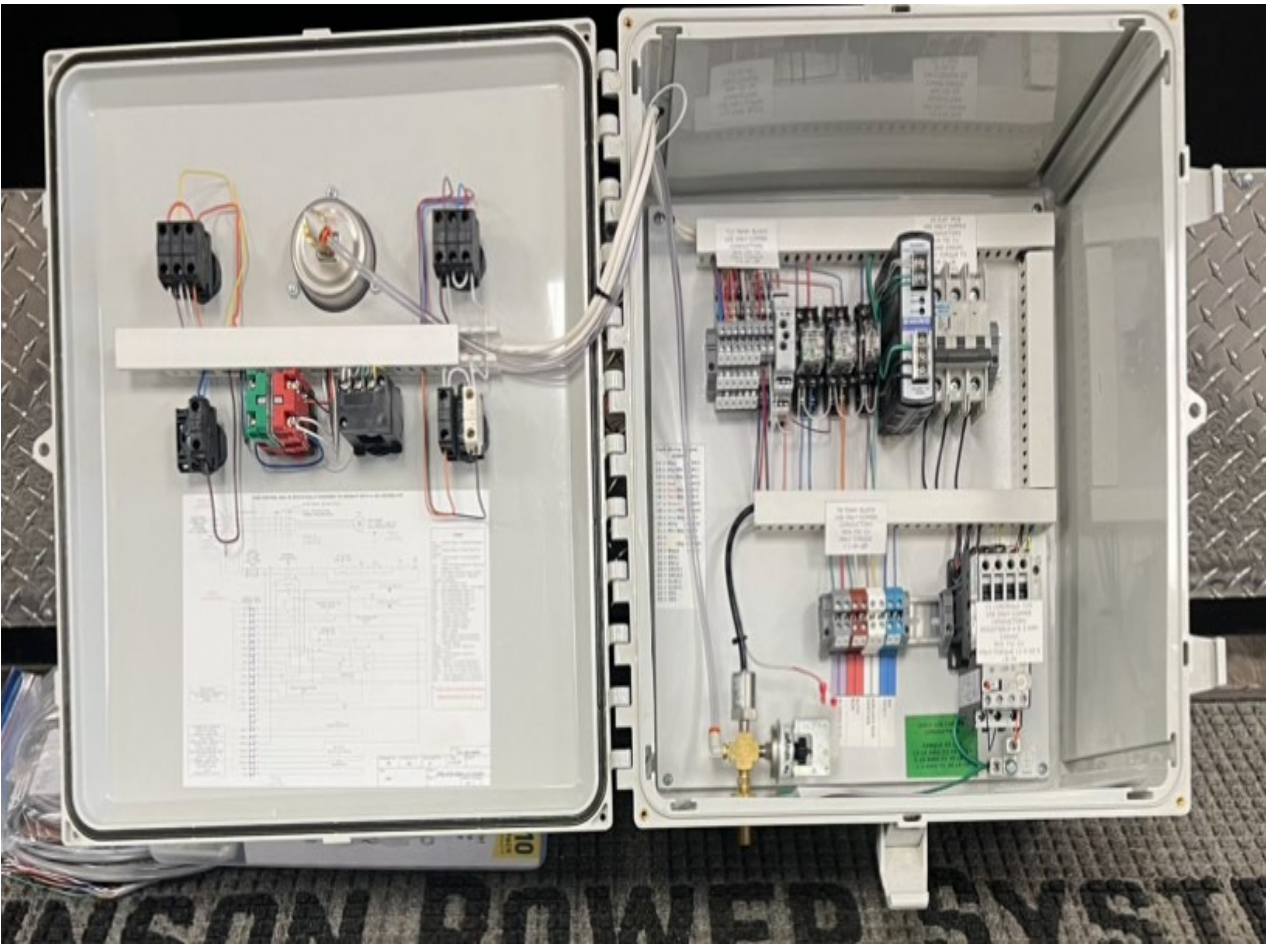
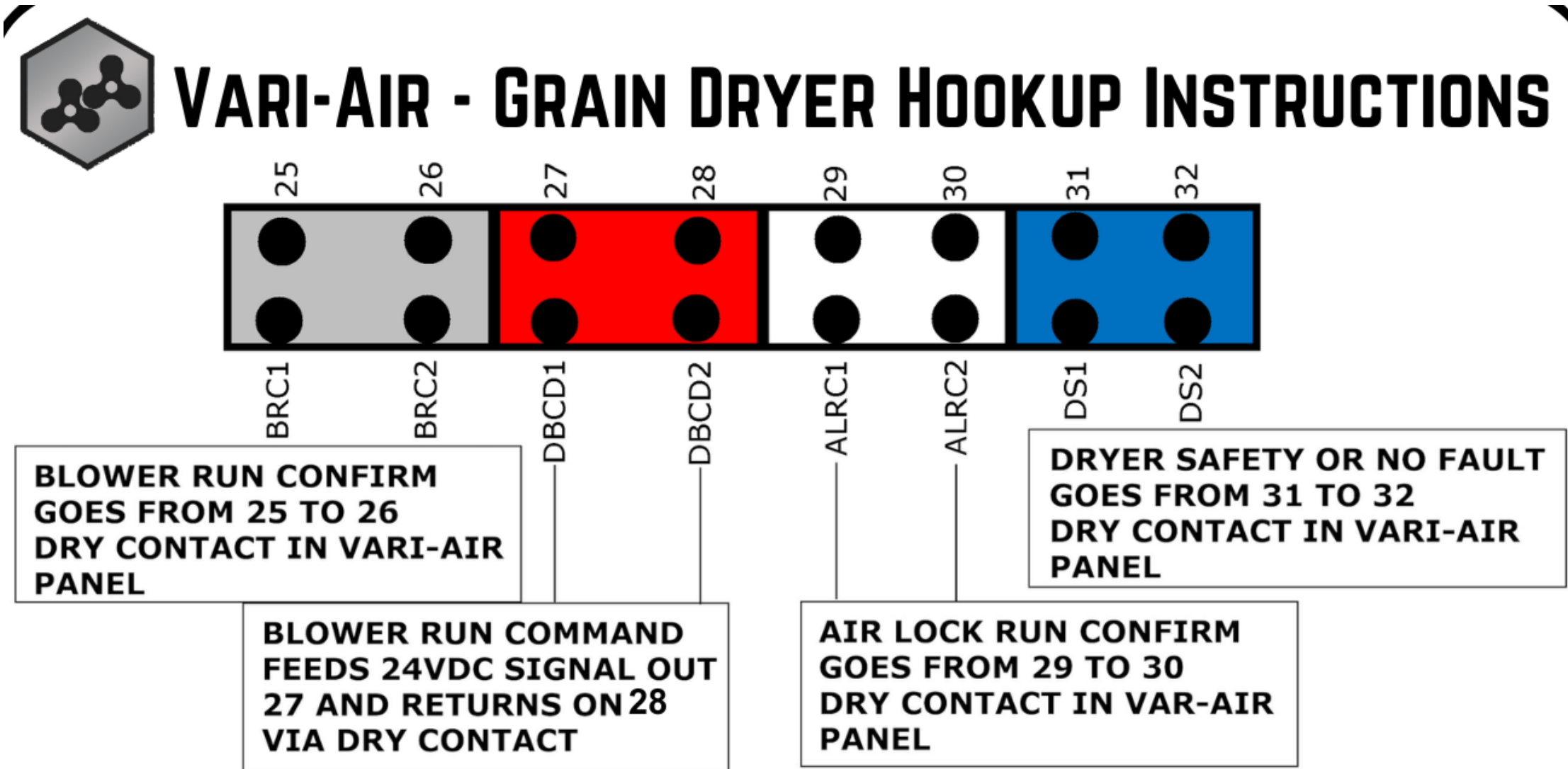


6" Airlock Dimensions



Main Components

VARI-AIR Control



Installation

The Control Panel

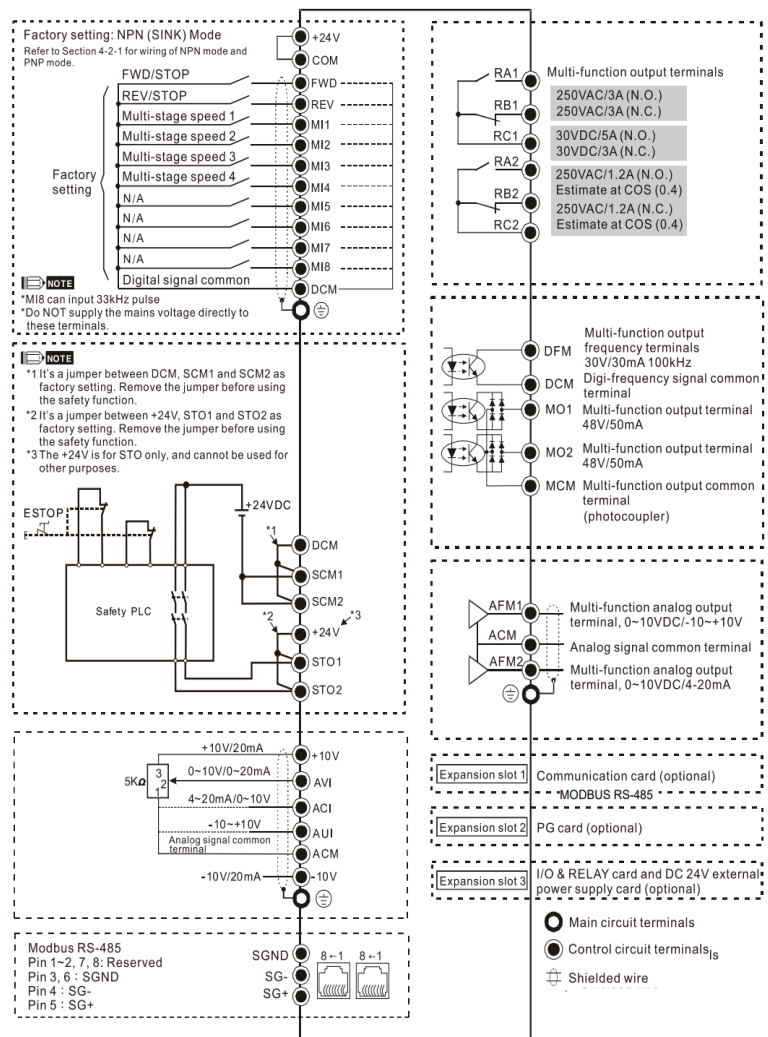
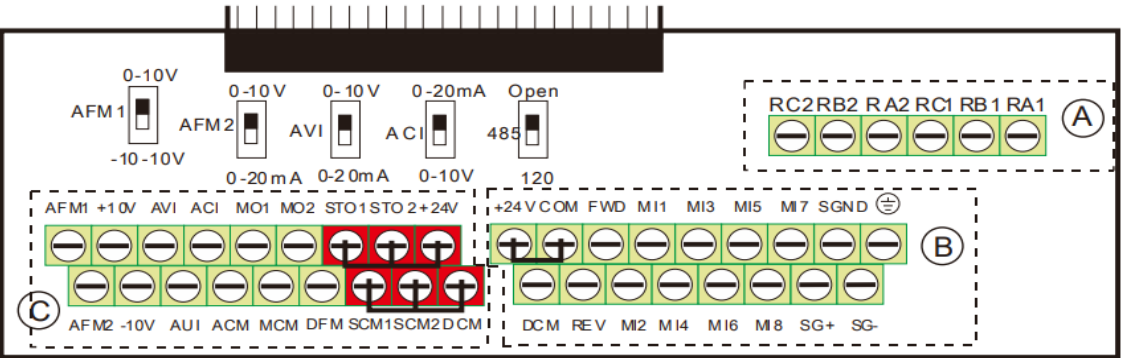


PLANNING YOUR CONTROL PANEL INSTALLATION

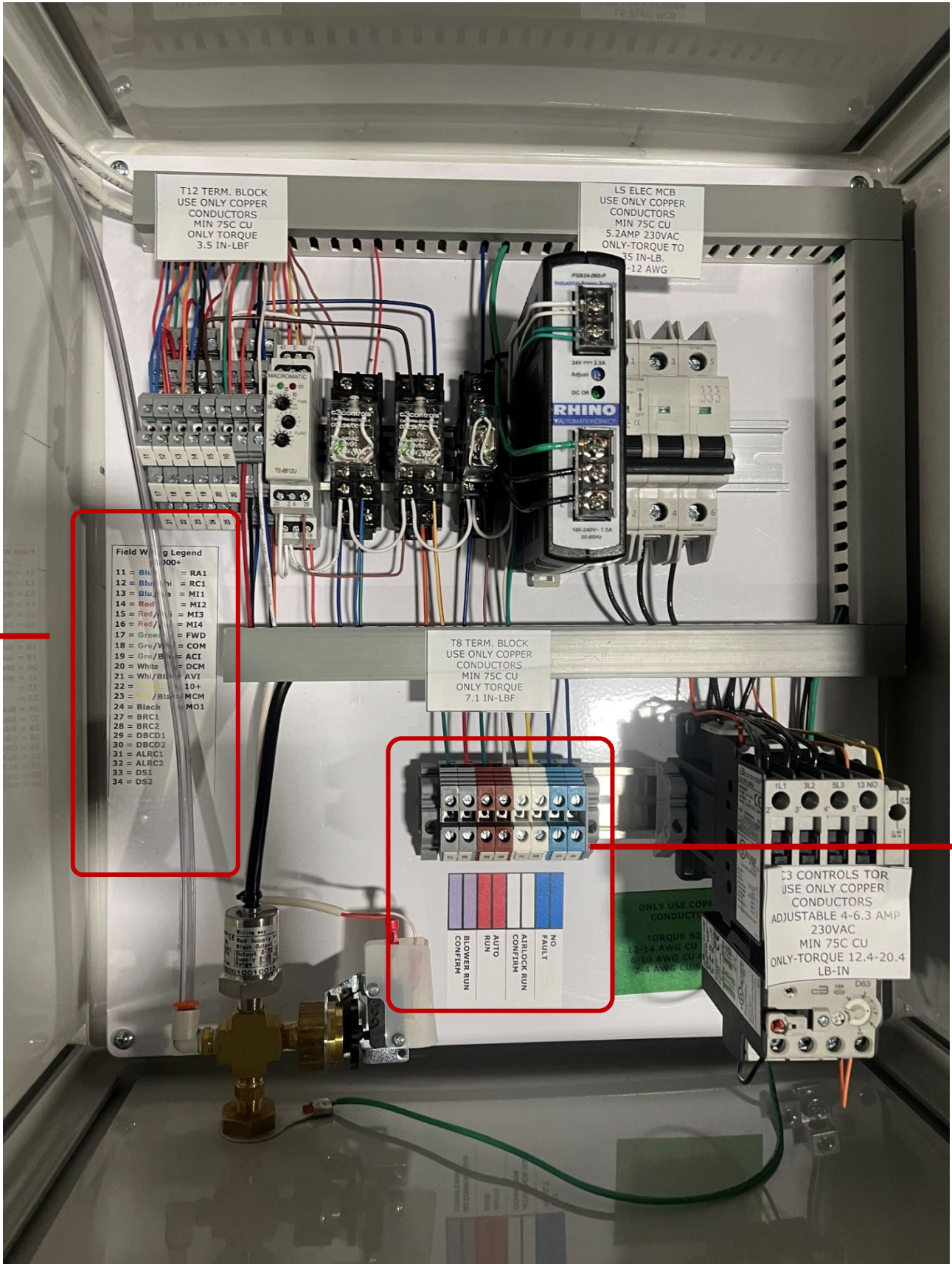
- We are a UL508A panel shop, all Vari-Air systems meet NEC and local code requirements.
- Heat dissipation needs to be addressed during installation. Adequate air movement and air quality will be required to dissipate the heat that is generated from our controls when in operation.
- A licensed Electrician is required for installation.
- All VFD's are programmed and tested before shipment.
- Size all incoming power wiring and devices should be sized to the input rating of VFD.
- All systems are equipped with a LINE Reactor, that should be installed on the LINE side.
- Please call with any questions on electrical installation procedures.

The system installation is perhaps the most important process of the initial investment from a farmer, as the installation can have customer requirements that can cause the system to under-perform.

CONNECTING DRYER TO A VARI-AIR



Field Wiring Legend C2000+		
11 = Blue	=	RA1
12 = Blu/Whi	=	RC1
13 = Blu/Bla	=	MI1
14 = Red	=	MI2
15 = Red/Whi	=	MI3
16 = Red/Bla	=	MI4
17 = Green	=	FWD
18 = Gre/Whi	=	COM
19 = Gre/Bla	=	ACI
20 = White	=	DCM
21 = Whi/Bla	=	AVI
22 = Orange	=	10+
23 = Ora/Bla	=	MCM
24 = Black	=	MO1
27 = BRC1		
28 = BRC2		
29 = DBCD1		
30 = DBCD2		
31 = ALRC1		
32 = ALRC2		
33 = DS1		
34 = DS2		



DRYER CONNECTION TERMINALS

BLOWER RUN CONFIRM (GRAY TERMINALS – BRC1/BRC2)

These are a normally open circuit that changes state to close when a run command is given to blower.

AUTO RUN (RED TERMINALS – DBCD1/DBCD2)

These terminals start the blower system by closing a circuit between the two AUTO RUN terminals

AIRLOCK RUN CONFIRM (WHITE TERMINALS – ALRC1/ALRC2)

These are a normally open circuit that changes state to close when a run command is given to the air lock.

NO FAULT (BLUE TERMINALS – DS1/DS2)

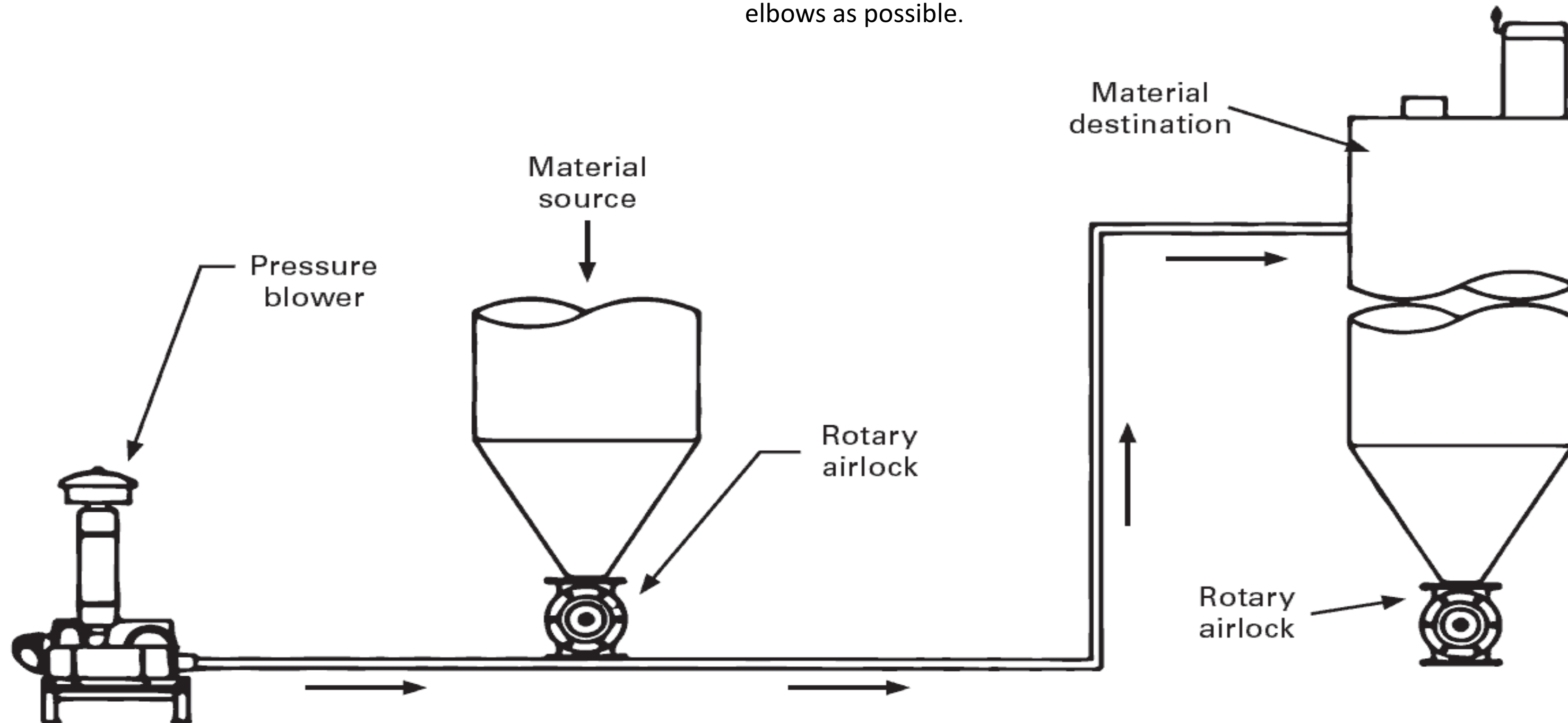
These are a normally closed circuit that changes state when the VFD faults.

	BLOWER RUN CONFIRM
	AUTO RUN
	AIRLOCK RUN CONFIRM
	NO FAULT

Main Components

The Piping

Pressure system

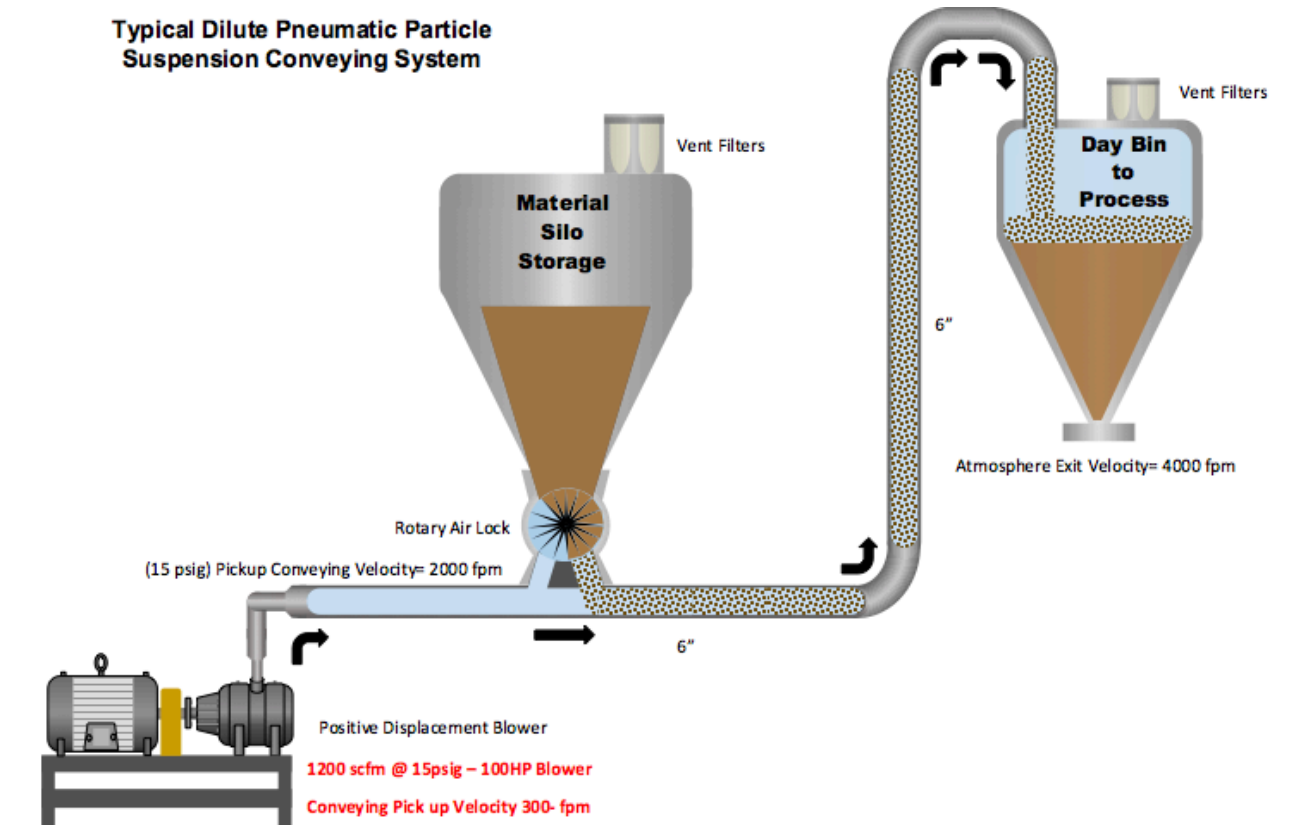
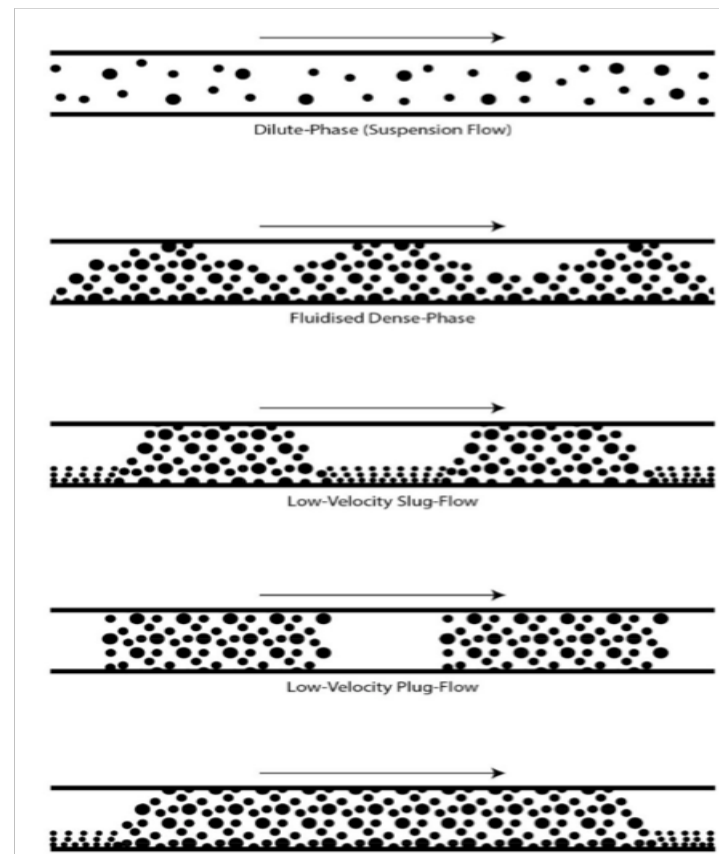
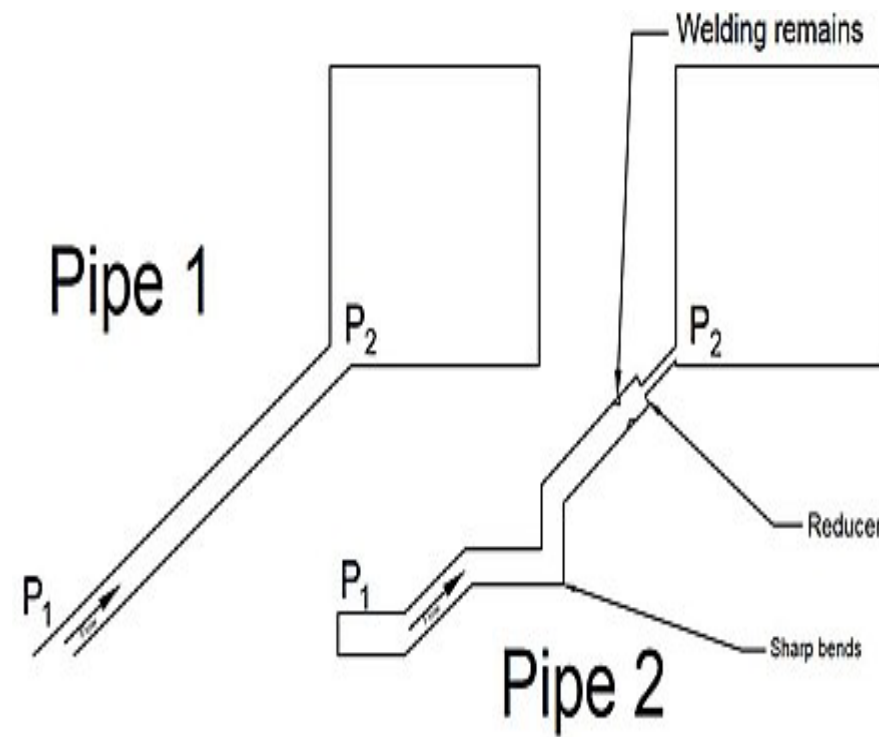


PLANNING YOUR PIPING

- Vari-Air Systems are designed to run at a lower speed, where other systems run full speed all the time.
- The elbows in a Vari-Air piping system have more of a pressure requirement at lower speed.
- The sharper of an angle of bend the more psi required and the greater reduction in system performance.
- The best piping systems over the lifetime of the system is to have the least amount of elbows as possible.

The Variability of the VFD

Variable Frequency Drives (VFD) help achieve the best pressure stability during the delivery process, moving conveyed materials at a uniform pace.



Too much speed beats up corn and causes backpressure



Not enough speed causes the system to plug

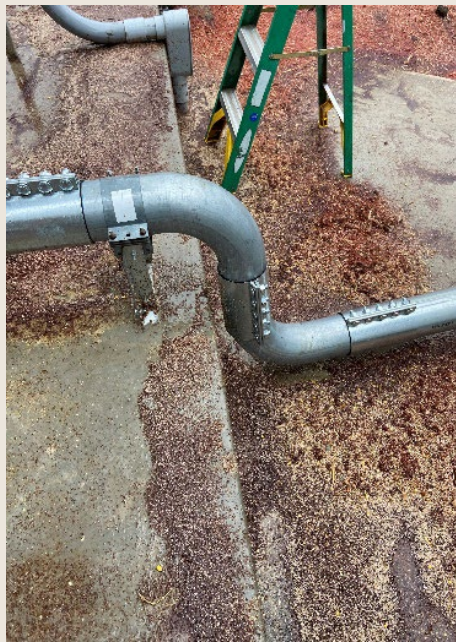


We want the correct mixture of material and air in the pipe.

Piping vs Performance

Elevation Change

Elevation changes cause one of the largest reduction in performance. We see this to get under a driveway or to get under the dryer.



Don'ts

Vertical Runs

The maximum vertical we recommend is 100' high. Please call with any special piping requirements.



Long 45's

45-degree angles that are longer than 20 feet can have build up issues at the peak of the angle.



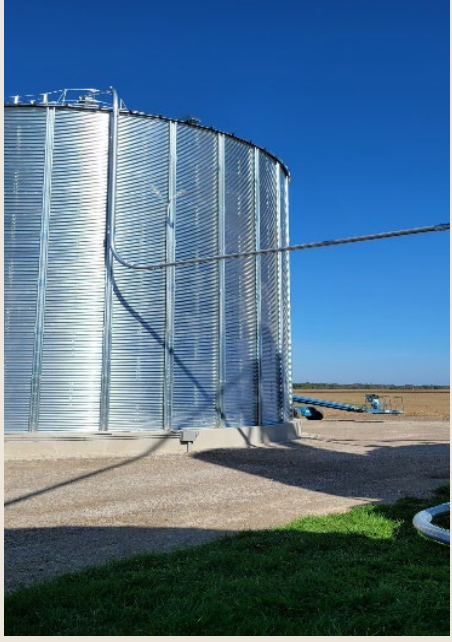
Allowable Distances

Allow for at least 15 feet between blower and air lock. Allow for at least 15 feet between the air lock and the first elbow.



Double psi zones

When corn goes vertical it is packed tight. When it goes horizontal the packed corn dissipates. Then when corn goes vertical again this causes a dead zone in between the double psi zones that can cause issues.



NO DRAIN TILE

Never use drain tile for air piping. Smooth wall piping has the least amount of friction loss. Drain tile has the most amount of friction loss when used for air piping.



Minimum hose use

We see a lot of hydraulic hosed used for transitions, we ask to use the least amount of hose as possible. Smooth wall pipe has the least amount of friction loss.



Slide Gate Location

When drawing out of a surge bin you will need to place a slide gate to meter the grain into the air system. Make sure the slide gate is as close as possible to the air lock.



Don'ts

Blower Location

The best placement of the blower we recommend is to put the intake air next the grain dryer fan. The grain dryer fan will help keep debris away from the intake air.



Minimize intake air

Excessive elbows on the intake air side will cause a performance reduction. Try to find a location or to examine a pre-filter system that will keep intake air clean.



Control Location

The Keypad of the VFD is important to be visible so the system capacity is easily monitored. Your control panel can create volatile conditions if not protected.



High Voltages

Our control systems cannot handle voltages above 500 volts. If your voltage is 10% above or below fundamental voltage (230/460) call to report this condition to your local power utility right away.



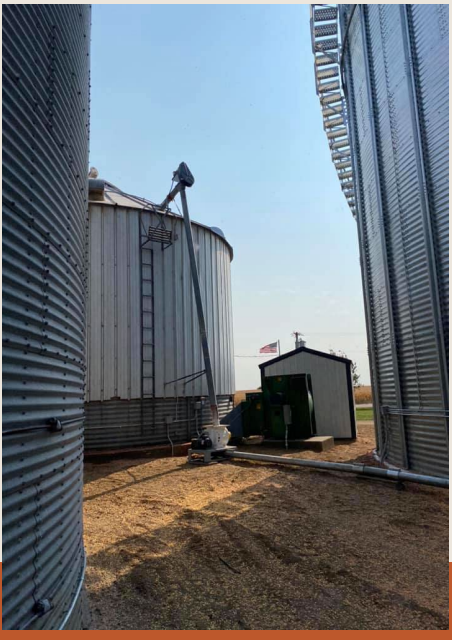
Room to Breathe

Air Transfer Systems need to ingest an enormous amount of air. To restrict intake air by locating the blower in a confined space will cause filters and systems to fail.



Dropping into Airlock

Dropping corn into the airlock from distances of more than 5 feet can cause damage to corn. Restrict the distance required between corn and the airlock if possible.



The Vari-Air System

Piping vs Performance

Do's

Uniform Piping

Running your piping at ground level and then up is an efficient layout. Try to avoid putting pipe overhead as much as possible.



Straight Across

Going straight up and and straight over with your piping will keep a more uniform pressure during the conveying process.



Towers

Running all your pipe up a tower to keep all your vertical runs together is a good way to help minimize your mounting hardware, an increase efficient operation.



Remote Air Intake

When blower placement is next to dryer consider remoting the intake air to a different location. Some customers have piped the intake into a close by building.



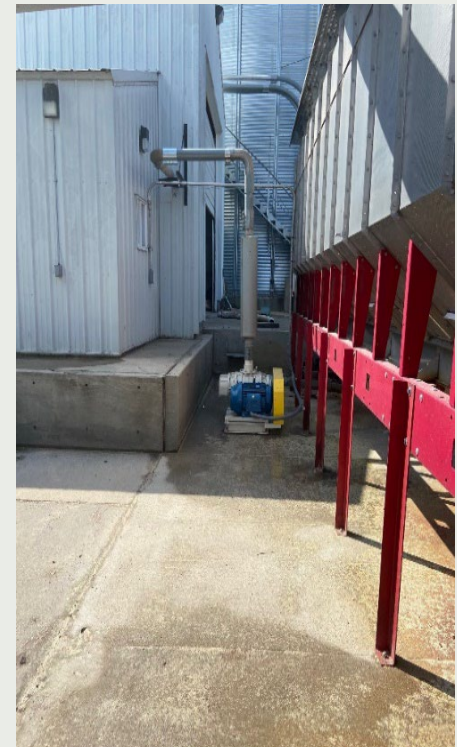
Blower Location?

When finding a location to place the blower when designing a system consider putting the blower in front of the intake fan of the grain dryer. This will pull all the debris away from the intake air filter.



Intake filters

Our system offers a couple of options to help with air intake pre-filters to keep mostly the bee's wings from going right to the intake filter on the air system.



Common Rotary Blower Issues

Blower Packages

- Blower issues represent about 1% of the problems in the field (if sized properly). If a blower package runs for the first week of installation it will usually run for the next 20 to 30 years if it's properly maintained. They are the “workhorse” of pneumatic conveying systems.
- **Common Issues:** Broken Belts, Motor issues, Blower oil
- **How to Troubleshoot:** A change in pressure will be the first indicator there is something off in your conveying system. Historical pressure data on the blower package should be the first place you check in your control system. This will be your best indicator of what is going on inside your conveying system.

Intake Air Filter Considerations and Recommendations

- Filter receivers and bin vents represent 5% of problems in field.
- **Common Issues:** Dirty environment
- **Troubleshooting:** Draw clean air from a different location your system. Place the air intake filter next to the grain dryer fan inlet, which will pull debris from the filter.
- The more a system runs with a plugged filter the harder it is on the system and could cost you 20% more energy to operate the system. Better filtration of intake air is always a good investment to the lifetime of the system.

System Piping

- Piping issues represent about 5% of the problems in the field.
- **Common Issues:** Improper placement, too many angles in piping, too much vertical run with not enough HP.
- **Troubleshooting:** We recommend adding 20 feet of effective feet for every elbow from the blower to the bin. Piping that runs vertical requires the most pressure, because the pipe is full.

Rotary Airlocks

- 89% of the typical problems can be attributed to the rotary airlocks, because airlocks are a precision device often in a rough environment. Tolerances are very tight inside of airlocks, and the airlocks we use leave the facility with a tolerance factor of 0.004 in. A valve is considered “worn-out” when tolerance between housing and rotor reaches 0.012 in. Because of this, these airlocks are very susceptible to rust and wear. Typically you need to check air lock tolerances after **1 million bushels** have passed through the airlock.
- **Common Issues:** Wear, rust, worn-out valves, foreign objects.
- **Troubleshooting:** Measures to mitigate rust are strongly recommended. The more an airlock rusts, the more air escapes the system and takes bushel an hour with it. Wear on a rotary valve occurs slowly and affects all internal components, which is hard to detect. Over time, you start to lose more air which takes away bushels an hour from performance. As the amount of air escaping the airlock increases with more wear, air leaking will start to impede the flow of corn coming into the airlock. The wear typically occurs with how materials are ingested in the airlock. Airlocks should have an even feed coming into the system that is uniform, and not surging more and less at a time. We recommend more pre-season and post-season maintenance done on airlocks

The Vari-Air System

Troubleshooting

Problem – System plugged

- Step1 – Turn blower and air lock switches to the off positions.
- Step2 – Turn Speed control switch to the MANUAL position and the Speed Dial to 100%.
- Step3 – Go to the blower and open the brass bypass ball valve
- Step4 – Go back to the control box and turn the blower switch to the HAND position which will start the blower.
- Step5 – To the blower and watch the PSI gauge, then close the ball valve and the PSI gauge will rise quickly, once the gauge reads 15 PSI open the ball valve, and let the blower recover. Repeat this process until the plug has been alleviated, and the system is running free.
- Step6 – Once the system has been un-plugged, return all the switches to their normal state: Blower and Air Lock switches in the AUTO position, and the Speed Control switch in the AUTO position. Then restart the dryer in the normal operating procedure.
- If the system plugs repeatedly, you are losing capacity somewhere, and you should call JPS to help troubleshoot further.

The best tool to help troubleshoot a Vari-Air System is a cell phone. Call us and we will get you going with minimum downtime.

System not rising in speed

- Transducers that show either 100% or 0% on VFD keypad have failed and need to be replaced.
- When the keypad on the VFD shows 0% on the 2 value - The VFD will not raise speed.
- If the keypad on the VFD shows 100% on the system runs at full speed all the time.

Air Lock Not Starting

- Check the contactor inside the Vari-Air control box and see if the Overload has been tripped from over amps.
- To reset the overload: press the RED button on the overload until you hear a click. This is the overload resetting. Once this has been reset, test run the air lock.
- Sometimes the airlock vanes won't turn when there has been condensation inside the air lock-causing the vanes to rust. It will need to be broke loose before operation can continue.
- To break loose, use a pipe wrench on the opposite of the drive end to move the vanes.

System Losing Capacity

- Make sure that you are not losing air from anywhere. The air lock can have air bypassing through it. If this is the case the airlock will need to be rebuilt.

VFD Fault

- When the VFD is protecting the motor it will fault out when the VFD sees non-standard voltage. If the VFD faults- there will be a fault code on the keypad that describes why the system faulted.
- To reset this fault: hit the Stop/Reset red button on the keypad. This will reset the drive.
- If you have the blower and air lock switches in the AUTO or HAND position
 - Switch the switches to OFF, and then back to what they were originally before the fault.
- If you perform these actions and your VFD keeps faulting, please call support.

VFD Overload

- When a system is overloaded by too many amps the VFD will trip out and have a fault code of OL on the front of the keypad.
- To clean out the intake air filter remove the filter from the intake muffler stack and used compressed air to blower from the inside out on the filter element.

Recommended Maintenance

Pre-season Checks

- Check blower, air lock, and piping system for any physical damage.
- Check electrical panels for any debris always before starting system
- Check air filter on blower system for any debris and blow compressed air from the inside out.
- Check oil sight glasses on both sides of the blower to make sure of oil reservoir capacity.
- Run both the air lock and blower with nothing in system. Check system while running and put two pumps with a grease gun into each bearing on blower and air lock electric motors.
- Remove belt guard from blower, and chain guard on air lock. Then test run the blower only, and check belt tension, and adjust if necessary. Then test run air lock only and check chain tension and adjust if necessary.
- Walk piping system when blower is running and listen for any possible air leaks.
- When first running corn for the year, run the dryer discharge feeding the system at a slower discharge rate, then feed more slowly to make sure there are no issues with capacity.

Post-season Checks

- Check blower, air lock, and electrical panels for any debris or damage after harvest.
- Check air filter on blower system for any debris and blow compressed air from the inside out.
- Check oil sight glasses on both sides of the blower to make sure of oil reservoir capacity.
- Run both the air lock and blower with nothing in system to check for any mechanical issues.
- It is recommended to run mineral oil in the air lock when the air lock is running to coat this inside of the air lock so that condensation will not result in internal rusting of the air lock causing mechanical parts to lock together.

Daily

- Check Blower oil level
- Check air filter for debris
- Whenever blower and air lock are not being used shut off main breaker feeding power to the system.

3 – years (1000 hrs)

- Check V-Belts on Blower
- Replace Intake Air Filter
- Check chain on Air Lock
- Clean out Blower and Air Lock electric motor fan with compressed air.

5 – years (1500 hrs)

- Change Oil on Blower
- Run Blower and Air Lock and check for air blow by through in the air lock.

Debris filtration ideas



<https://www.youtube.com/watch?v=rxoKJLFI34>



WHAT VARI-AIR BLOWER FILTER DO I NEED?

Before harvest, check your Vari-Air blower filter to ensure it is clean and ready for the upcoming season. You will sacrifice performance with a dirty, plugged filter. Call Vari-Air or your dealer with any questions!

5" VARI-AIR FILTERS

- **FILTER 1:** Used on all Showfou brand blowers. A large majority of all our systems use this filter. The blower will have the word "SHOWFOU" imprinted on the end of the blower (circled in orange-->). PN: VAT-5FIL1
- **FILTER 2:** Used on Blowtac/Vari-Air brand blowers. A small majority of blowers sold in 2020 use this filter. The blower will have the word "BLOWTAC or VARI-AIR" imprinted on the end of the blower. (circled in orange-->) PN: VAT-5FIL2



4" and 6" VARI-AIR FILTERS

- All Vari-Air 4" systems take the same filter. PN: VAT-4FIL
- All Vari-Air 6" systems take the same filter. PN: VAT-6FIL

Other filtering options

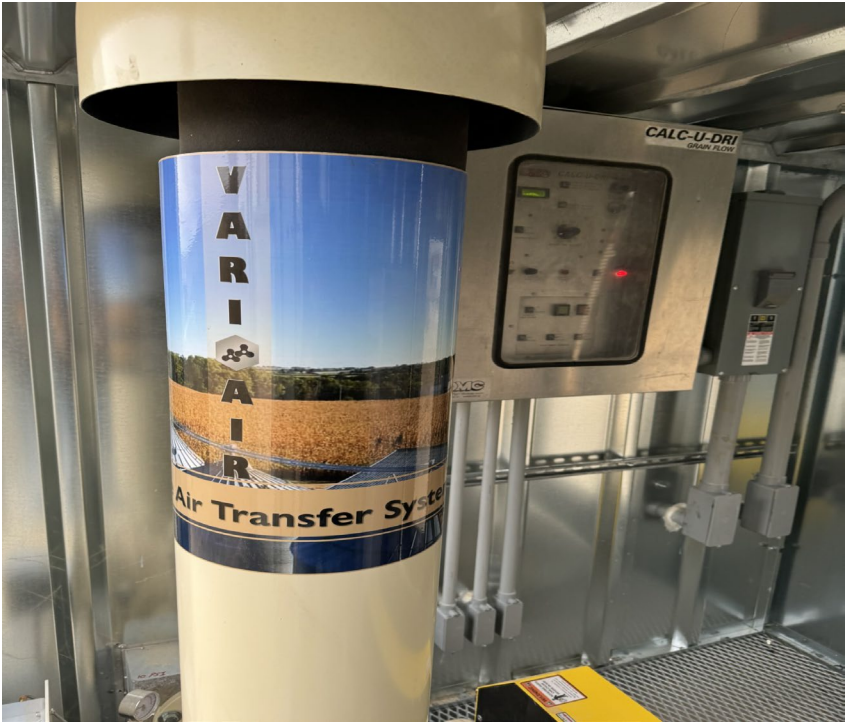
If your blower is placed in an area where there is lots of fine particles in the air, you may need additional filtering for your blower.

- **MESH FILTER:** The Vari-Air mesh filter provides additional protection for your blower against fine particles in the air. This filter is a mesh sock that fits over the top of your blower. This filter can be used interchangeably on 4"/5"/6" blower sizes. PN: VAT-PF
- **WHIRLEY INTAKE FILTER:** This is our highest level of filtering for your blower. This assembly will increase the surface area of your air filter, and also includes a pre-cleaner. It fits on top of your existing blower. Available for 5" and 6" systems. PN: VAT-INTAKE



VARI-AIR
218-512-0438
WWW.VARI-AIR.COM

2024 PowerHouse Installations



Vari-Air POWERHOUSE

- Turnkey
- Pre-wired
- Easy to Install
- Free Delivery
- Free Start-up
- Double warranty
- Customizable
- Mobile



POWERHOUSE

The Vari-Air Powerhouse is a turn-key complete air system, in a pre-wired shed.

Powerhouse highlights:

- Premanufactured shed with blower mounted inside.
- Galvanized enclosure with a 4x7 tube iron and c-channel floor.
- All items pre-wired, which allows you to bring in main power to one circuit breaker.
- All Vari-Air system controls mounted on exterior.
- Yard Lights: Red=System Off / Green=System
- Maintenance kit Included
- Warranty doubles from 2 to 4 years on blower, motor, and VFD.
- Factory designed, assembled, wired, and tested!



To find your local distributor, call Vari-Air:
218-512-0438
Or visit our website: www.vari-air.com



POWERHOUSE COMPONENTS

VFD/PSI Control

- The Vari-Air PSI Control is designed to increase motor speed when system pressure increases.
- This system runs at the minimum speed required to deliver the corn to the bin, reducing damage.
 - Our VFD/PSI control increases lifetime of blower, motor, piping, and other system parts.
 - Single phase systems available up to 6" - 60 Hp

Tri-Lobe Blower

- Our blower has three lobes, which leads to **quiet operation** due to **lower operating RPM**.
- The **tri-lobe** delivers more air than twin lobe design
- Blowers are re-packaged specifically for agricultural conveying
- Blowers are PSI tested before shipment
 - Also included: Blower motor, check valve, air filter, PSI gauge, bypass valve, control air tubing, blower oil
 - 5 year warranty on blower



Airlock

- Standard airlock, with .004 clearance with feeler gauge
- Also Included: air Lock stand, discharge hopper, 1Hp motor/gearbox, sprockets and guards.



PowerHouse Accessories

- External and Internal On/Off Light
- Start-Up Services
- Remote Air Box
- Maintenance Kit

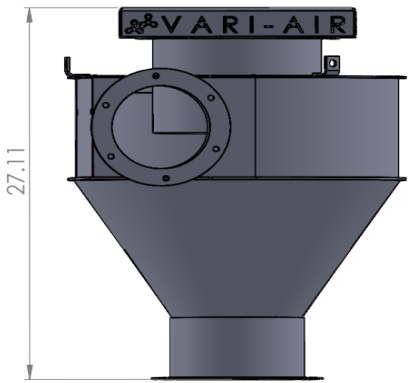
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Or visit our website: www.vari-air.com



Vari-Air

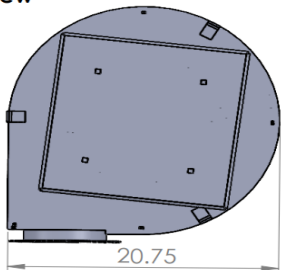
Accessories

Front View



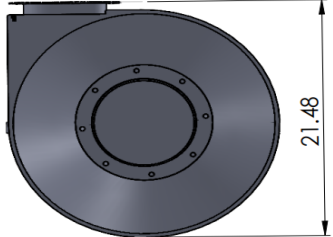
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Top View



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Bottom View



21.48

 **JOHNSON
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SYSTEMS**

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TOLERANCES:
FRACTIONAL ±
ANGULAR: MACH ± BEND ±
TWO PLACE DECIMAL ±
THREE PLACE DECIMAL ±

MATERIAL

FINISH

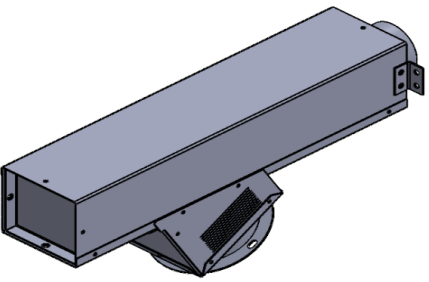
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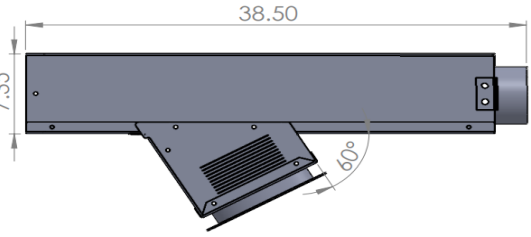
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A		

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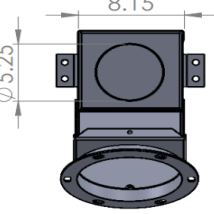


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MATERIAL

FINISH

DO NOT SCALE DRAWING

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TITLE: Deadhead Assembly

SIZE	DWG. NO.	REV
A	Assembly-7	

SCALE: 1:10 SHEET 1 OF 1



Piping Accessories

PIPING/ACCESSORY ! NEW FOR 2024!

Vari-Air will be offering an additional discount on your new Vari-Air systems when you purchase your piping through us. In addition to 20 and 40 foot lengths, we are also offering these piping accessories. Please contact Vari-Air with any questions!

CYCLONES



4" / 5" / 6" SIZES

DEADHEADS



60 / 90 DEGREE

DISTRIBUTOR VALVES



2-WAY / 3-WAY / 6-WAY

ELBOWS



30 / 60 / 90 DEGREE

ALSO AVAILABLE:

- EPOXY-BACKED ELBOWS
- SIGHT GLASS INSERTS
- TELESCOPING PIPE MOUNTS
- COMPRESSION COUPLERS (MORRIS)

PIPING AND ACCESSORIES

Vari-Air Accessories include:

Piping, elbows, distributors, deadheads, cyclones, pre-filters, and couplings. Discounts on accessories when purchased with a COMPLETE Vari-Air system.

BLOWER ACCESSORIES

- Pre-Filter tarp assembly
- Whirly Pre-Filter Assembly
- Remote Air Box—Removes the use of air hose.
- Double Stack (DS) intake filter element)
- Maintenance Kit (1gallon oil/DS filter/Pre-Filter Sock)
- Remote Air Intake Flange Kit

AIRLOCK ACCESSORIES

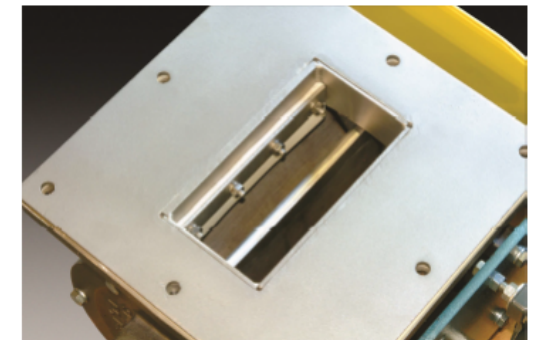
- Air Lock VFD (Slow air lock down when blower is high in amps to keep from plugging)
- Pellet Valve with wiper (STANDARD OPTION)
- TYPE 2 airlock with Teflon coating for longer lifetime
- Aspirator system for debris removal
- Single phase or Three phase electric drive motor

PIPING ACCESSORIES

- Cyclone or Deadheads
- Distributors Valves or Consignor Valves
- 20 or 40 foot pipe lengths available
- 30/60/90 degree pipe elbows-Epoxy backed available
- Sight Glass Inserts
- Compression Couplers (Morris)

CONTROL ACCESSORIES

- Jump Conveyor/Wet Auger interlock
- Yard Lights
- Multiple Run Confirmation Connection Points
- Dryer Controls
- Wet Load Controls
- Remote Monitoring Options



To find your local distributor, call Vari-Air:
218-512-0438
Or visit our website: www.vari-air.com



Piping Price Sheet 5“ & 6“

5 INCH Piping Quote VARI-AIR

Piping Description	Qty	Pipe Diameter	Model Number	List Price	Dealer Price (X.51)	Dealer Price (X.95)	Total Price
5" - 6 way distributor	0	5	VAT-5VALVE6	\$4,200.00	\$2,142.00	\$2,034.90	\$0.00
5" - 3 way distributor	0	5	VAT-5VALVE3	\$2,540.00	\$1,295.40	\$1,230.63	\$0.00
5" - 2 way distributor	0	5	VAT-5VALVE2	\$2,450.00	\$1,249.50	\$1,187.03	\$0.00
5" - Output Tube Kit	0	5	VAT-5VALVEKIT	\$320.00	\$163.20	\$155.04	\$0.00
5" - 90 Deadhead	0	5	VAT-5DH90	\$660.00	\$336.60	\$319.77	\$0.00
5" - 60 Deadhead	0	5	VAT-5DH60	\$700.00	\$357.00	\$339.15	\$0.00
5" - Cyclone	0	5	VAT-CYCLONE	\$830.00	\$423.30	\$402.14	\$0.00
5" - 2 Leg Support	0	5	VAT-5LEG2	\$110.00	\$56.10	\$53.30	\$0.00
5" - 3 Leg Support	0	5	VAT-5LEG3	\$127.00	\$64.77	\$61.53	\$0.00
5" - Adjustable Leg Support	0	5	VAT-5LEGA	\$165.00	\$84.15	\$79.94	\$0.00
5" - 4 Bolt Coupler	0	5	VAT-5COUP4/5	\$105.00	\$53.55	\$50.87	\$0.00
5" - Coupler Gasket	0	5	VAT-5COUPGSK	\$70.00	\$35.70	\$33.92	\$0.00
5" - Sight Glass	0	5	VAT-5SIGHT	\$350.00	\$178.50	\$169.58	\$0.00
5" - Offset Tube	0	5	VAT-5OT	\$1,200.00	\$612.00	\$581.40	\$0.00
5" - 30 Degree Elbows	0	5	VAT-5EL30	\$260.00	\$132.60	\$125.97	\$0.00
5" - 60 Degree Elbows	0	5	VAT-5EL60	\$360.00	\$183.60	\$174.42	\$0.00
5" - 90 Degree Elbows	0	5	VAT-5EL90	\$460.00	\$234.60	\$222.87	\$0.00
5" - Discharge Flange	0	5	VAT-6DF	\$165.00	\$84.15	\$79.94	\$0.00
5" - Whirly Intake Filter	0	5	VAT-6INTAKE	\$1,300.00	\$663.00	\$629.85	\$0.00
5" - 40 ft Stick - 14 Gauge Pipe	0	5	VAT-5SPO40	\$440.00	\$224.40	\$213.18	\$0.00
				\$0.00	\$0.00	\$0.00	\$0.00
				\$0.00	\$0.00	\$0.00	\$0.00

Total Piping Price: \$0.00

PIPING AND ACCESSORIES

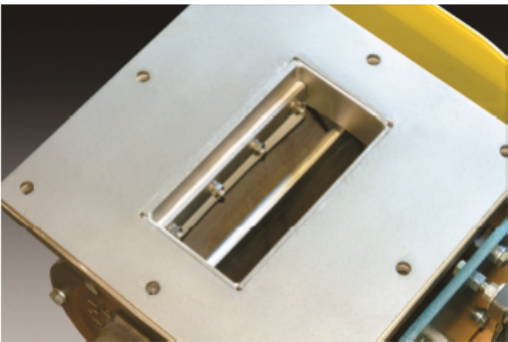
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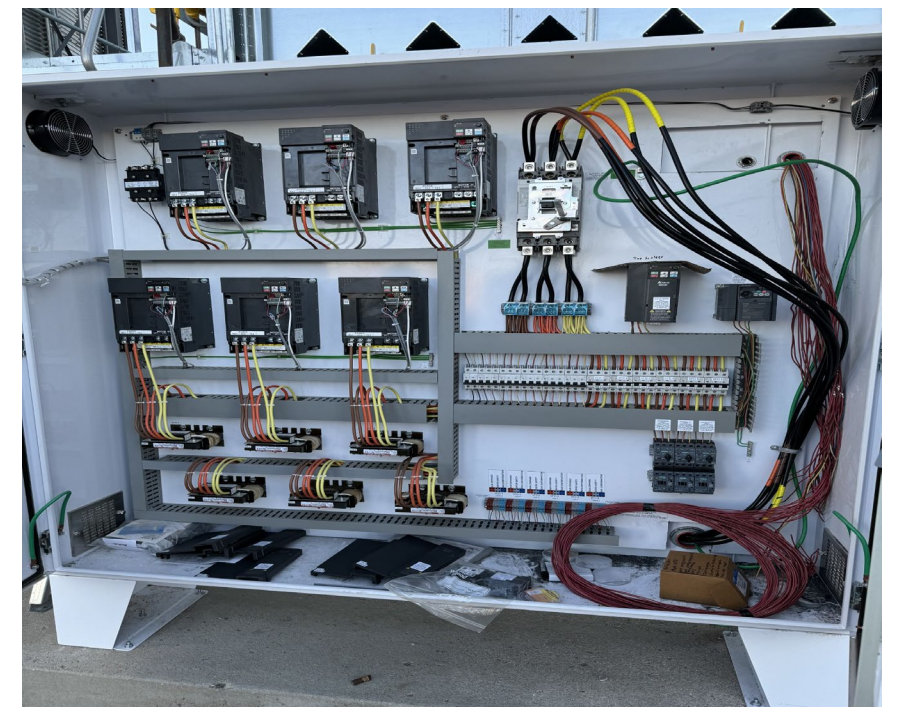


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Grain Dryer Controls w/VFDs

Grain Dryers are starting to use more VFD's for single phase fan applications.



Average cost of three phase power in the United States is \$50K/Mile.

VFD's

Grain Dryer Controls w/VFDs

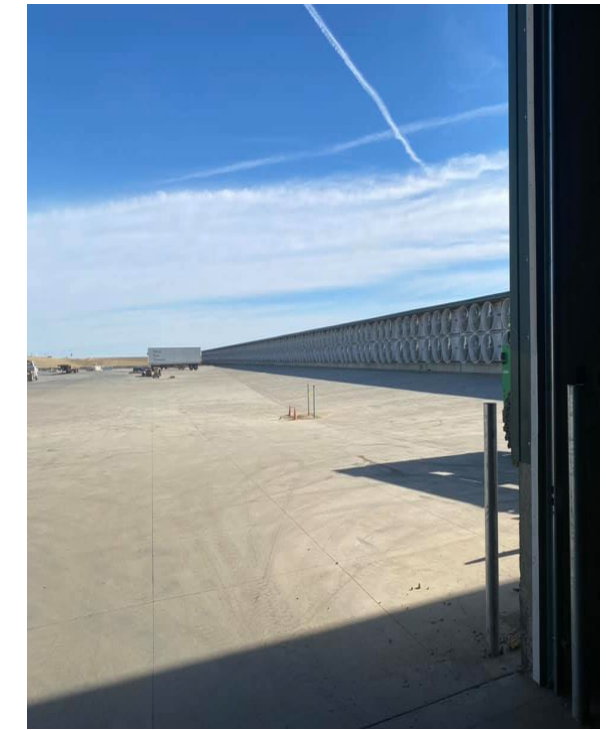
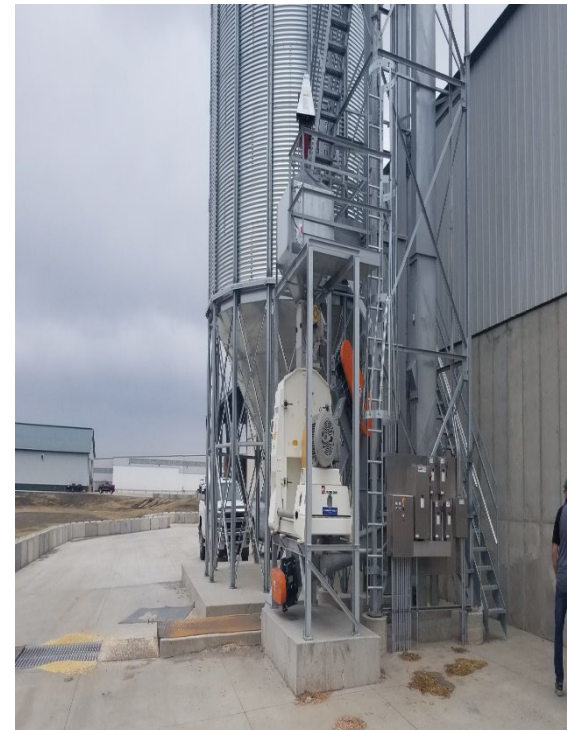
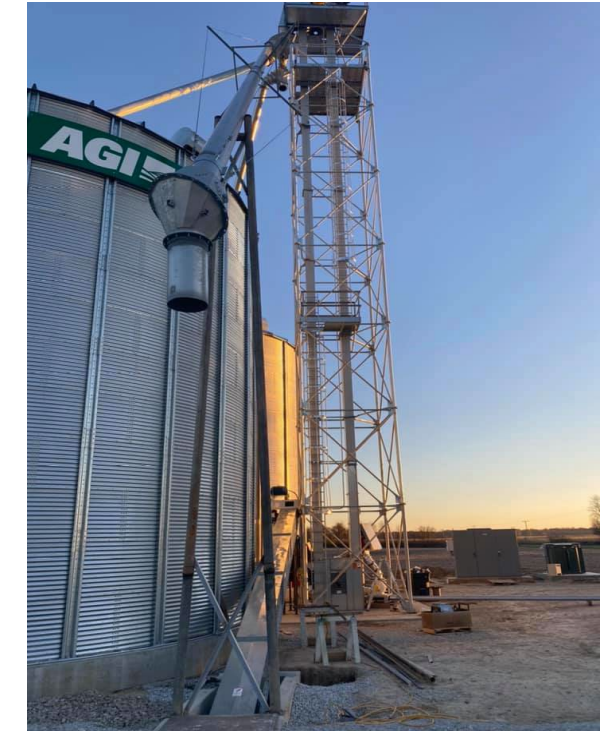
Every year we do newer dryer models and learn how to run the system more efficiently.



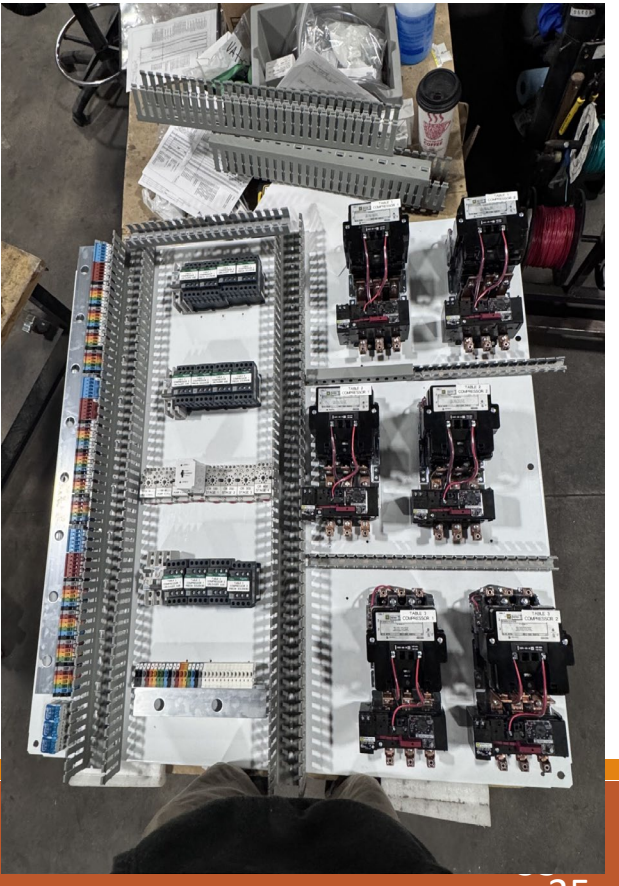
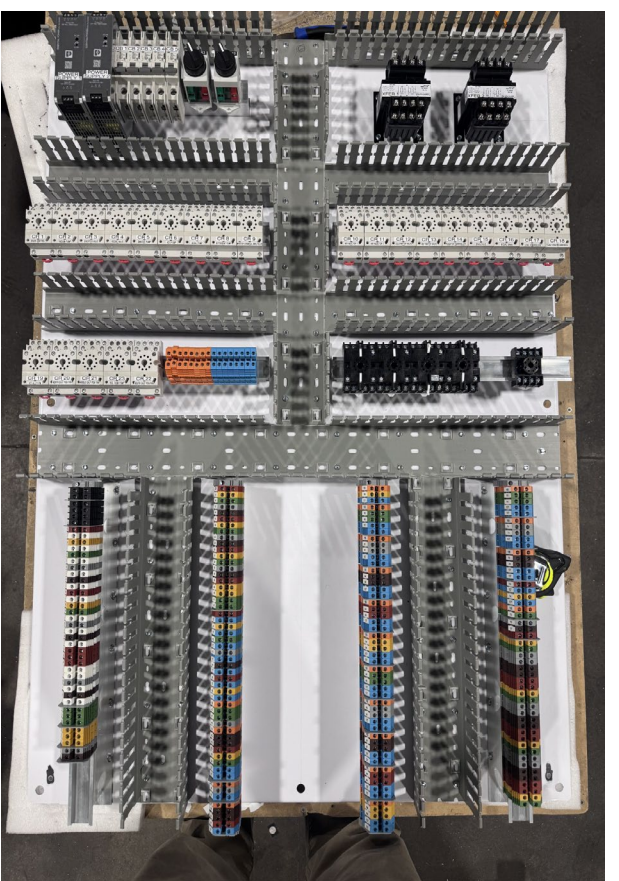
VFD Uses

Air Transfer Systems
Air Compressor systems
Air Conditioning Systems
Air Handler Units
Aerating Systems
Agitators
Anhydrous Ammonia Compressor
Augers
Axial Fans and pumps
Blower Systems
Boilers
Bridge Cranes
Centrifugal pumps and fans
Centrifuges
Chillers
Clothes washers and dryers
Cooling towers
Conveyors
CNC Machines
Dairy
Drilling Machines
Drill Press
Elevators
Fans
Furnaces
Gear Boxes
Geothermal Pumps
Golf Courses
Grain Dryers
Grain Legs

Gear Boxes
Geothermal Pumps
Golf Courses
Grain Dryers
Grain Legs
Hoists
HVAC
Inter-rollers
Irrigation Systems
Lathes
Material Handling
Milling Machines
Mixers
Oil Pumps
Packaging Machines
Printing Presses
Refrigeration
Rock Crushers
Rolling Machines
Roller Coasters
Rotary mills
Saw mills
Separators
Shaker tables
Ski Lifts
Snow Makers
Steel Press
Submersible Pumps
Treadmills
Vacuum Systems
Wind Generators



Dairy Applications



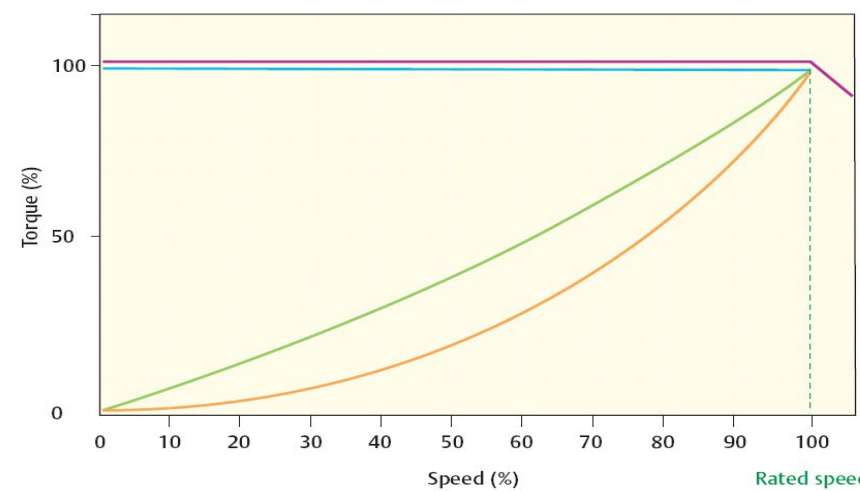
Introduction to VFD's for other Farm Applications

VFD Facts

- VFD's lifespan is determined by the environment and applied voltage. We have many VFDs that have been in service for over 30 years
- Capacitor failure is the most common VFD failure. Line reactors extend capacitor life.
- Loose connections are the 2nd most common VFD failure.
- The largest VFD is 8 MW (10,782 HP)
- On-farm electric motor usage will increase with the increase of more automation of agricultural applications, and corporate farming.
- Average cost of three phase power in the United States = \$50K/mile, or \$8-\$11/foot.
- More power cooperatives are offering rebates for VFD installations.
- REAP grants offer more points for more VFD useage, and increased energy efficiency.

3 most common reasons for using a VFD

- (1) - Your applications need more precise control
- (2) – Your application has a variable load (Fans and Pumps)
- (3) – Your application requires a lot of starting and stopping (Feed Conveyors)



■ AC drive torque ■ Constant torque - (conveyor) ■ Linear torque - (Screw compressor) ■ Variable torque (pump/fan)

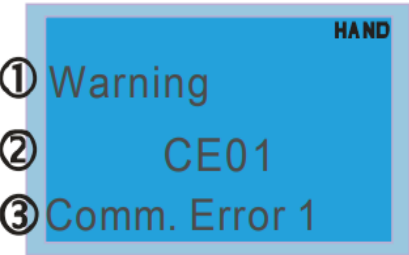
VFD History

- VFD's were invented by Martti Harmoinen in Finland with test projects in the 1960s and 1970s and the first installation in 1982.
- Before VFDs most applications that needed speed variability utilized DC motors that were maintenance intensive or with pulleys or gears to achieve desired speeds.
- VFDs are the number 1 way to save energy and increase lifetimes of electric motors
- VFD's have a linear relationship between volts and frequency. $460\text{v}/60\text{Hz} = 7.67 \text{ V/Hz}$ or $230\text{v}/60\text{Hz} = 3.83 \text{ V/Hz}$
- Voltage is torque and torque is horsepower, with lower frequency operating speed you will have lower voltage. We do not recommend an operating speed less than 35 Hz.
- More VFD's are being used in residential uses which had dramatically increased their usage and decreased the VFD purchase price.

Troubleshooting A VFD

VFD Troubleshooting

- Your VFD from Vari-Air comes programmed and tested before shipment.
- If there is ever an issue with the programming, we do save a copy of the set parameters in the keypad of the VFD. We can re-program the VFD to original settings. Please call JPS to have a technician assist you with re-programming your VFD.
- Your VFD troubleshooting will be handled mostly by the VFD keypad. The keypad will display the fault that had occurred and will the VFD has a history in the program that displays the volts and amps at the time of the fault.
- To clear a fault, you can hit reset on the keypad during a fault condition and try to restart again.
- Connections are a large root cause of faults and to quickly check connections, and if loose, please disconnect all power feeding VFD, and then tighten connections, both main power and control connections.
- When the VFD is first commissioned is when most problems will be discovered.



- ① Display error signal
- ② Abbreviate error code
The code is displayed as shown on KPC-CE01.
- ③ Display error description

7	Fault HAND ovA Ov at accel	DC BUS over-voltage during acceleration (230V: DC 450V; 460V: DC 900V)	1. Check if the input voltage falls within the rated AC motor drive input voltage range. 2. Check for possible voltage transients. 3. If DC BUS over-voltage due to regenerative voltage, please increase the acceleration time or add an optional brake resistor.
11	Fault HAND LvA Lv at accel	DC BUS voltage is less than Pr.06-00 during acceleration	1. Check if the input voltage is normal 2. Check for possible sudden load
15	Fault HAND OrP Phase lacked	Phase Loss	Check Power Source Input if all 3 input phases are connected without loose contacts. For models 40hp and above, please check if the fuse for the AC input circuit is blown.
16	Fault HAND oH1 IGBT over heat	IGBT overheating IGBT temperature exceeds protection level	1. Ensure that the ambient temperature falls within the specified temperature range. 2. Make sure that the ventilation holes are not obstructed. 3. Remove any foreign objects from the heatsinks and check for possible dirty heat sink fins. 4. Check the fan and clean it. 5. Provide enough spacing for adequate ventilation.
21	Fault HAND oL Over load	Overload The AC motor drive detects excessive drive output current.	1. Check if the motor is overloaded. 2. Take the next higher power AC motor drive model.
22	Fault HAND EoL1 Thermal relay 1	Electronics thermal relay 1 protection	1. Check the setting of electronics thermal relay (Pr.06-14) Take the next higher power AC motor drive model
26	Fault HAND ot1 Over torque 1	These two fault codes will be displayed when output current exceeds the over-torque detection level (Pr.06-07 or Pr.06-10) and exceeds over-torque detection (Pr.06-08 or Pr.06-11) and it is set to 2 or 4 in Pr.06-06 or Pr.06-09.	1. Check whether the motor is overloaded. 2. Check whether motor rated current setting (Pr.05-01) is suitable 3. Take the next higher power AC motor drive model.
27	Fault HAND ot2 Over torque 2		

NEW SHOW DEMOS AVAILABLE FOR 2025



NEW SERVICES FOR 2025

Vari-Air system
and piping
delivery available



Custom Pipe
Bending



Piping and
Accessories



Custom Builds



NEW INFORMATIONAL STICKERS

Vari-Air LOG

INPUT AMP
REQUIREMENTS

Air Lock
Information

Pre-Filter
Installation
Information

Vari Air
Information

VARI-AIR LOG		
	PSI	AMPS
BIN 1		
BIN 2		
BIN 3		
BIN 4		
BIN 5		
BIN 6		
VARI-AIR 218-512-0438 WWW.VARI-AIR.COM/FILES		

NEMA-3B

INPUT POWER REQUIREMENTS

230Volt - 3Phase

BLOWER MOTOR Horsepower	VFD INPUT AMPS
20	19
30	14.3
40	223
50	245
60	231

NEMA-3B

INPUT POWER REQUIREMENTS

230Volt - 3Phase

BLOWER MOTOR Horsepower	VFD INPUT AMPS
20	19
30	14.3
40	223
50	245
60	231

NEMA-3B

INPUT POWER REQUIREMENTS

230Volt - 3Phase

BLOWER MOTOR Horsepower	VFD INPUT AMPS
20	19
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40	223
50	245
60	231

NEMA-3B

INPUT POWER REQUIREMENTS

460Volt-3Phase

BLOWER MOTOR Horsepower	VFD INPUT AMPS
20	35
30	47
40	63
50	74
60	80
75	104
100	137
125	167

NEMA-3B

INPUT POWER REQUIREMENTS

460Volt-3Phase

BLOWER MOTOR Horsepower	VFD INPUT AMPS
20	35
30	47
40	63
50	74
60	80
75	104
100	137
125	167

NEMA-3B

INPUT POWER REQUIREMENTS

460Volt-3Phase

BLOWER MOTOR Horsepower	VFD INPUT AMPS
20	35
30	47
40	63
50	74
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100	137
125	167

NEMA-3B

INPUT POWER REQUIREMENTS

460Volt-3Phase

BLOWER MOTOR Horsepower	VFD INPUT AMPS
20	35
30	47
40	63
50	74
60	80
75	104
100	137
125	167

NEMA-3B

INPUT POWER REQUIREMENTS

460Volt-3Phase

BLOWER MOTOR Horsepower	VFD INPUT AMPS
20	35
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NEMA-3B

INPUT POWER REQUIREMENTS

460Volt-3Phase

BLOWER MOTOR Horsepower	VFD INPUT AMPS
20	35
30	47
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60	80
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NEMA-3B

INPUT POWER REQUIREMENTS

460Volt-3Phase

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125	167

NEMA-3B

INPUT POWER REQUIREMENTS

460Volt-3Phase

BLOWER MOTOR Horsepower	VFD INPUT AMPS
20	35
30	47
40	63
50	74
60	80
75	104
100	137
125	167

NEMA-3B
20-125 HP
75-125 AMP

NEMA-3B
20-125 HP
75-125 AMP

NEMA-3B
20-125 HP
75-125 AMP

NEMA-3B
20-125 HP
75-125 AMP

NEMA-3B
20-125 HP
75-125 AMP

NEMA-3B
20-125 HP
75-125 AMP

NEMA-3B
20-125 HP
75-125 AMP

NEMA-3B
20-125 HP
75-125 AMP

NEMA-3B
20-125 HP
75-125 AMP

NEMA-3B
20-125 HP
75-125 AMP

**AIRLOCK
INFORMATION**

- AIRLOCK MEASUREMENTS
- AIRLOCK MAINTENANCE
- AIRLOCK TROUBLESHOOTING

OR VISIT: WWW.VARI-AIR.COM/AIRLOCK

YOUR AIRLOCK MAY NEED TO BE REBUILT

- AFTER 1 MILLION BUSHELS
- IF TOLERANCES ARE OVER .012

VISIT OUR WEBSITE OR CALL US FOR MORE INFORMATION.

SUPPORT:
218-512-0438

**VARI-AIR
INTAKE FILTER**

OR VISIT: WWW.VARI-AIR.COM

SCAN ME

FOR MORE INFORMATION ON
OUR VARI-AIR SYSTEM

OR VISIT:
WWW.VARI-AIR.COM

SUPPORT:
218-512-0438

NEW PRODUCTS FOR 2025



2" - 10 Hp System



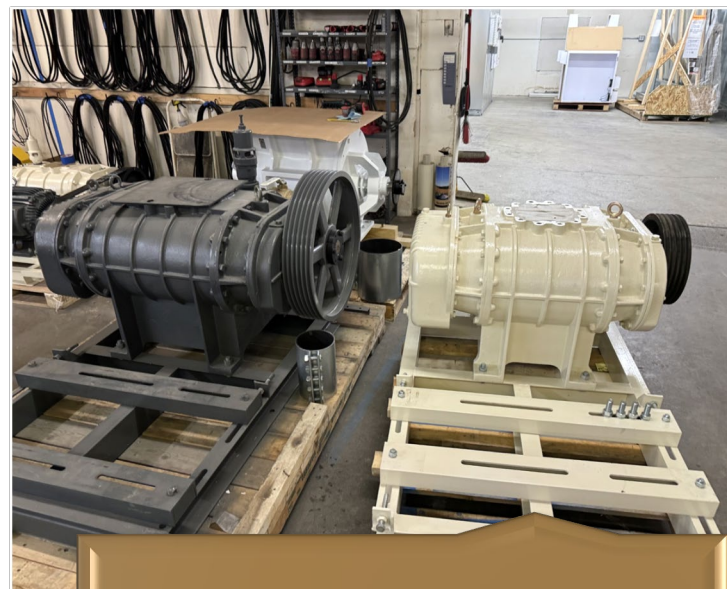
4" - 15 – 20 Hp
Systems



5" - 25 – 40 Hp
Systems



6" - 50 – 100 Hp
Systems



8" – 100 Hp System



10" – 125 Hp
System

NEW PRODUCTS FOR 2025

Quick Change
Filter
Attachment



Skinny Air Lock



4-way
distributor



POWER ROOF
VENT
CYCLONE

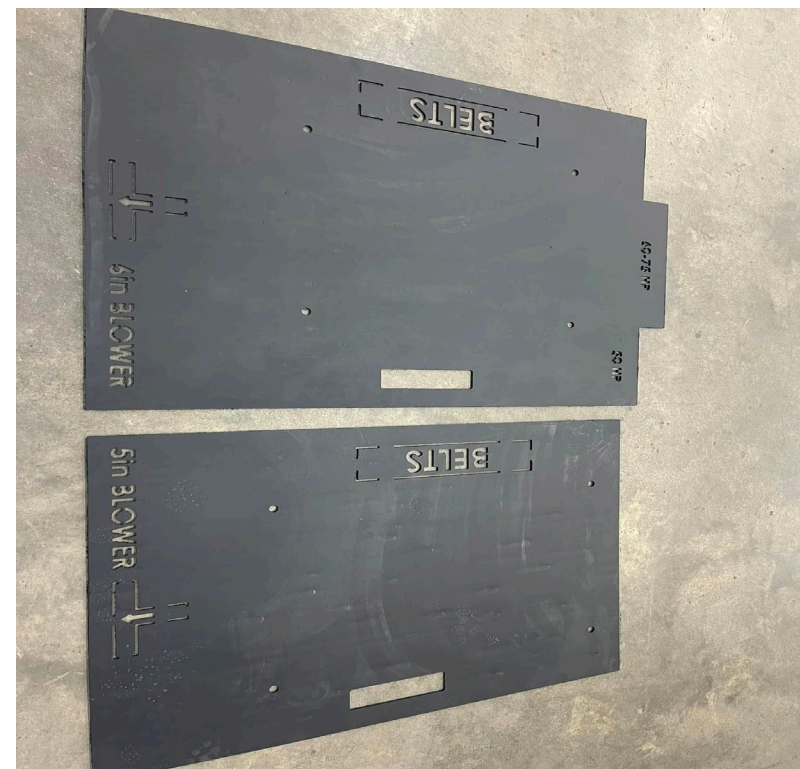


NEW PRODUCTS FOR 2025

Explosion
Proof Blower



Blower
Footprint
Template



Flexible
Blower
Transition



NEW PRODUCT ANNOUNCEMENT

Flexible Transition

When we do on-site start-ups we see a lot of different installations.

We see what works best and what does not.

Some of the best flexible transitions we see are utilizing heavy duty 5" and 6" tubing used as a flexible transition for spouting between the blower to the airlock on the air side of the air lock.

When encountering different elevations from blower to airlock this flexible tubing will allow a connection with minimal friction loss.

This heavy-duty tubing lasts longer than any other tubing we have seen used for on-site installations.



Call today and we can cut any length you require.

Call today with any questions.

www.vari-air.com
218-512-0438

Vari-Air
2421 16th Ave. South
Moorhead, MN 56560

Skinny – Direct
Drive Air Lock



NEW PRODUCT ANNOUNCEMENT

Skinny Air Lock

We are building an airlock system that will be installed in a service tunnel under a large bin that has a diverter tube that is able to unload the grain from the bin into the airlock.

The system has extreme space constraints, and we redesigned our air lock system to be used in these tight spaces.



Skinny Air Lock Dimensions:

19.5" - Wide

31.75" Tall

41.25" Long

Discharge pipe is 2" from the ground.

6" skinnier than our standard air lock.

Call today with any questions.

www.vari-air.com
218-512-0438

Vari-Air
2421 16th Ave. South
Moorhead, MN 56560

THANK YOU!

QUESTIONS?

