vPlume™

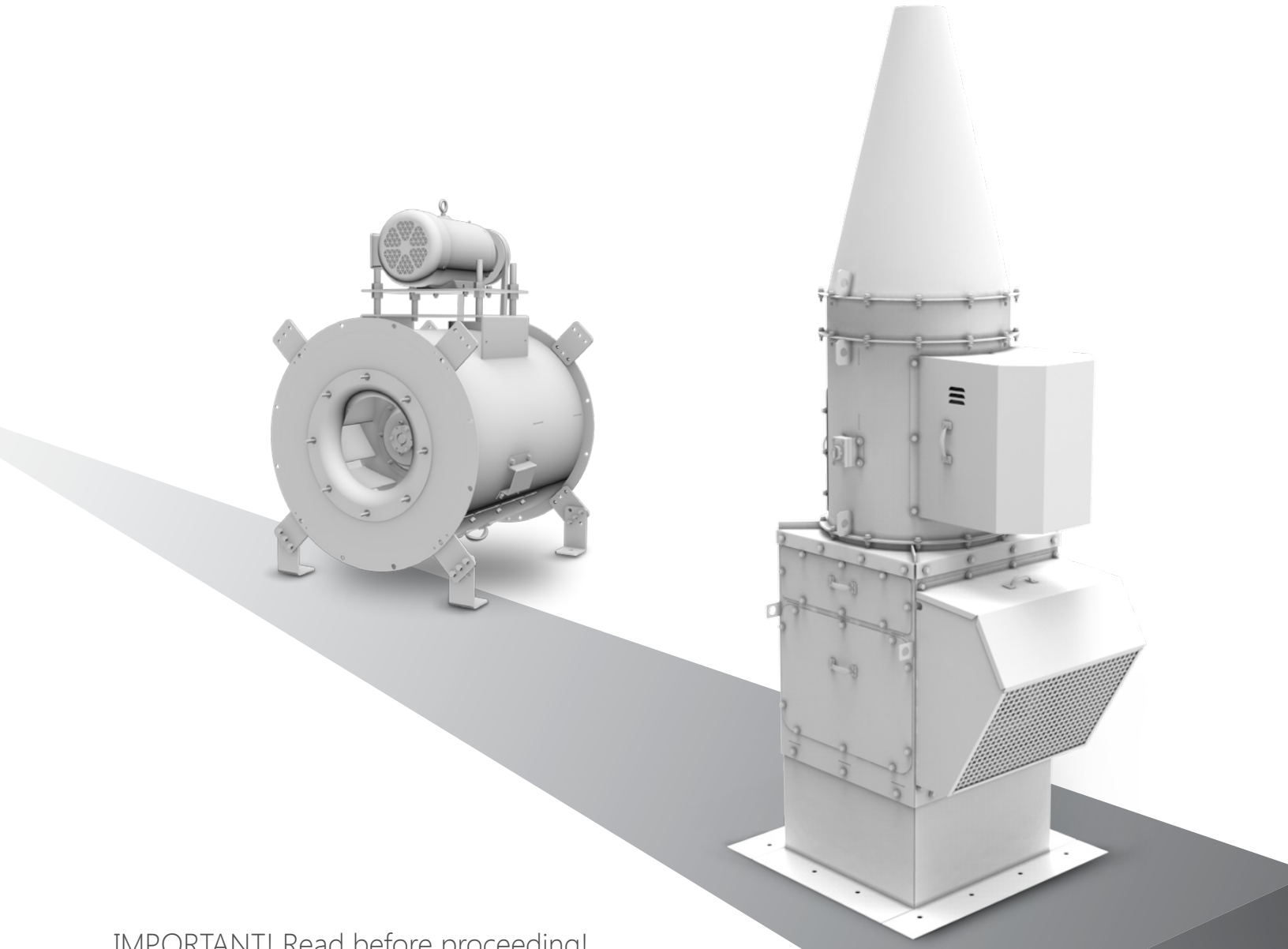
Laboratory Exhaust System

INSTALLATION, OPERATION AND MAINTENANCE MANUAL

PENNBARRY™

TCI

Tubular Centrifugal Inline Fan



IMPORTANT! Read before proceeding!

Please read and save these instructions. Read carefully before attempting to assemble, install, operate or maintain the product described in this document. Protect yourself and others by observing all safety information noted in this document. Failure to comply with these instructions could result in personal injury, injury to others and/or property damage.

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GENERAL SAFETY INFORMATION

Only qualified trained personnel should install or maintain equipment described in this document. Improper installation can result in electric shock, possible injury due to high speed moving parts, or other potential hazards. Special circumstances such as high winds or wet surfaces must be considered when installing the unit. Contact a PennBarry engineer if any questions or issues arise or if any other information is needed before installing or maintaining the fan.

1. Follow all local, state and federal electrical and safety codes, as well as the National Electrical Code (NEC), and the National Fire Protection Agency (NFPA), where applicable. Follow the Canadian Electrical Code (CEC) in Canada.
2. Make sure that the wheel spins freely without hitting or rubbing on any parts or objects.
3. The motor must be grounded; failure to ground a motor can result in a serious safety hazard.
4. The fan impeller should not be operated at RPM's exceeding the rated RPM. If fan speed is higher than rated, the motor may over amp, causing serious damage to the motor and other moving parts of the fan.
5. Power cord must be free of any kinks or pinches and must not come into contact with grease, oil or other liquids, flammable or otherwise.
6. Verify that incoming power to the unit is of the correct voltage stated on the unit and/or motor nameplate.
7. Turn unit off before opening any access panels.

DANGER

Always disconnect power before working on or near a fan. Lock and tag the service switch or breaker to prevent accidental power up.

CAUTION

When servicing the fan, motor may be hot enough to cause pain or injury. Allow motor to cool before servicing.

CAUTION

Precaution should be taken in explosive atmospheres.

Receiving

PennBarry fans are carefully inspected and tested before leaving the factory. When the unit is received, inspect the packaging for any signs of tampering. Inspect the unit for any damage that may have occurred during transit and check for loose, missing or damaged parts. Mishandled units can void the warranty provisions. If units are damaged in transit, it is the responsibility of the receiver to make all claims against the carrier. PennBarry is not responsible for damages incurred during shipment. Avoid severe jarring and/or dropping. Handle units with care to prevent damage to components or finishes. If the unit is scratched due to mishandling, the protective coating may be damaged. Incorrect lifting may damage the fan and void the warranty.

Unpacking

Upon reception, verify that all required parts and the correct quantity of each part have been received. If any items are missing, report these to your local PennBarry representative. Due to variation in shipping carriers and availability, some items are shipped separate from one another. Confirmation of shipment(s) must be limited to only items on the bill of lading.

GENERAL SAFETY INFORMATION

Storage

Store in a dry, protected area being sure fan shaft, bearings and impeller are protected against dust and corrosion. If it is necessary to store outdoors or within a building under construction, special care must be taken to prevent moisture, corrosion, dirt or dust accumulation. Coat the shaft with grease or rust preventative compound. Cover and seal bearings to prevent entrance of contaminants. Impeller should be rotated at least once a month to circulate the grease in bearings. If stored outdoors over seven (7) days, cover completely with a tarp or heavy waterproof paper. Electrical connections and leads must be protected from moisture. Block impeller to prevent natural rotation. Do not allow material of any kind to be piled on top or inside of fan.

Inspection and Maintenance during Storage

Long-term storage is defined as storage for period exceeding one month from the date the equipment was received. Fans and motors should be stored in a dry, low humidity area indoors. Equipment which is to be installed, but not operated for several months, should first be blocked to take the weight off of the vibration isolators (if provided) and then given the same protection, periodic inspection and maintenance as a unit in storage. To prevent puddle corrosion of fan bearings that undergo long-term storage, the following preventive maintenance must be performed

1 Fan bearings must be re-lubricated every month until the fans are put into service. A clear 1/16" bead of grease must appear on each side of the bearings. Fan wheels are to be rotated manually while the bearings are re-lubricated. Refer to the specific bearing lubrication instructions located on the fan housing for the type of lubricant to use.

2 Motor bearings should be lubricated as recommended by the motor manufacturer.

Removing from Storage

Fans should be hoisted with slings placed around the fan housing. When a single hoist is used, a "spreader" will keep the sling from slipping on the housing. Fans must be protected and maintained from the time of storage to the time of assembly and installation.

Ensure that the fan is in working order before assembly and installation. Be sure that no damage has occurred between storage and time of assembly.

1 Ensure that all fasteners, fittings, screws, etc. are tightened to recommended specifications.

2 Make sure that no parts or objects are rubbing on the fan wheel as it is turned.

Notes:

This document is applicable for the following PennBarry models.

TCI-90	VPLUME-90
TCI-105	VPLUME-105
TCI-122	VPLUME-122
TCI-135	VPLUME-135
TCI-150	VPLUME-150
TCI-165	VPLUME-165
TCI-182	VPLUME-182
	VPLUME - 200
	VPLUME - 222
	VPLUME - 245
	VPLUME - 270
	VPLUME - 300
	VPLUME -330
	VPLUME -365
	VPLUME -402

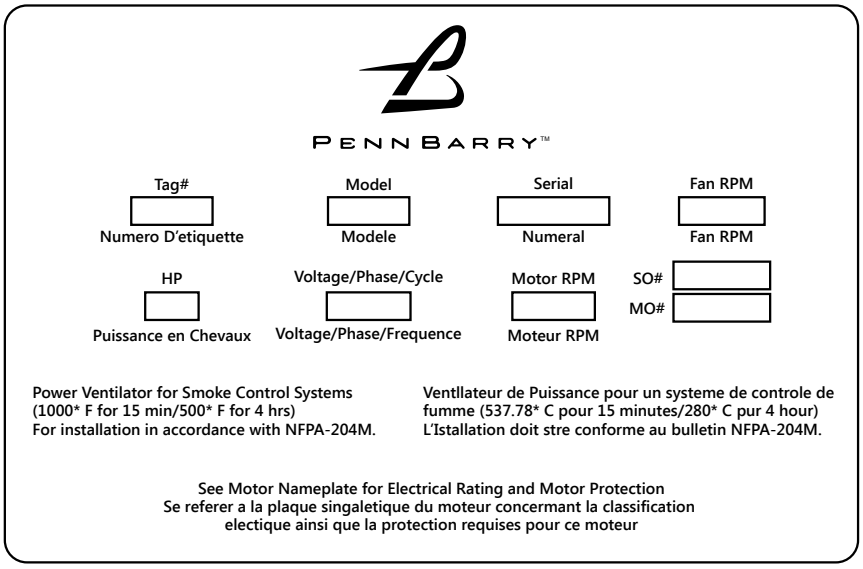
GENERAL INFORMATION

Unit identification tags

Each unit has a permanently affixed nameplate with various identifications including, but not limited to, the unit model and serial numbers, motor ratings and voltages.

The figure below is an example of a PennBarry unit nameplate. It includes all of the specifications of the unit, as referenced above. When contacting your PennBarry representative, please have the information on the nameplate readily available, as this will help to streamline your help request.

Fan components may arrive in pieces or assemblies depending on the fan configuration. Components of the fan will have matching nameplates, and these components should not be mixed with other PennBarry fans. If mismatched components are installed in the same fan, fan performance may be reduced.



Pre-Installation information

Ensure that the mounting surface where the unit is to be installed is completely level and free of debris. The mounting surface must also be able to bear the entire weight of the fan.

Electrical service switches

An electrical service switch must be installed either on the unit or in visual proximity to the unit, so that the unit can be easily turned off for maintenance or trouble shooting. These must be locked out when the unit is being maintained or serviced.

Moving parts

Any moving parts on the unit must have covers or guards to protect any servicers or personnel. These guards are to be installed in accordance with local codes. The fan wheel must be secured before performing any maintenance on the unit; damage to the wheel is possible if this precaution is not taken.

Guards (Motor/Weather cover)

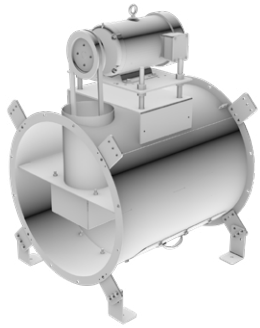
All parts of the unit, including guards and covers, must be installed before attempting to start the unit. Do not operate the unit with any missing pieces, particularly any guards or covers; this includes any hardware including nuts and bolts, which hold these covers in place.

Air pressure and suction

Fans moving at any speed create suction with varying degrees of strength. Special consideration needs to be taken when working around these units. Do not leave any loose articles of clothing or materials in or around air intake or fan inlet.

LIFTING INFORMATION

Fans should be hoisted with slings placed around the fan housing. When a single hoist is used, a "spreader" will keep the sling from slipping on the housing. If it is necessary to use hooks placed in lifting holes of fan, BE CAREFUL NOT TO DISTORT OR BEND THE HOUSING. Large units may have lifting lugs or holes which should be used only to stabilize the unit while using a sling to support the weight. Chain or wire slings should be well-padded where they contact the fan, especially where special coatings and paints are involved. Rubber, phenolic enamels, etc. require special care as they may easily be damaged by contact in lifting. Even a small chip will destroy the corrosion prevention seal of the coating and allow corrosion to start. Always repair scratched surfaces with touch up of like coating prior to installation. The unit discharge nozzle is to be lifted per handling recommandations provided above by specified mounting points at the top of the cone, separately from the other sections of the unit.



TCI Fan Assembly
Stand Alone Assembly

TCI Fan Assembly for
vPlume System Assembly

Bypass Air Plenum

The following is a list of recommendations for lifting the various assemblies of your vPlume™ fan system:

Discharge nozzle and stack extension may be pre-assembled and lifted as one assembly, or each component can be lifted separately. These lifting methods are recommended.

A. Lifting discharge nozzle: please use a sling in conjunction with lifting lug located at the base of the discharge nozzle.

B. Lifting stack extension: please use a sling in conjunction with lifting holes located in the flange at either end of the tube.

C. Stack extension/discharge nozzle assembly: please verify extender tube and discharge nozzle are tightened to the proper torque value. Using a sling in conjunction with available lifting lugs located at the base of the discharge nozzle, the discharge assembly may be safely lifted.

CAUTION

Fan body and plenum box should be lifted separately
Never attempt to lift a fan body while it remains affixed to the plenum box

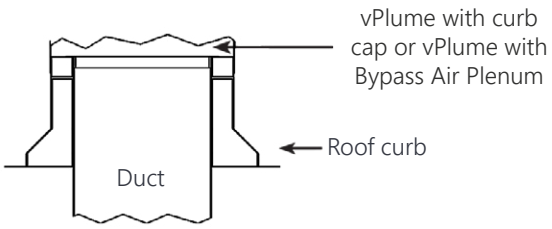
DUCT INSTALLATION FOR VPLUME

Bottom Inlet Duct Connection

If a customer supplied duct is to be installed on the unit, it is to be secured between the curb cap of the unit and the curb's top edge. If there is an isolation damper to be installed, it is to be installed between the duct and the unit.

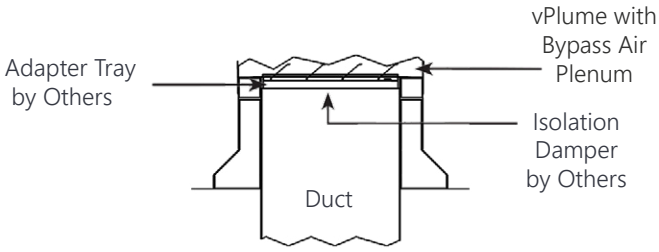
Option 1

- No isolation damper in roof curb
- Bottom inlet on vPlume



Option 2

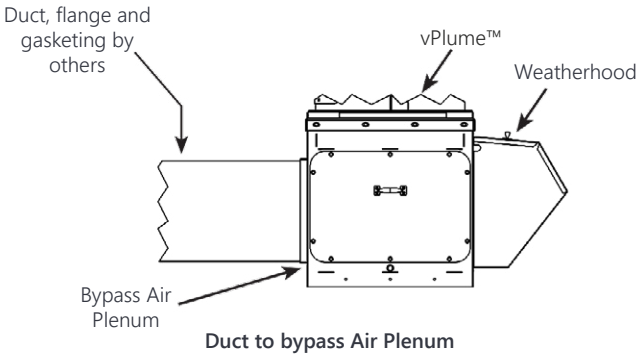
- With isolation damper in roof curb
- Bottom inlet on vPlume with Bypass Air Plenum



Duct connection to curb

Option 3

- No isolation damper in duct
- Side inlet on vPlume with Bypass Air Plenum



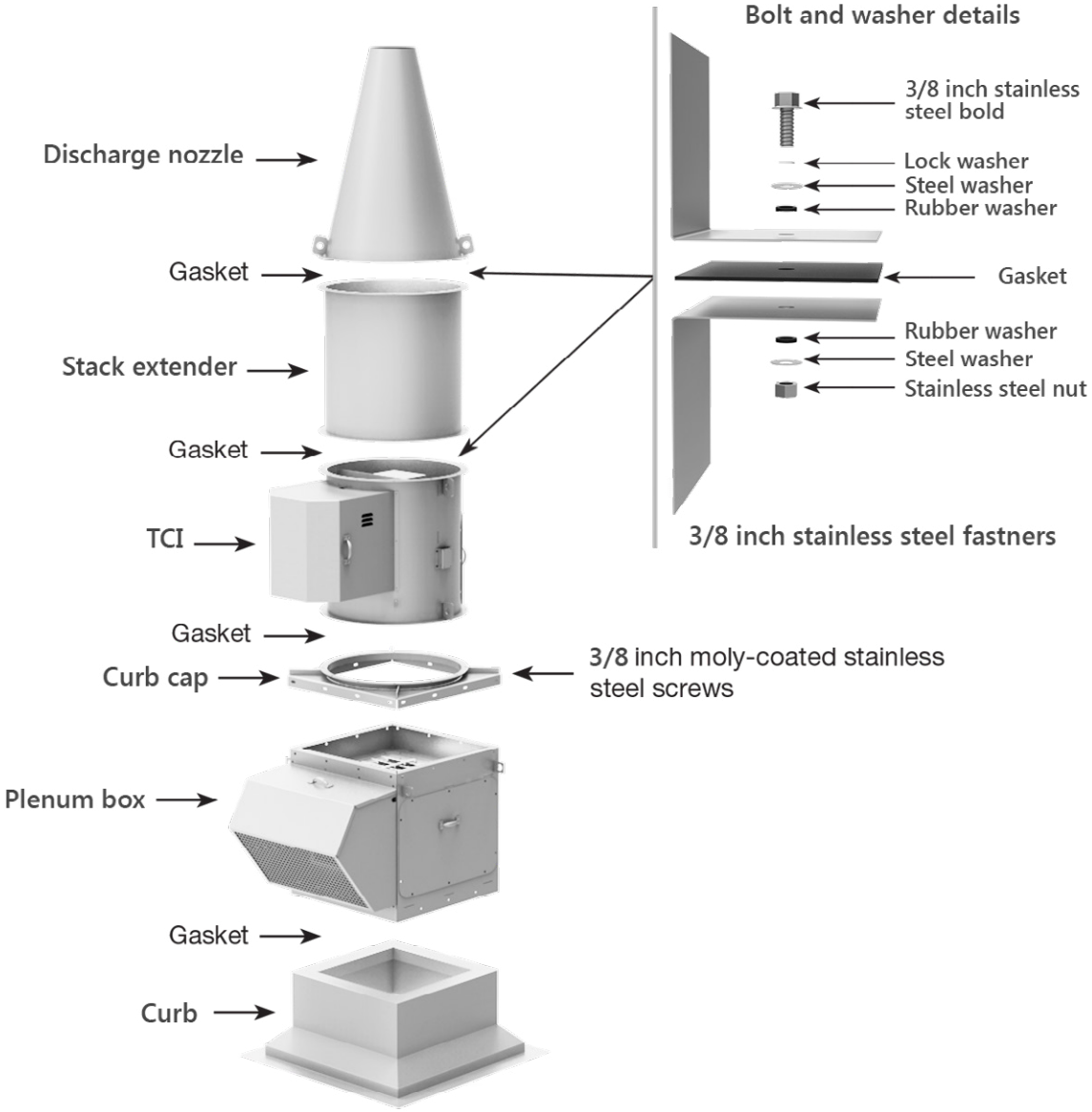
Duct to bypass Air Plenum

Notes:
Steel, concrete or wood roof support is per structural engineer and in accordance with load requirements and applicable building codes.

Stack Extensions

Units with multiple stack sections must be assembled on site after the unit but before the outlet cone.

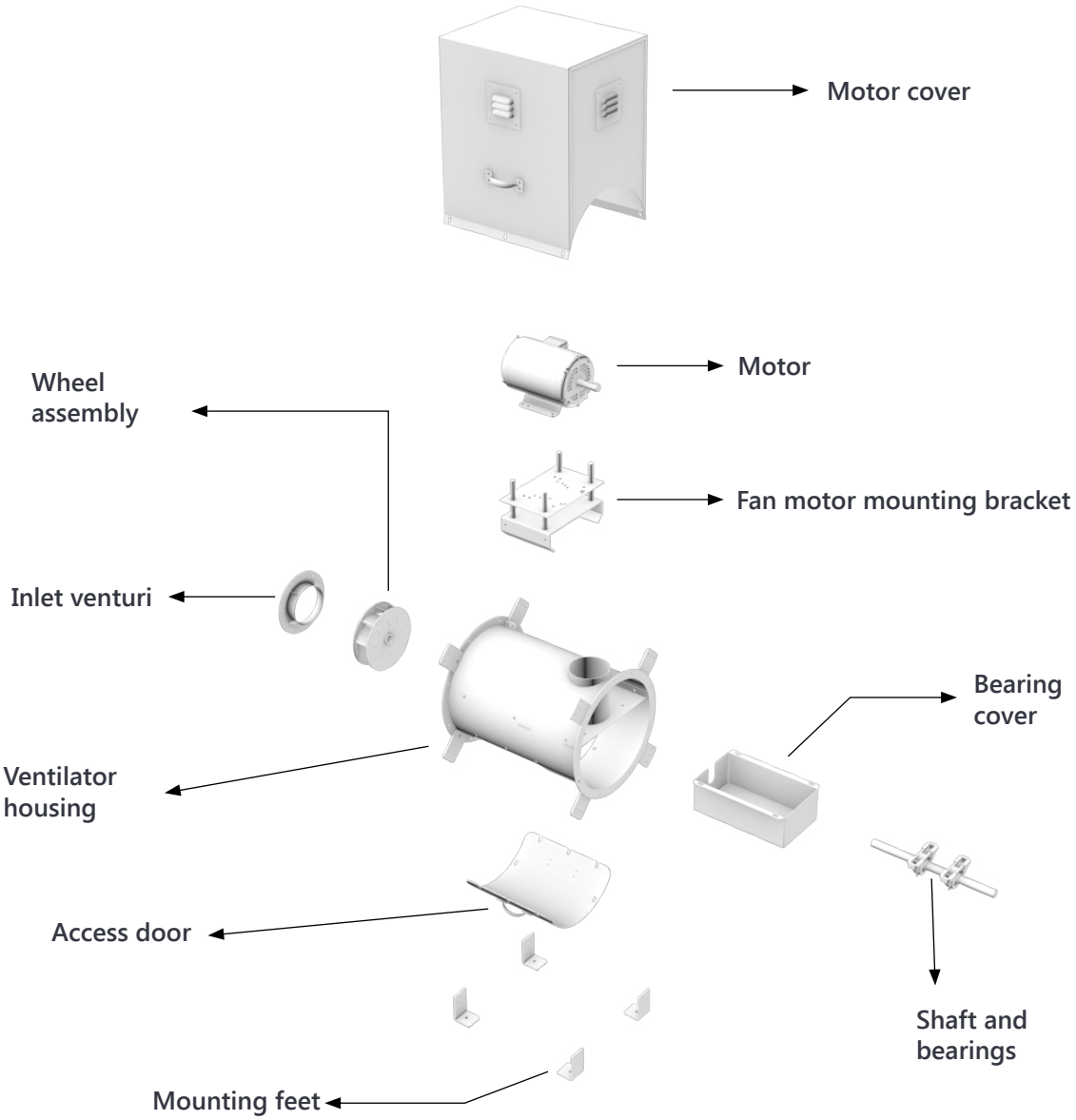
VPLUME SYSTEM ASSEMBLY



Sequence for fan system assembly

1. Mount the curb to the roof. Be sure to follow engineering specification in compliance with all applicable local, state, and federal codes.
2. If there is a bypass plenum to be installed, put it in place onto the roof curb and attach the plenum to the roof curb with hardware. If Bypass Air Plenum is not provided for the unit, skip to Step 4.
3. Install provided gasket onto the top of the bypass plenum, using the adhesive to adhere the gasket to the plenum.
4. Place the bottom of the unit onto the bypass plenum or roof curb gasket and secure the unit with mounting hardware.
5. Install stack extention if applicable with a discharge nozzle to the top of the unit, as shown in the diagrams, and secure with mounting hardware through the unit's mounting holes; be sure to include gasket.
6. Follow electrical connection and pre-start-up checks as listed on pages 11 to 13.

SYSTEM ASSEMBLY FOR STANDALONE TCI



Sequence of fan system assembly

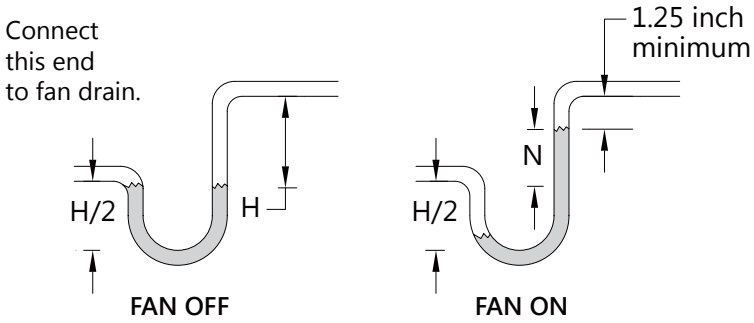
1. Adjust feet location on fan for desired mounting position as needed.
2. Adjust covers on motor covers to desired orientation. Louvers should be open in a downward position.
3. Follow electrical connection and pre-start-up checks.

VPLUME
DRAINAGE PIPE/TRAP DETAIL (BY OTHERS)

Drainage ports are provided on both the fan housing and plenum box to provide drainage for the system. It is recommended that these drains are piped to allow proper drainage of any condensation collected in the unit.

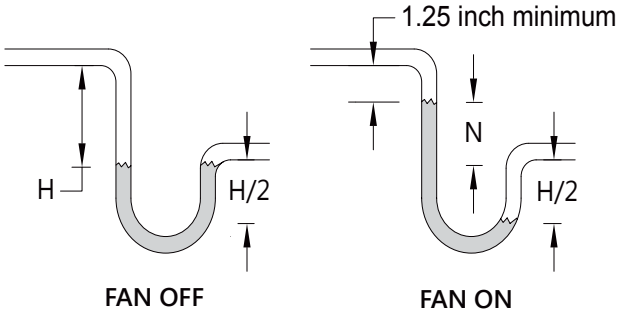
1. Drain connections are 0.5 inch NPT
2. Drain piping installed must have proper slope
3. P traps are to be filled to proper level prior to unit start up

Positive Pressure Trap on Tubular Fan Housing



N = Negative fan pressure (inches W.C.)
H = N - (0.5 inches minimum)

Negative Pressure Trap on Bypass Air Plenum



N = Negative fan pressure (inches W.C.)
H = N - (0.5 inches minimum

Rain Mitigation

Inline laboratory exhaust fans, such the vPlume, require mitigation of water below the fan if the fan is not running at all times. The vPlume has a rain diverter plate which will direct water towards the drain but water entry is possible during heavy rain events. In bottom intake installations rain mitigation must take place in the ductwork below the fan. A side intake mixing box is another solution, the side intake mixing box will not allow water into the ductwork.

Fan should be selected at nozzle velocities of 3000 fpm or higher to prevent rain from entering during operation.

ELECTRICAL CONNECTIONS

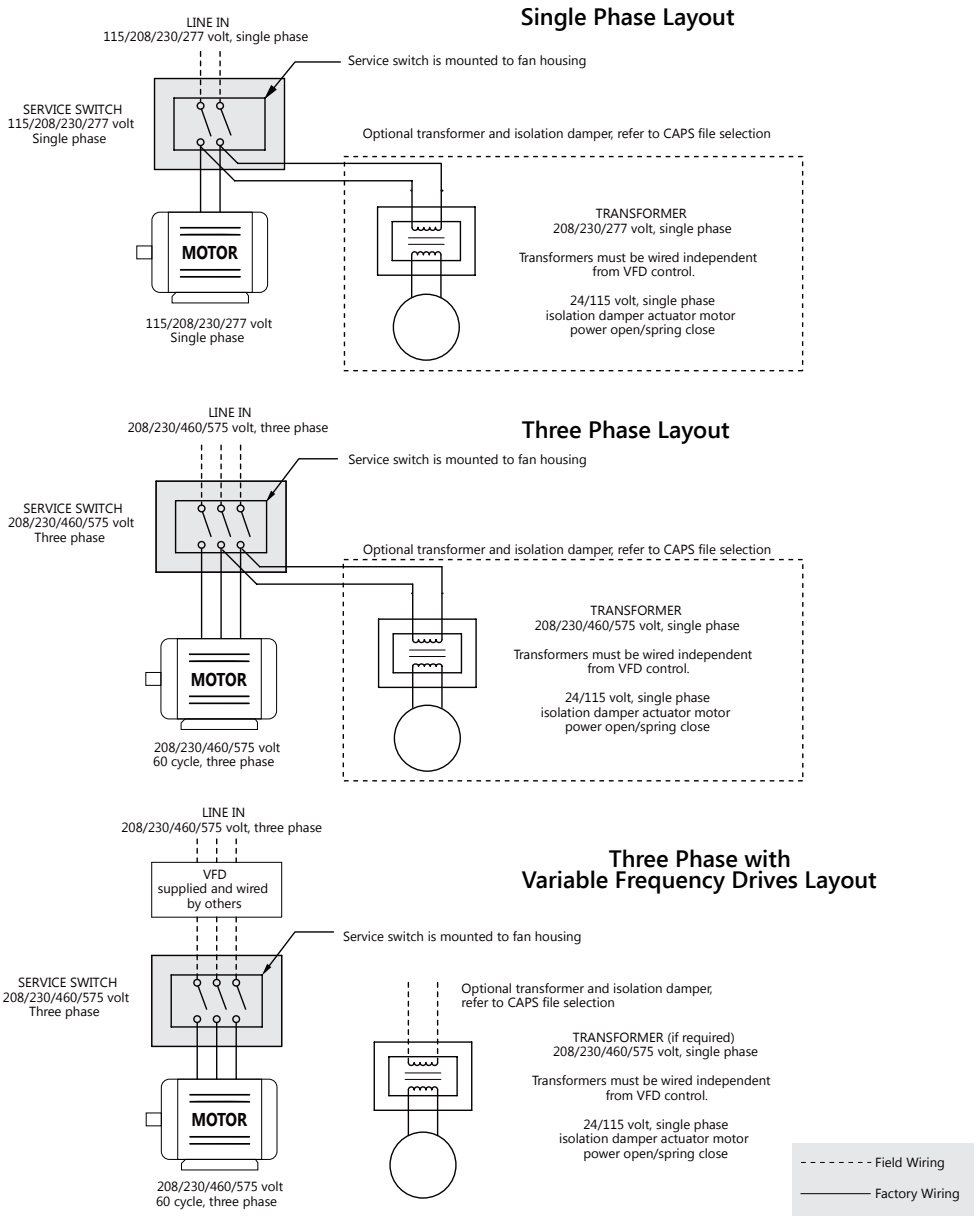
WARNING

Warning: follow state and local electrical codes

Ensure supplied electrical power is of the correct voltage, current and phase and that electrical connections are properly sized and suitable for the intended application. All connections to the unit must conform to local electrical codes and standards. If the unit has an installed service switch, be sure that it is wired correctly to the fan motor. Do not install electrical power to the unit unless the service switch is in the off position. If there is no connection, ensure that the breaker supplying voltage to the unit is in the off position.

vPlume™ Motor Disconnect and Isolation Damper Wiring Diagram

The service switch should always be mounted within visible sight of the unit, and if at all possible, it should be mounted on the unit itself.



APPLICATIONS WITH VARIABLE FREQUENCY DRIVE (VFD)

For systems with single-point, three-phase wiring per blower, the isolation damper actuator will be powered via a step-down transformer, which is wired to the fan service switch, as shown in the wiring diagrams on page 7.

If fan flow (motor speed) is to be controlled using a variable frequency drive with this wiring, the reduced voltage and frequency supplied to the fan will cause control problems with the isolation damper actuator.

When vPlume™ control sequence requires the use of a VFD, it is suggested that the control contractor supply the isolation damper actuator voltage, independent of the power supplied to the vPlume™ fan motor.

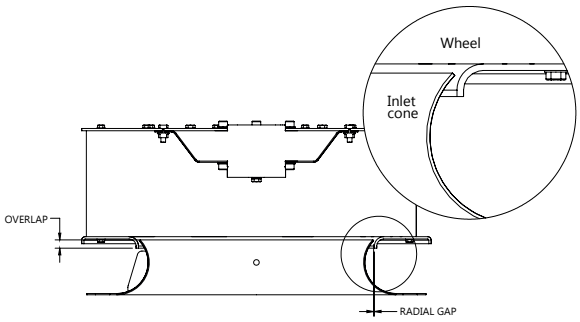
PRE-START-UP CHECKS

Ensure that all mounting hardware and fasteners are properly installed and tightened to recommended torque specifications.

Ensure that the wheel is aligned and has the correct spacing in relation to the inlet cone; it should be centered in the inlet cone as well. If adjustment is needed, loosen the inlet cone bolts and shift the inlet cone until the radial gap is the same at every point across the circumference of the inlet cone.

If adjustment of the overlap between the wheel and inlet cone is needed, loosen the set screw on the shaft and slide the wheel forwards or backwards until the correct overlap is achieved, then tighten the set screws back down.

There is a rotation sticker on the unit that specifies the direction the wheel should turn. Ensure that the wheel is rotating in the proper direction before powering on the unit. In 3 phase units, simply switch two incoming leads to reverse rotation.



Notes: Any increase in fan speed represents a substantial increase in horsepower required from the motor. Always check motor load amperage and compare to nameplate rating when changing fan speed.

Gap/ overlap dimensions			
Size	Minimum overlap (Inches)	Maximum overlap (Inches)	Minimum radial gap (Inches)
90	0.12	0.29	0.06
105	0.12	0.29	0.06
122	0.12	0.32	0.07
135	0.12	0.35	0.07
150	0.19	0.41	0.09
165	0.25	0.47	0.11
182	0.31	0.5	0.11
200	0.38	0.57	0.12

Gap/ overlap dimensions			
Size	Minimum overlap (Inches)	Maximum overlap (Inches)	Minimum radial gap (Inches)
222	0.44	0.63	0.14
245	0.50	0.69	0.17
270	0.56	0.76	0.20
300	0.62	0.88	0.24
330	0.75	0.96	0.26
365	0.81	1.13	0.27
402	0.88	1.23	0.31

PRE-START-UP CHECKS

When the unit is removed from storage, all grease should be purged and replenished with fresh grease. The following check list should be followed to ensure proper operation:

Operation Check List

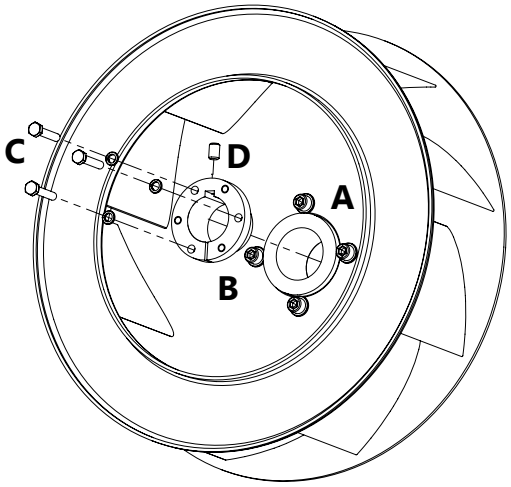
Check fan mechanism components:
- System connections are properly made and tightened.
- Impeller and fan surfaces are clean and free of debris.
- Impeller has been rotated by hand to verify it has not shifted in transit.

Check fan electrical components
- Motor is wired for proper supply voltage.
- Motor was properly sized for power
- Motor is properly grounded.
- All leads are properly insulated.

Trial "bump"
- Turn on power just long enough to start assembly rotating.
- Check rotation for agreement with rotation arrow.

Perform checklist again until unit is operating properly. Verify fastener tightness. These may have loosened during shipment or installation.
- Bushing set screw torque
- Bolts on inlet funnel.
- Motor bolt torque
- Nuts holding housing frame to base and base to
- ground (customer specifications)
- Bushing fastener torque

Ensure piezo tubing will not contact the impeller



A Hub
B Bushing
C Bushing screws
D Bushing set screw

C Bushing fastener torque		
Bushing type	Screw size	Recommended toque
JA	10-24	60 in-lbs.
SD/SDS	1/4-20	108 in-lbs.
SK	5/16-18	180 in-lbs.
SF	3/8-16	360 in-lbs.
D Bushing set screw torque		
Bushing type	Screw size	Recommended toque
SD/SDS	1/4-20	60 in-lbs.
SK	5/16-18	110 in-lbs.
SF	3/8-16	200 in-lbs.

MAINTENANCE

The benefits of regular inspections and routine maintenance are well documented; regular service intervals keep the system operating at peak efficiencies, extend operational life and ensure safe product operation.

Notes:
In this section, routine service internals are recommended.
Scheduled maintenance must be performed on the unit after it is in operation to ensure that it runs efficiently and reliably

CAUTION

Ensure that all incoming power to the unit is switched off before attempting to service the unit. If this measure is not taken, serious injury can occur to the servicer

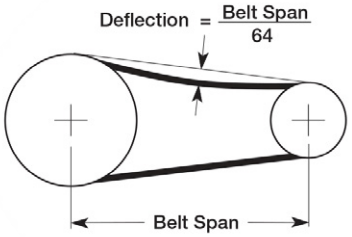
BELTS

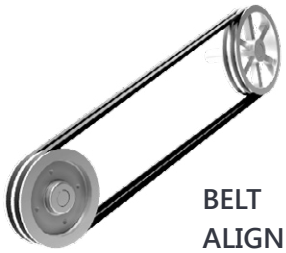
Improper belt tensioning is the most common cause of early belt failures. As such, it is imperative to tension a belt down to the correct tension, which is the lowest tension at which the belt does not slip at peak running speed.

As a general rule, the belt should not deflect any more than 1/64 inch for every inch of belt span.

It is advised to check the belt tension at least twice within 24 hours of installation and regularly with scheduled maintenance thereafter. Adjust belt tension by loosening the bolts on the motor plate to relieve the tension. Tighten belt tension by tightening down the bolts on the motor plate.

Drive pulleys must be properly aligned, or belt slippage can occur. If pulleys are not aligned, the unit will not run efficiently, and noise or premature failure can occur.





BELT ALIGNMENT

FASTENERS AND SET SCREWS

All hardware, screws and fasteners should be checked for torque at every scheduled maintenance

MOTORS

Most fractional horsepower motors provided with the unit do not require greasing or lubrication after they are installed. If motors have grease fittings, then they should be re-lubricated according to motor manufacturer specifications.

REMOVAL OF DUST AND DIRT

The impeller and interior surfaces of the unit should be inspected and cleaned, if necessary, on a regular basis in accordance with the maintenance schedule. Dirt and dust accumulation can throw the wheel off balance and cause other early failures in the unit. Do not get water in bearings or motors when attempting to clean the unit.

FAN SHAFT BEARINGS

Bearings selected for Pennbarry fans are specially paired with the unit to achieve the maximum attainable efficiency and performance of the fan. As such, they are one of the most crucial parts of the fan and must be maintained and mounted accordingly.

MAINTENANCE

Ensure bearing set screws and collars are torqued to the correct specifications upon installation and every scheduled maintenance thereafter. Never mix lubricants or greases while re-greasing bearings; check bearing specifications for the correct grease recommended by the manufacturer.

- Lubrication intervals depend on many factors such as temperature, moisture, or dirt. Consult a local PennBarry representative for lubrication recommendations.
- Lubricant should be selected based on the bearing manufacturer specifications.
- If the unit is stored for longer than 3 months at a time, rotation of the shaft is recommended to free up grease in the bearing

Recommended Bearing Lubrication Schedule Relubrication Schedule in Months*				
Fan Size	**9-13**	**16-22**	**24**	**30-36**
Fan RPM	Bearing Bore (inches)			
	1/2 - 1	1 1/8 - 1 1/2	1 5/8 - 1 7/8	1 15/16 - 2 3/16
to 250	12	12	12	12
500	12	12	12	12
750	12	12	12	12
1000	12	12	12	12
1250	12	12	12	12
1500	12	12	12	10
2000	12	10	8	6
2500	12	7	5	4
3000	12	5	3	2
3500	12	3	2	0.75
4000	12	2	0.5	
5000	12	1		
Number of shots grease**	4	8	8	10

* Lubrication interval is based on 12 hour per day operation and maximum 160°F. housing temperature. For 24 hour per day operation, the interval should be cut in half.

** Lubricant should be added with the shaft rotating and until clean grease is seen purging from the bearing. The lubrication interval may be modified based on the condition of the purged grease. If bearing is not visible to observe purged grease, lubricate with number of shots indicated for bore size.

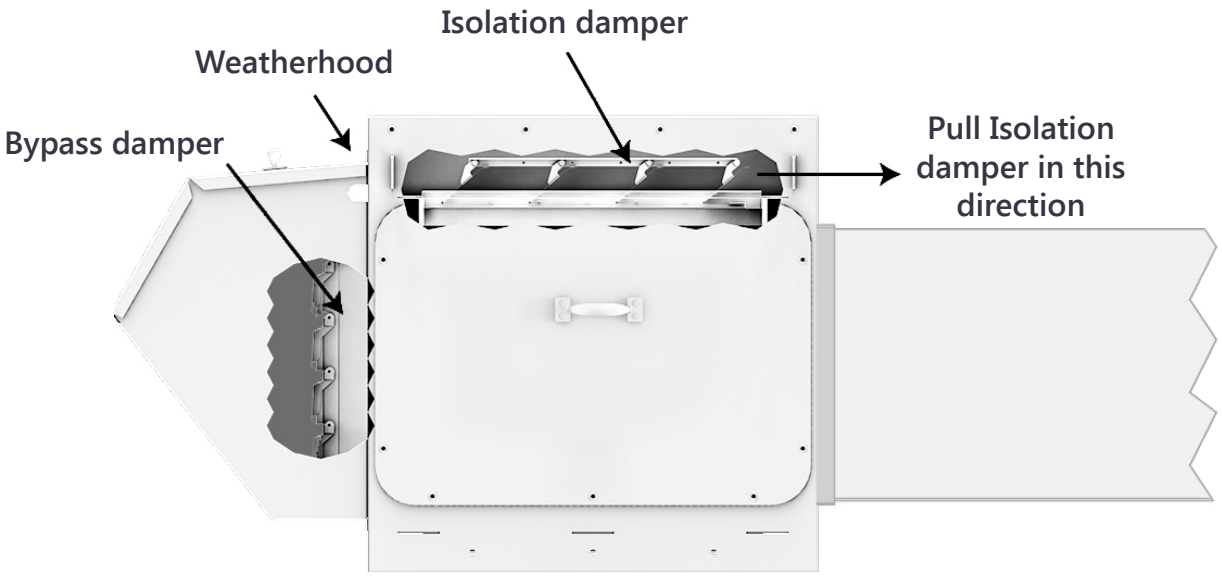
DAMPER AND DAMPER ACTUATORS

Notes: Disconnect power to damper before attempting any maintenance.

If access is required to a gravity isolation damper, remove the panel opposite the weatherhood on the bypass air plenum section and slide the damper straight out toward you.

When performing maintenance on an isolation damper with an actuator, remove the bolted weatherhood and disconnect the actuator from damper. Then, remove the panel opposite the weatherhood on the bypass air plenum section and slide the isolation damper out.

Damper actuators, when supplied by PennBarry, are designed to be maintenance free. No lubrication is required.



ACCESSORY

PennBarry now offers an airflow measuring system on vPlume™ fans. The airflow through the cone produces a pressure that can be measured from its surface. The difference in the cone surface pressure and the fan inlet pressure results in a value that correlates to the volumetric airflow rate the fan is moving. A differential pressure transducer with a digital display is connected to each of these locations to provide a real time read out of fan performance accurate to +/- 5%.

To complete the installation of the transducer, follow the installation instructions located at http://hkinstruments.fi/products/air-flow-velocity-transmitters/dpt-flow/.
The configuration should use the "common probe" selection, and flow output can be measured using the following equation:

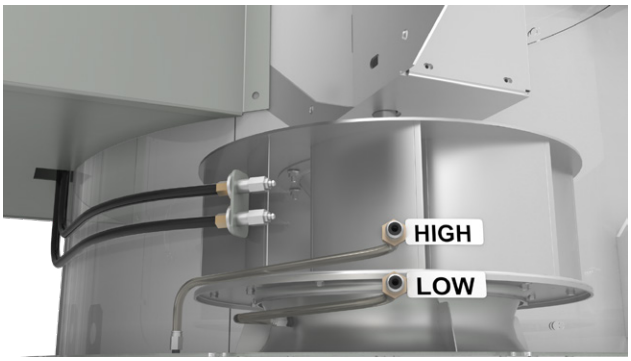
$Q = K * \sqrt{(Dp)}$
Q = Volumetric flow rate (CFM)
Dp = Differential Pressure (inWC)
K = Fan constant, as noted below:

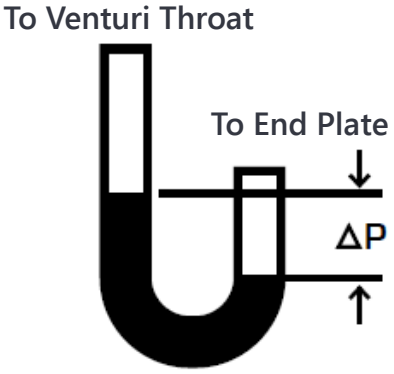
vPlume™ Unit Size	K
090	441
105	443
122	679
135	847
150	997
165	1314
182	1579
200	1783
222	2207
245	2676
270	3249
300	4012
330	4855
365	5938
402	7222

MEASUREMENT OF AIRFLOW

Several factors affect the accuracy of this method of determining flow. The equations below assume the following:

- There are no vanes or other obstructions in or near the inlet
- Impeller to inlet funnel overlap
- Flow entering the funnel (no pre-swirl)
- Accurate determination of air density at the inlet

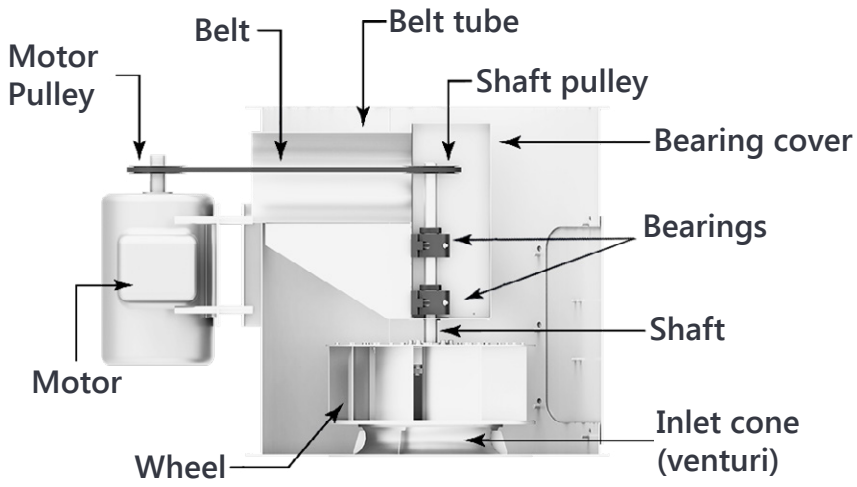




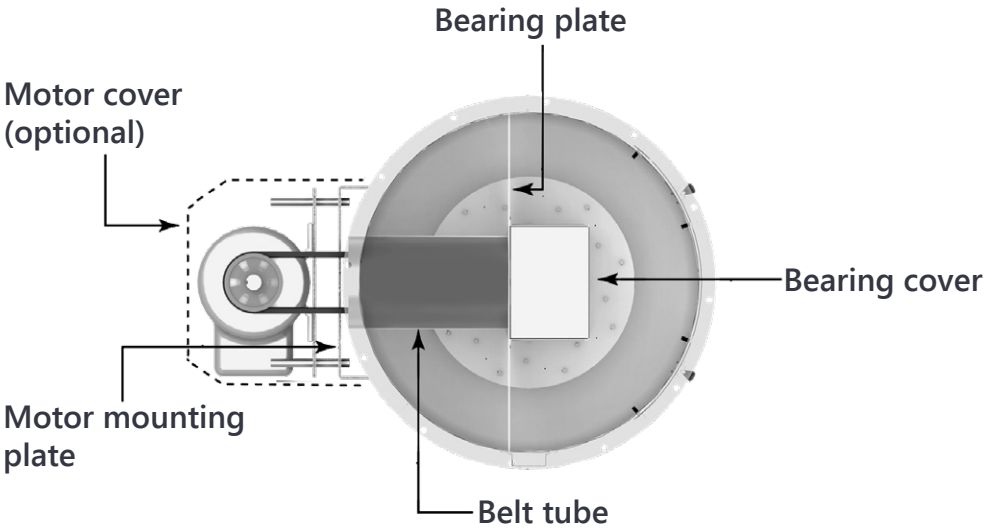
TCI EXHAUST FAN PARTS LIST AND ASSEMBLY

There is a nameplate located on each unit that contains a model number and serial number; always have this information ready when contacting a PennBarry representative as it will expedite your request.

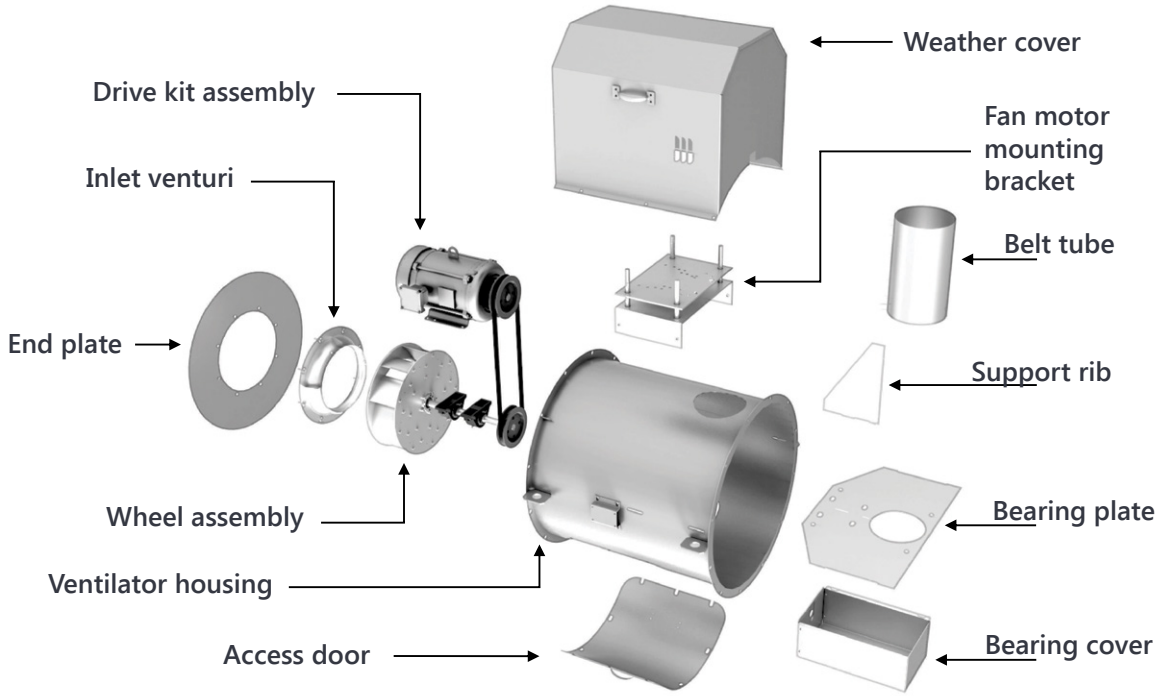
SIDE VIEW



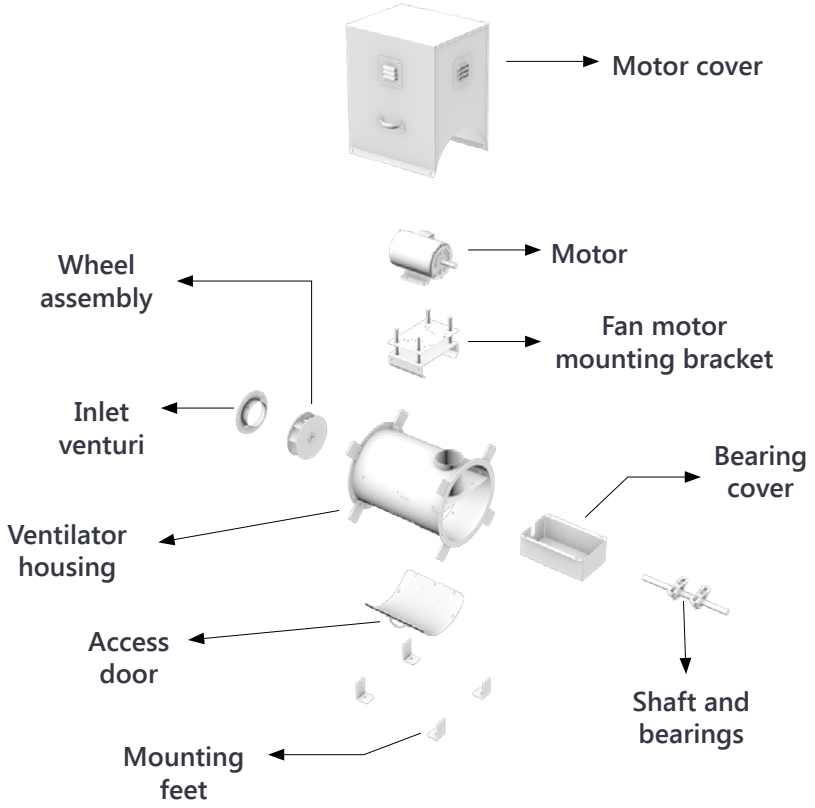
TOP VIEW



EXPLODED VIEW OF TCI FAN FOR VPLUME ASSEMBLY



EXPLODED VIEW OF STAND ALONE TCI



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