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AUTO-DRAFT® VSUB-SERIES VSUB BLOWERS

For providing combustion air; sidewall or vertically venting heating appliances, dryers and ovens. Can be installed indoors or outdoors.

MODELS

VSUB8

VSUB12

VSUB16

VSUB20



Listings:

ETL CERTIFIED TO:

UL 378 - Draft Equipment / Variable Speed

UL 705 - Power Ventilators

CSA-CAN3-B255-M81

▲ RECOGNIZE THIS SYMBOL AS AN INDICATION OF IMPORTANT SAFETY INFORMATION!

▲ WARNING

THESE INSTRUCTIONS ARE INTENDED AS AN AID TO QUALIFIED, LICENSED SERVICE PERSONNEL FOR PROPER INSTALLATION, ADJUSTMENT AND OPERATION OF THIS UNIT. READ THESE INSTRUCTIONS THOROUGHLY BEFORE ATTEMPTING INSTALLATION OR OPERATION. FAILURE TO FOLLOW THESE INSTRUCTIONS MAY RESULT IN IMPROPER INSTALLATION, ADJUSTMENT, SERVICE OR MAINTENANCE POSSIBLY RESULTING IN FIRE, ELECTRICAL SHOCK, CARBON MONOXIDE POISONING, EXPLOSION, PERSONAL INJURY OR PROPERTY DAMAGE.

DO NOT DESTROY. PLEASE READ CAREFULLY AND KEEP IN A SAFE PLACE ON JOB SITE FOR FUTURE REFERENCE.

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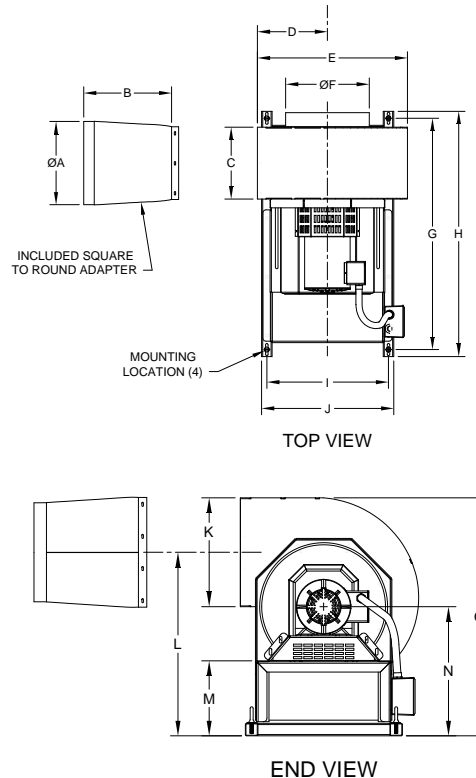
Tjernlund Products welcomes your comments and questions. Call us at 800-255-4208, Fax 651-426-9547, Email us at fanmail@tjfans.com or write to: Customer Service, Tjernlund Products, Inc., 1601 Ninth Street, White Bear Lake, MN 55110-6794.

VSUB-SERIES UNIVERSAL BLOWER DESCRIPTION

The VSUB-Series Universal Blowers are a multi-purpose adjustable-fixed speed or automatic-variable speed blower. It can vent natural gas, LP-gas and oil fired heating appliances, clothes dryers or be used as a utility blower that will handle up to 575° F. It can also be used as a adjustable-fixed speed or as an automatic-variable speed combustion air intake blower. All models are supplied with the model PSA-1 Fan Proving Switch which will disable the burner(s) if an exhaust/supply malfunction should occur, and a FFP-1 fire /freeze limit that will shut the VSUB Blower off in the event of extreme temperature swings for combustion air applications. The VSUB Blower is rated for indoor or outdoor installation. Use positive pressure rated vent on the discharge side of the blower when venting flue gases and mounting indoors. Refer to heating appliance manufacturer's instructions regarding specific venting requirements.

DIMENSIONS AND SPECIFICATIONS

MODEL		VSUB8	VSUB12	VSUB16	VSUB20	
Voltage	VAC	3x230/460	3x230/460	3x230/460	3x230/460	
Max RPM with VFD		2875	2125	2115	1760	
Full Speed	@ 208 V	1.6	3.2	6.0	8.8	
Amps *	@ 230 V	1.5	3.0	5.6	8.2	
	@ 460 V	0.8	1.5	2.8	4.1	
Power Rating	hp	1/3	1	2	3	
Weight	lbs	66	153	218	319	
Dimensions	A	in	7 7/8	11 7/8	15 7/8	19 7/8
	B	in	10	12 1/2	14	14
	C	in	5 1/4	9 5/8	12	14 1/2
	D	in	7 5/8	10	13 1/4	14
	E	in	16 1/2	21 1/2	27 3/4	32 3/4
	F	in	7 7/8	11 7/8	15 7/8	19 3/4
	G	in	28 1/2	33	42 3/8	44 3/4
	H	in	30 1/2	35	44 3/8	46 3/4
	I	in	14 1/2	17 3/8	23 1/4	26 1/2
	J	in	15 1/2	18 7/8	24 3/4	28
	K	in	10 1/4	13	16	23 1/4
	L	in	18 1/2	22	26 3/4	25 1/2
	M	in	8	9	15 3/8	19
	N	in	13 3/8	15 1/2	18 7/8	23 1/2
	O	in	23 1/2	28 1/2	34 3/4	43 3/4
Variable Speed Motor		Yes with VFD	Yes with VFD	Yes with VFD	Yes with VFD	



COMPLETE VSUB-SERIES UNIVERSAL BLOWER SYSTEM SOLUTIONS

This installation manual does not contain any vent system design documentation. Installation and use of Tjernlund controls like the CPC-2 Constant Pressure Controller, VFD Series Variable Frequency Drives, EXP-4 Appliance Interlock Expansion boards, UC-1 Universal Control or MAC1E and MAC4E Multiple Appliance Controls are not covered by this manual. Please refer to those installation manuals for details.

VSUB-SERIES FAN PERFORMANCE CURVES

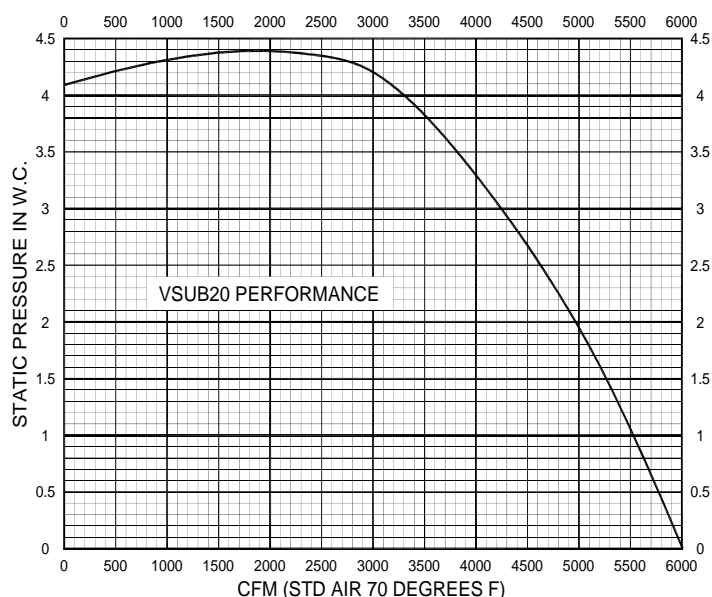
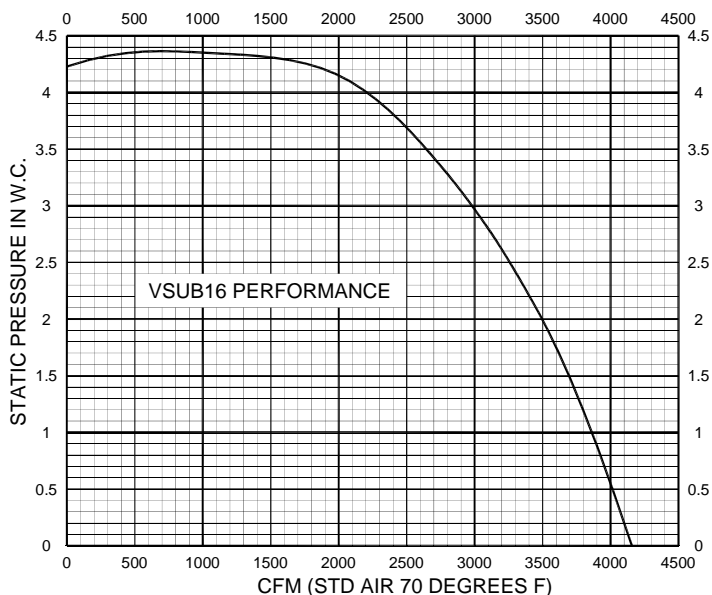
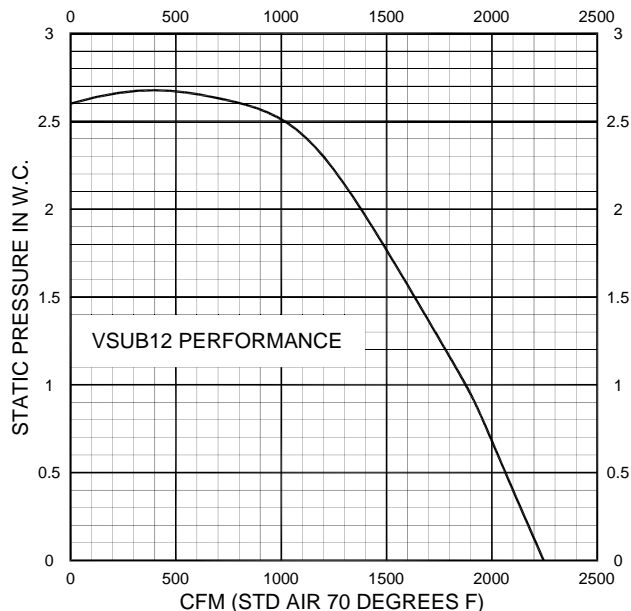
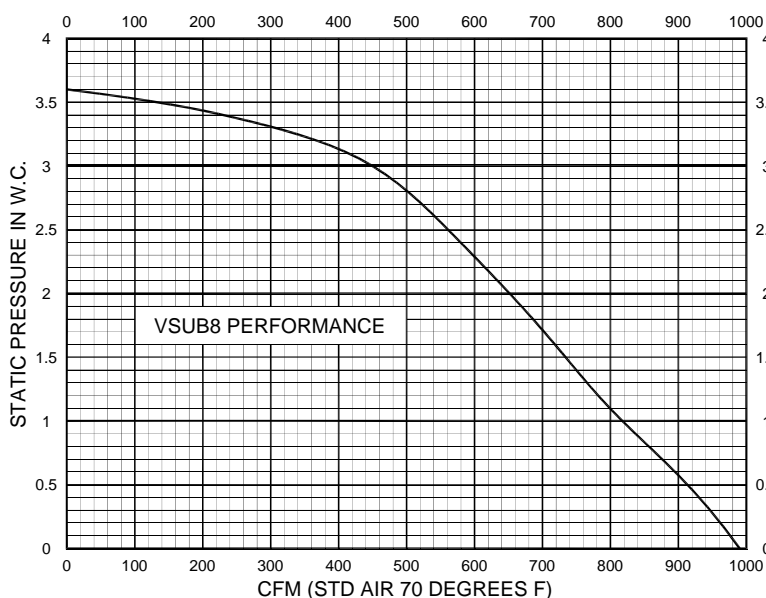
VSUB Blower performance was independently tested by an accredited AMCA certified testing facility.

Selection of a VSUB Blower as a Draft Inducer involves determination of the maximum volume of gas to be handled, the density of the gas and the maximum static pressure which the fan must overcome. Using the VSUB Blower as a combustion air intake or commercial clothes dryer vent blower, involves the determination of the maximum volume of air to be handled and the maximum static pressure which the fan must overcome.

Variable speed VSUB Blowers can operate at virtually any point to the left of the performance curve. For sidewall termination applications add 0.60" W.C. to vent system resistance to accommodate the effects of wind loading.

Consideration must be given to the temperature of the gases being handled and the elevation above sea level of the installation when selecting a VSUB Blower. Blower performance curves are based on standard air conditions @ sea level.

Please feel free to contact us for application and model selection assistance by calling 800-255-4208 or email us at fanmail@tjfans.com. Vent layout or other information can be faxed to 651-426-9547.



INSTALLATION RESTRICTIONS

WARNING

Failure to install, maintain and/or operate the VSUB Blower in accordance with manufacturer's instructions may result in conditions which can produce bodily injury and property damage.

WARNING

The VSUB Blower must be installed by a qualified installer in accordance with these instructions and all local codes or in their absence in accordance with the latest edition of The National Fuel Gas Code (NFPA 54), NFPA 211 or 31 when applicable, the latest edition of the National Electrical Code (NFPA 70) and the Occupational Safety and Health Act (OSHA) when applicable. In the absence of local codes in Canada, installations must comply with the Canadian Electrical Code (CSA Std 22.1), the latest edition of the Natural Gas Installation Code (CAN/CGA-B149.1), the Propane Installation Code (CAN/CGA-B149.2) and the Installation Code for Oil Burning Equipment (CSA Std B139-M91).

Improper installation can create a hazardous condition such as an explosion, fire, electrical shock or carbon monoxide poisoning resulting in property damage, personal injury or death.

1. The VSUB Blower is intended to be installed on natural gas, LP-gas or oil-fired heating appliance systems. The VSUB Blower is not Listed for use on condensing equipment in Canada.
2. The VSUB Blower was tested with exit flue gas temperatures of 575°F (300°C).
3. The VSUB Blower may not be installed on incinerators, incinerating toilets or solid-fuel burning appliances.
4. The VSUB Blower shall not be installed on an appliance with an automatic valve having a manual opener unless the manual opener has been rendered inoperative or the automatic valve has been replaced with a valve not equipped with a manual opener.
5. VSUB Blowers not utilizing the Tjernlund CPC-2 Constant Pressure Control may only be installed on appliances equipped with a draft hood, draft diverter or barometric draft control.
6. Tjernlund's Model FFP-1, Fire and Freeze Protection Limit must be installed when using the VSUB as a combustion air intake to protect the boiler room from temperature extremes. Do not install FFP-1 when VSUB is used as a draft inducer. It is designed to disrupt power to a combustion air supply blower in the event of a boiler room fire or an extended period where frigid outdoor air supply could cause pipes to freeze.

WARNING

Never operate a mechanical draft or combustion air system without a proving device that proves the flow of flue gasses or combustion air and is interlocked with all of the heating appliances. If installing a VSUB Blower in conjunction with a CPC-2 controller, the CPC-2 provides the safety interlock. If installing a VSUB Blower without a CPC-2 controller the PSA-1 fan proving switch must be installed in conjunction with a UC1 Universal interlock control and any additional MAC-Series multiple appliance controls necessary to interlock all heaters being vented.

INSTALLER CAUTIONS

WARNING

Disconnect the power supply when making wiring connections or when working around the fan impeller and motor. Failure to do so can result in electrical shock, personal injury, death or property damage.

1. The VSUB Blower must be interlocked with the heating appliance burner(s).
2. Plan the vent system so that the code required clearances are maintained from plumbing, wiring and combustibles.
3. Make certain the power supply is adequate for VSUB Blower motor and VFD requirements. Do not add the VSUB Blower to a circuit where the total load is unknown.
4. The installer must verify that the appliance on which the VSUB Blower will be installed is in a safe operating condition. Consult appliance manufacturer's Instructions for details.
5. VSUB Blower housing is single wall. Standard clearances to combustibles must be maintained when venting flue products.
6. VSUB Blowers must use the appropriate Tjernlund VFD model.

REQUIREMENTS WHEN USING THE VSUB BLOWER FOR COMBUSTION AIR INTAKE

WARNING

Unless properly screened or guarded to prohibit contact with the blower wheel, a minimum of 3' of pipe must be connected to the inlet/discharge of the VSUB Blower.

Use the FFP-1, Fire and Freeze Protection Limit that was provided in the VSUB Blower. Place this limit in the physical location as defined in the limit installation instructions and wire into the control circuit as recommended for your type of installation. This limit is designed to shut off the combustion air supply if excessive heat or extremely cold air is present in the mechanical room. Do not mount the limit next to hot or cold surfaces or in the flow of the blower discharge.

1. Make sure the VSUB specified is large enough to supply the combustion air for all heating appliances in the mechanical room. Tjernlund Products, Inc. is not responsible for vent layout, appliance type, size or design changes to the air supply system. The Mechanical room must be sealed to keep the supplied air from being bypassed to other parts of the building or outdoors. We recommend that the blower be oversized by 25% to accommodate any unforeseen leakage.

2. If possible, discharge the air at or towards ceiling levels to mix the supply air with the warmer stratified mechanical room air. Consideration should be given to the use of ducts and diffusers to evenly distribute the air throughout the mechanical room. **NOTE:** Do not discharge air directly across water lines, temperature control devices, or draft hoods/draft controls. If correctly installed no additional air heating means will be required beyond what heating means would be required for conventional air supply louvers.
3. Give careful consideration to the air inlet opening as it enters the building to connect to the supply duct system. Too high of a capture velocity can entrain rain or snow into the mechanical room. We recommend a capture velocity no greater than 800 feet per minute for rain and 650 feet per minute for snow. Capture velocity is calculated by dividing the maximum Cubic Feet per Minute (CFM) of air by the Square Feet of area it is pulled through. 1000 CFM through a 1' x 2' opening, would have a capture velocity of 500' per minute. **Note:** Inlet screens and louvers are typically not fully open and have an open area percentage. Make sure to add area to the air opening to compensate for the reduction caused by the screen and/or louver blade.
4. The inlet shape has a bearing on the entrainment and capture velocity of the incoming air. In general, long tapered openings are preferred to short flat openings. Inlet screening will help spread the velocity more evenly across the air inlet opening.
5. If possible, use gravity to your advantage, rain and snow are harder to pull up than they are to pull sideways. Do not design an inlet opening that points upwards.
6. Refer to the Industrial Ventilation Manual produced by the American Conference of Governmental Industrial Hygienist or the ASHRAE Fundamentals handbook for more in depth information.

REQUIREMENTS WHEN USING THE VSUB BLOWER FOR MECHANICAL DRAFT

1. Make sure the VSUB Blower specified is large enough to remove the exhaust gasses for all the heating appliances connected to it. Tjernlund Products, Inc. is not responsible for vent layout, appliance type or design changes to the heating system.
2. **For Vertical discharges:** The VSUB Blower housing can be rotated to facilitate a vertical discharge. Make sure the clearance to combustible surfaces inside and outside the building are followed as discussed in your state and local codes or in their absence, the National fuel gas code NFPA 211 and NFPA 54 or 31. Canadian installations must comply with local codes or in their absence, the latest edition of the Natural Gas Installation Code (CAN/CGA-B149.1), the Propane Installation Code (CAN/CGA-B149.2) and the Installation Code for Oil Burning Equipment (CSA Std B139-M91). The VSUB Blower is designed for variable speed applications and the discharge velocity from the outlet of the blower or vent system can be similar to a conventional chimney.

For Horizontal discharges: The VSUB Blower can be rotated if necessary to facilitate a horizontal discharge. Make sure the clearance to combustible surfaces inside and outside the building are followed as discussed in your state and local codes or in their absence, the National fuel gas code NFPA 211 and NFPA 54 or 31. Canadian installations must comply with local codes or in their absence, the latest edition of the Natural Gas Installation Code (CAN/CGA-B149.1), the Propane Installation Code (CAN/CGA-B149.2) and the Installation Code for Oil Burning Equipment (CSA Std B139-M91). In addition, we strongly recommend that an exhaust termination be developed that has an outlet opening at least 1.5 times the area of the outlet area of the VSUB being used. If the discharge opening is screened, verify that the screen does not reduce the open area to less than that of the connected vent pipe. The termination should not direct the flue gasses down the building exterior and should not face directly into wind. The VSUB is rated to handle 575°F flue gases. Consider the application temperature when developing the termination.

WARNING

Never operate a mechanical draft or combustion air system without a proving device that proves the flow of flue gasses and is interlocked with all of the heating appliances. If installing a VSUB Blower in conjunction with a CPC-2 controller, the CPC-2 provides the safety interlock. If installing a VSUB Blower without a CPC-2 controller the PSA-1 fan proving switch must be installed in conjunction with a UC1 Universal Control and any additional MAC-Series multiple appliance controls necessary to interlock all heaters being vented.

MECHANICAL DRAFT TERMINATION CLEARANCES FOR CANADIAN INSTALLATIONS

In the absence of local codes in Canada, installations must comply with the latest edition of the Natural Gas Installation Code (CAN/CGA-B149.1), the Propane Installation Code (CAN/CGA-B149.2), the Installation Code for Oil Burning Equipment (CSA Std B139-M91) or as follows, (See Diagram A).

- A venting system shall not terminate underneath a veranda, porch, or deck, or above a paved sidewalk or a paved driveway that is located between two buildings, and that serves both buildings.
- The exit terminals of mechanical draft systems shall not be less than 2.13m (7ft) above grade when located adjacent to a paved sidewalk or driveway.
- A venting system shall not direct flue gases towards brickwork, siding, or other construction, in such a manner that may cause damage from heat or condensate from the flue gases.
- A venting system shall not direct flue gases so as to jeopardize people, overheat combustible structures, or enter buildings.

A venting system shall not terminate within 1.8 m (6ft) of the following:

- A window, door or mechanical air supply inlet of any building, including soffit openings
- A gas service regulator vent outlet
- A combustion air inlet
- A property line
- A direction facing combustible materials or openings of surrounding buildings

A venting system shall not terminate within 1m (3ft) of the following:

- Above a gas meter/regulator assembly within 1m (3ft) horizontally of the vertical centreline of the regulator
- A oil tank or an oil tankfill inlet

A venting system shall not terminate within .3m (1ft) of the following:

- Above grade level or any surface that may support snow, ice, or debris

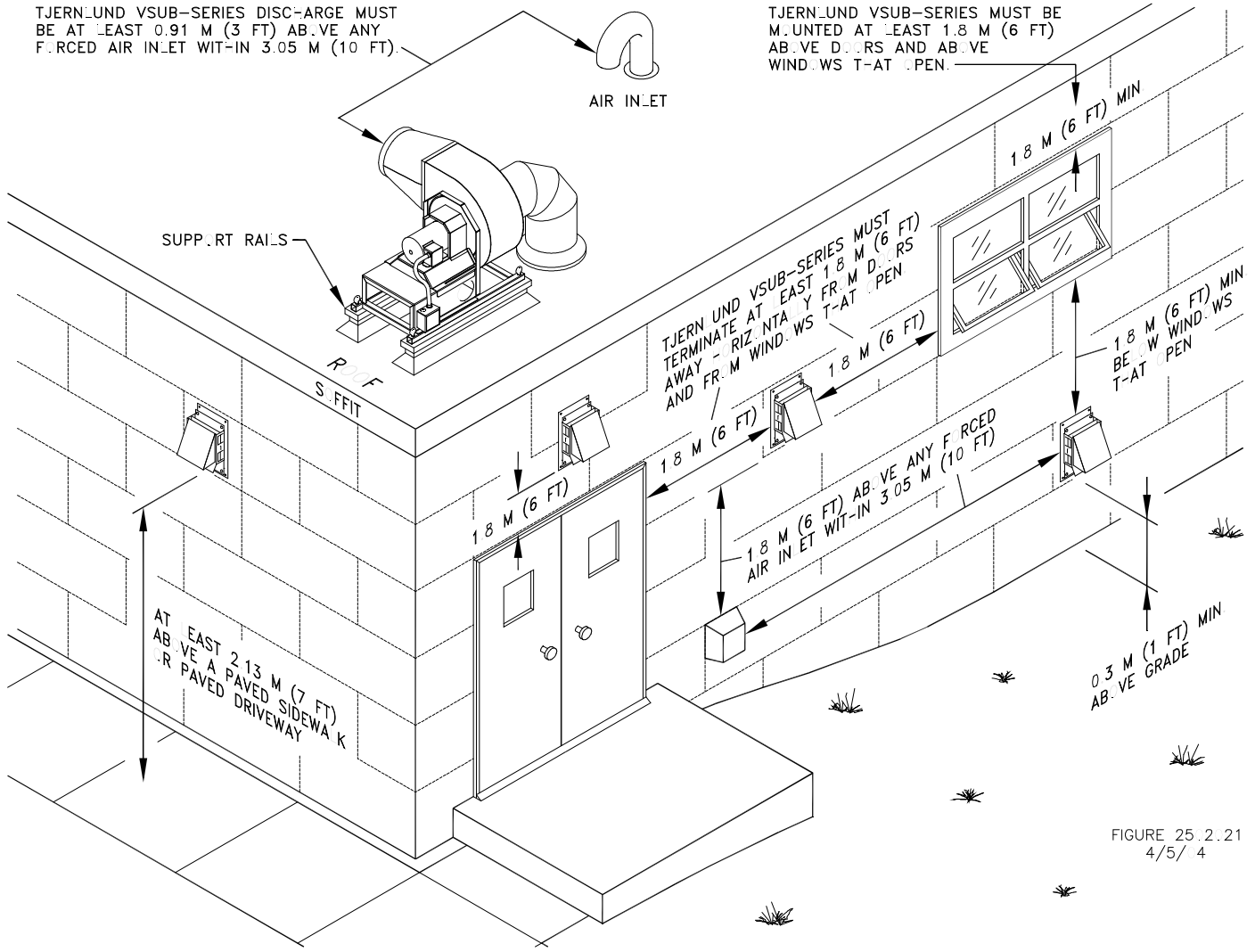


FIGURE 25.2.21
4/5/ 4

MECHANICAL DRAFT TERMINATION CLEARANCES FOR U.S. INSTALLATIONS

CODE REQUIREMENTS

Terminate the VSUB Blower so that proper minimum clearances are maintained as cited in the latest edition of the National Fuel Gas Code (NFPA 54), NFPA 211 or 31 when applicable, (See Diagram B):

- Not be less than 7 feet above grade when located adjacent to public walk ways.
- At least 3 feet above any forced air inlet located within 10 feet.
- At least 4 feet below, 4 feet horizontally from or 1 foot above any door, window or gravity air inlet into any building.
- At least 1 foot above grade.
- So that the flue gases are not directed so as to jeopardize people, overheat combustible structures or enter buildings, and
- Not less than 2 feet from an adjacent building.

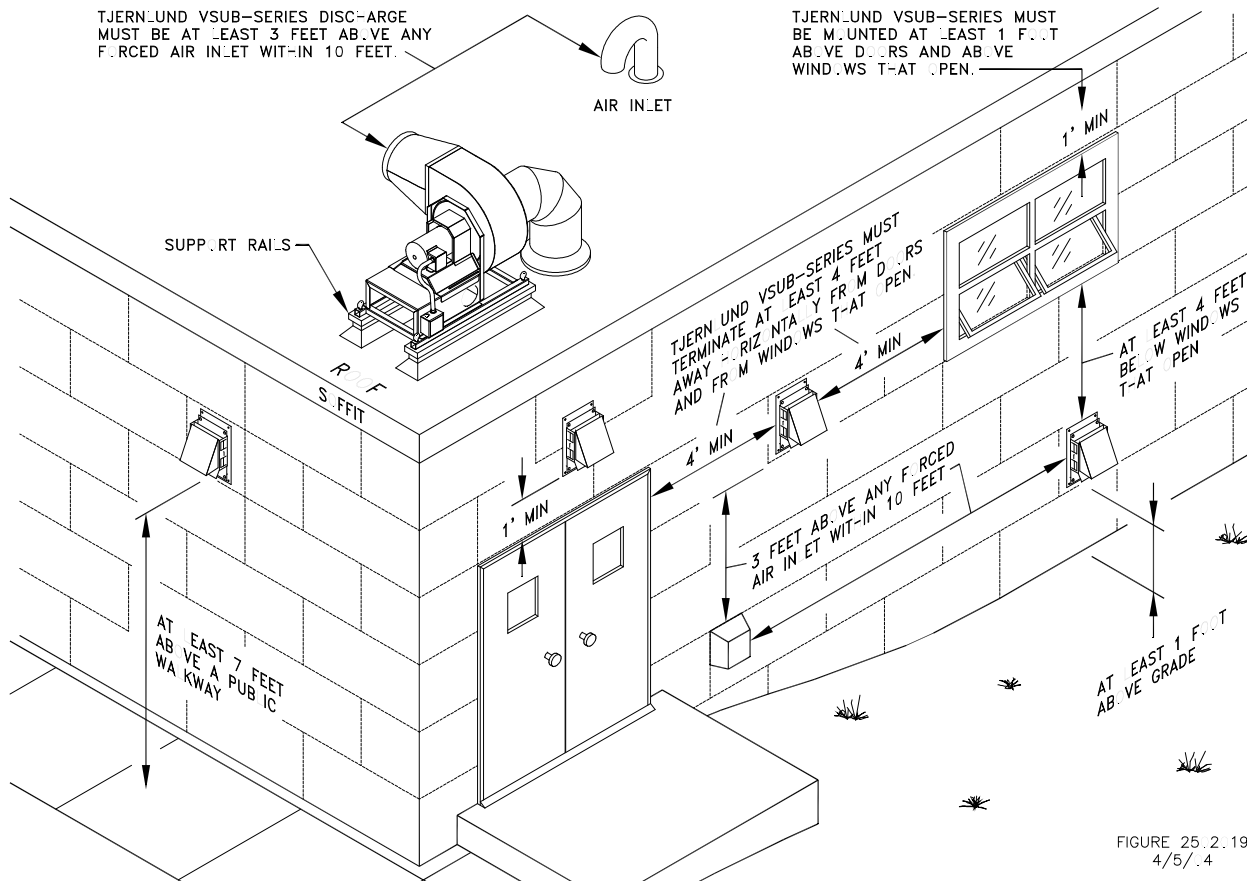


FIGURE 25.2.19
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INTAKE HOOD/LOUVER LOCATIONS WHEN USING THE VSUB BLOWER AS A COMBUSTION AIR INTAKE

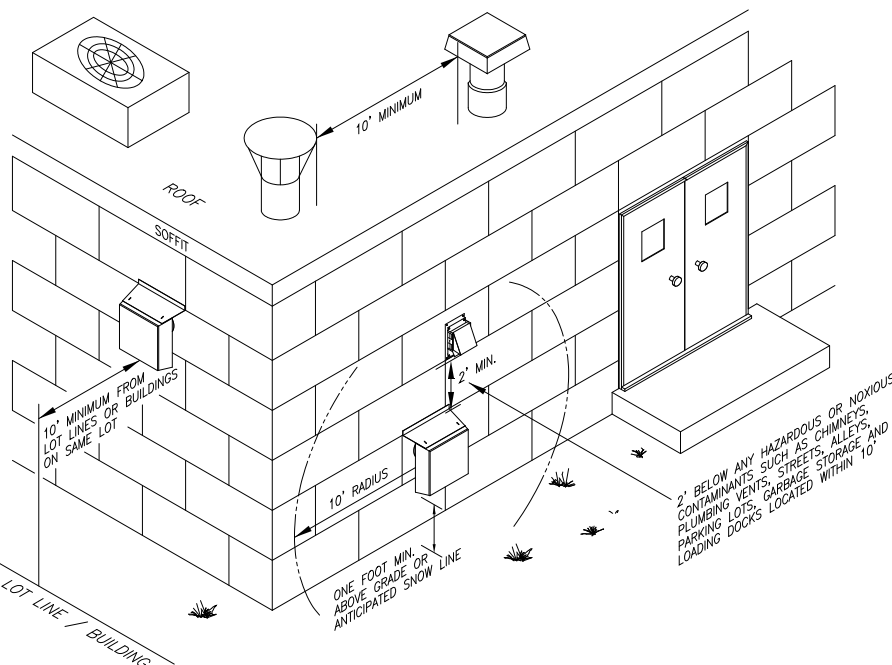
The VSUB Intake Hood/Louver location must conform with the BOCA National Mechanical Code or local codes.

LOCATION:

Outside air exhaust and intake openings shall be located a minimum of 10 feet (3048mm) from lot lines or buildings on the same lot. When openings front on a street or public way, the distance shall be measured to the center-line of the street or public way.

INTAKE OPENINGS:

Outside air intake openings shall be located a minimum of 10 feet (3048mm) from any hazard or noxious contaminant such as vents, chimneys, plumbing vents, streets, alleys, parking lots and loading docks. When a source contaminant is located within 10 feet (3048mm) of an intake opening, such opening shall be located a minimum of 2 feet (610mm) below the contaminant source.



On wall installations, if possible, terminate the Intake Hood/Louver on a wall that does not face the direction of prevailing winds. This will diminish the possibility of wind infiltration.

INTAKE HOOD/LOUVER SIZING WHEN USING THE VSUB BLOWER AS A COMBUSTION AIR INTAKE

When sizing an intake opening for northern climates always use 650' /min as a maximum capture velocity with respect to outside air being entrained to an inside environment. For southern applications where snow is infrequent, 800' /min can be used in respect to rain.

1000 CFM will require a minimum 15" x 15" opening to have a maximum capture velocity of 650'/min.
 If an intake grille is 75% open, the area will need to increase to 17.25" x 17.25" to maintain a design maximum velocity of 650'/min.
 2000 CFM will require a minimum 21" x 21" opening to have a maximum capture velocity of 650'/min.
 If an intake grille is 75% open, the area will need to increase to 24.25" x 24.25" to maintain the design maximum velocity of 650'/min.
 4000 CFM will require a minimum 30" x 30" opening to have a maximum capture velocity of 650'/min.
 If an intake grille is 75% open, the area will need to increase to 34.25" x 34.25" to maintain the design maximum velocity of 650'/min.
 6000 CFM will require a minimum 36.5" x 36.5" opening to have a maximum capture velocity of 650'/min.
 If an intake grille is 75% open, the area will need to increase to 42" x 42" to maintain the design maximum velocity of 650'/min.

INSTALLATION OF THE VSUB BLOWER

The VSUB Blower is designed to fit any type of industry standard 8", 12", 16" or 20" diameter vent pipe. Vent pipe must be installed and supported according to manufacturer's instructions, local codes and/or in accordance with NFPA 211, "Chimneys and Vents". The VSUB Blower is rated for indoor or outdoor installation. Factory insulated vent pipe may reduce clearances to combustibles when penetrating a combustible roof or wall. Refer to vent pipe manufacturer's instructions for details.

⚠ WARNING

Unless properly screened or guarded to prohibit contact with the blower wheel, a minimum of 3 feet of pipe must be connected to the inlet/discharge of the VSUB Blower.

Do not use the VSUB Blower inlet or outlet collars to support the vent pipe. Support the vent pipe as instructed by the vent pipe manufacturer.

The VSUB Blower housing can rotate 180 degrees in 45° increments, see "Housing Rotation", Page 13. Always mount the VSUB Blower so the shaft of the motor is horizontal and base is pointing down.

INSTALLING VSUB BLOWERS OUTDOORS WHEN USED AS A MECHANICAL DRAFT INDUCER

When installing VSUB Blowers outdoors as a mechanical exhaust, never orient the discharge vertically without installing a rain cap or a vent pipe that alters the discharge to horizontal. Rain caps must be raised a distance equal to the vent diameter above the VSUB Blower outlet. A minimum of 3 diameters of straight vent must be installed prior to connecting any elbow. Never connect a 90° elbow directly to the discharge.

INSTALLING CONDENSATE DRAIN

IMPORTANT:

If the VSUB Blower is mounted outdoors or potentially subject to condensation, we recommend the use of the supplied condensate drain. Make sure to mount the condensate drain into the lowest point of the VSUB Blower housing.

1. Use mounting plate as template and a drill bit for stainless steel to drill (4) 5/32" holes and (1) 1/2" hole into lowest point of VSUB Blower housing, (See Diagram C)
2. Use supplied mounting screws to fasten mounting plate to the bottom of housing. Seal connection with RTV sealant.
3. Connect to 3/8" NPT fitting and route drain to appropriate location.

DIAGRAM C



MOUNT AT LOWEST POINT IN VSUB HOUSING.

DIAGRAM D

MOUNT WITH SUPPORTS AT A 30° ANGLE TO PREVENT UNIT FROM SWINGING.

1. Make sure the overhead support will handle 4 times the static weight of the Universal Blower being installed, See "Specifications" on page 1.
2. To help prevent the VSUB Blower from swinging while operating we recommend mounting the supports at a 30° angle, (See Diagram D).
3. Use either the provided eyebolts or 3/8" rod to suspend the VSUB Blower from overhead.
4. Make sure the VSUB Blower is mounted level and plumb. If necessary, rotate the housing **only** for desired discharge angle, see "To Rotate Housing", Page 14. Keep motor shaft parallel with floor/roof and mounting base pointed down.



MOUNTING ON ROOF

1. Make sure the roof surface you plan to mount the VSUB Blower on is level.
2. When mounting on a roof we recommend using rooftop mounting support rails.
3. Make sure roof top mounting support rails are rated to handle the weight of the VSUB Blower, See "Specifications" on page 1.
4. Install vibration isolation pads between rooftop support rail and VSUB Blower base.
5. After positioning VSUB Blower remove the four eyebolts from the base and secure blower to roof rail with lag screws.

MOUNTING ON FLOOR

1. Make sure the surface you plan to mount the VSUB Blower on is level.
2. When mounting on the floor we recommend using anti-vibration floor mounts, springs or pads.
3. Make sure anti-vibration floor mounts, springs or pads are rated to handle the weight of the VSUB Blower you are installing.
4. Fasten the floor mount, springs or pads to the bottom frame of the VSUB Blower.
5. Secure the VSUB Blower to the floor to ensure that it doesn't move during operation.

PSA-1 FAN PROVING SWITCH FOR ADJUSTABLE-FIXED SPEED MECHANICAL DRAFT INDUCER INSTALLATIONS

The PSA-1 is a field adjustable pressure switch that is the primary fan prover for VSUB Blowers not installed in conjunction with a CPC-2 controller, and the manual operation mode fan prover for installations incorporating a CPC-2 controller.

1. Install Fan Proving Switch sampling tube in the vent connector as close as possible to VSUB inlet and 2-3 pipe diameters away from any elbow or "T". For multiple appliances venting into a common manifold, install after appliance closest to the VSUB Blower. If the vent run is completely vertical, install after draft hood or barometric damper, (See Diagram E).
2. Drill 1/4" hole for Fan Proving Switch sampling tube. The hole should be burr free. Secure sampling tube bracket to pipe with sampling hole centered.
3. Insert stainless steel sampling tube through 1/4" hole enough to just penetrate interior of vent pipe and lock in place with compression nut, (See Diagram F). With the VSUB Blower on, a negative pressure reading on a draft gauge is an indication that the interior of the pipe has been penetrated.

4. Fan Proving Switch diaphragm must be mounted in a **VERTICAL** position within six feet of the sensing location. Firmly insert flexible tubing on sampling tube and Fan Proving Switch fitting marked (LOW). Leave the other Fan Proving Switch port open to room atmosphere for reference. Make sure there are no sharp bends or kinks in flexible tubing. Do not mount the PSA-1 so that is directly in the path of the VSUB Blower discharge, unit heater or duct discharges. Doing so may cause a false reference pressure reading, (See Diagram G).

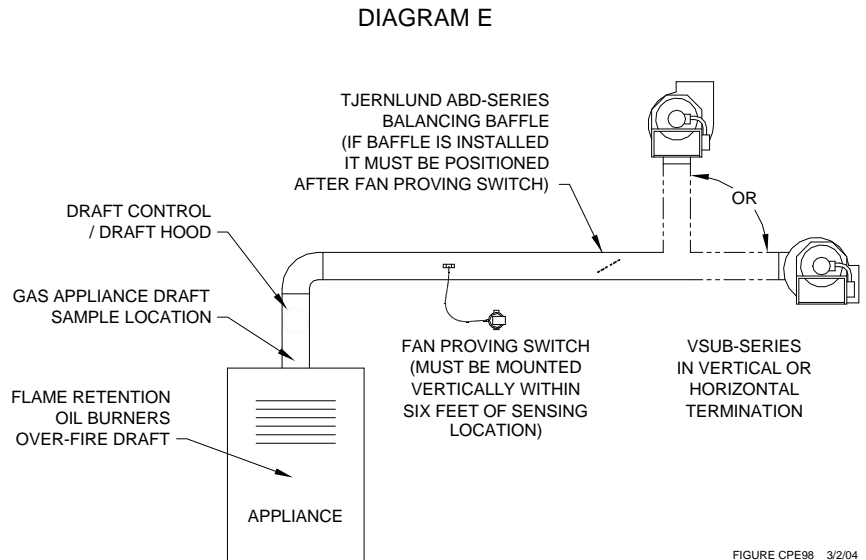


DIAGRAM F

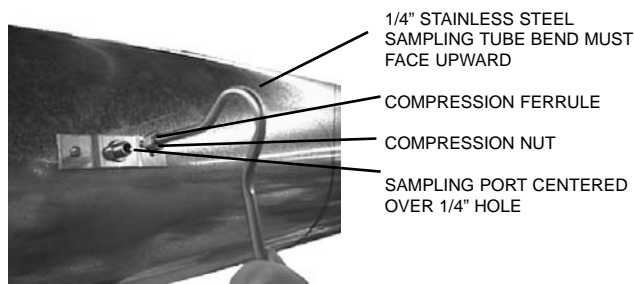
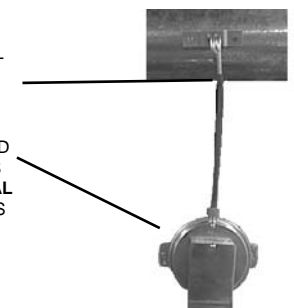


DIAGRAM G

FAN PROVING SWITCH MUST
BE MOUNTED WITHIN SIX
FEET OF SAMPLING TUBE.

SWITCH CAN BE ORIENTATED
IN A 360° PLANE AS LONG AS
DIAPHRAGM IS IN A **VERTICAL**
ORIENTATION AND TUBING IS
NOT KINKED.

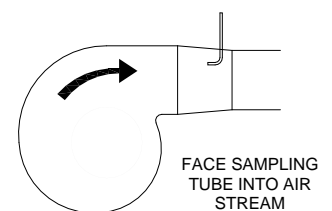


PSA-1 FAN PROVING SWITCH FOR ADJUSTABLE-FIXED SPEED COMBUSTION AIR INTAKE INSTALLATIONS

The PSA-1 is a field adjustable pressure switch that is the primary fan prover for VSUB Blowers not installed in conjunction with a CPC-2 controller, and the manual operation mode fan prover for installations incorporating a CPC-2 controller.

1. Install Fan Proving Switch sampling tube in the DISCHARGE/OUTLET duct as close as possible to the outlet collar of the VSUB Blower. Directly after the VSUB Blower outlet collar the pressure will be greatest at the point in line with the top of the scroll blower housing, (See Diagram H). If VSUB Blower is mounted outside install sampling tube on closest indoor section of duct.
2. Drill 1/4" hole for Fan Proving Switch sampling tube. Insert sampling tube with 90° bend so that the short side faces directly towards the VSUB discharge/outlet. Secure sampling tube bracket to pipe with sampling hole centered. With all pipe connected, start VSUB Blower and adjust tube until a high pressure reading is available, (at least +0.10" w.c.)

DIAGRAM H



- Lock in place with compression nut. With the VSUB Blower on, a positive pressure reading on a draft gauge is an indication that the tube has been orientated properly.
- Fan Proving Switch diaphragm must be mounted in a **VERTICAL** position within six feet of the sensing location. Firmly insert flexible tubing on sampling tube and Fan Proving Switch fitting marked (HIGH). Leave the other Fan Proving Switch port open to room atmosphere for reference. Make sure there are no sharp bends or kinks in flexible tubing. Do not mount the PSA-1 so that is directly in the path of the VSUB Blower discharge, unit heater or duct discharges. Doing so may cause a false reference pressure reading.

WIRING

WARNING

All wiring from the VSUB Blower to the appliance must be in compliance with local codes or in their absence, the National Electric Code (NFPA 70).

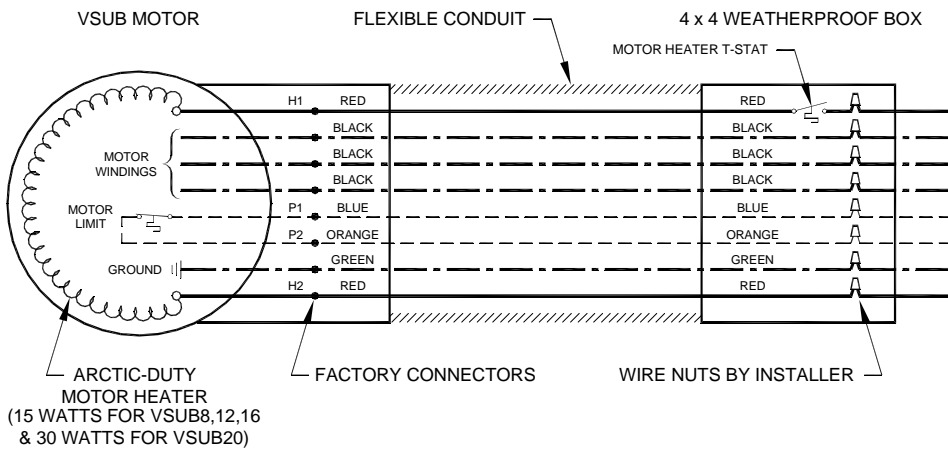
All wiring from the VSUB Blower to the appliance must be appropriate class 1 wiring as follows: Installed in rigid metal conduit, intermediate metal conduit, rigid non-metallic conduit, electrical metallic tubing, Type M1 cable or be otherwise suitably protected from physical damage.

IMPORTANT:

All wiring from the VFD Variable Frequency Drive or CPC-2 constant Pressure Controller must be in metal conduit or shielded cable where appropriate. Do not route these wires with any other wires. Improper system operation could result.

This installation manual does not contain any system design documentation. Installation and use of Tjernlund controls like the CPC-2 Constant Pressure controller, EXP-4 Appliance Interlock Expansion Boards, VFD-Series Variable Frequency Drives, UC1 Universal Control, TD-2/TD-3 Pressure Transducer or MAC1E and MAC4E Multiple Appliance Controls are not covered by this manual. Please refer to those accessory installation manuals.

WIRING VSUB MOTOR FOR PROPER VOLTAGE



IMPORTANT:
THIS UNIT IS FACTORY-WIRED FOR 460 VAC VFD APPLICATIONS. IF YOU ARE USING THIS UNIT WITH A 230 VAC VFD, REWIRE THE MOTOR LEADS AT THE MOTOR ELECTRICAL BOX AS SHOWN BELOW. ALL MOTOR WIRES ARE LABELED T1 THROUGH T9. THE MOTOR LIMIT WIRES ARE P1 AND P2. THE MOTOR HEATER WIRES ARE H1 AND H2. USE THE MOTOR HEATER WHEN THE VSUB IS INSTALLED OUTDOORS WHERE THE AVERAGE WINTER TEMPERATURES ARE BELOW FREEZING.

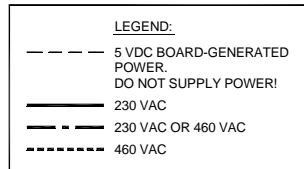


FIGURE 8055001 4/5/04

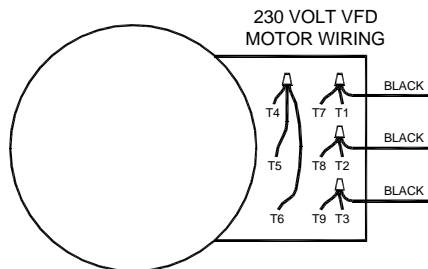
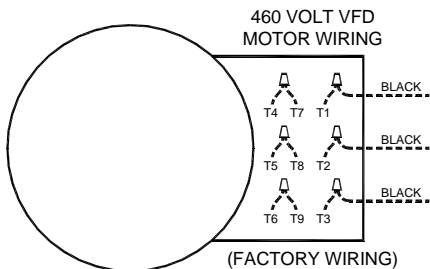
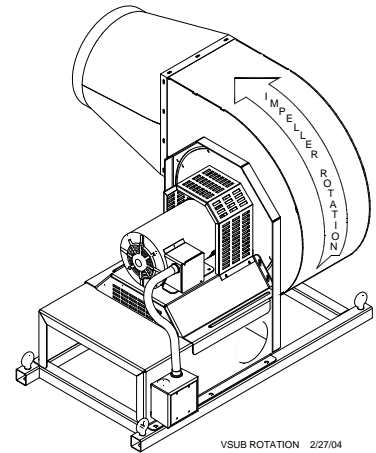


DIAGRAM I



IMPORTANT: CONFIRM PROPER IMPELLER ROTATION

If this VSUB Blower is being installed in conjunction with a CPC-2 Controller, follow impeller rotation check instructions outlined in the CPC-2 installation instructions. Failure to insure correct rotation will result in higher power usage and poor blower performance.

All VSUB Blowers must use a Variable Frequency Drive (VFD) supplied by Tjernlund which is factory programmed specifically for the VSUB model being installed.

VISUAL METHOD TO VERIFY PROPER ROTATION:

VSUB Series impeller must rotate counter-clockwise as viewed from the motor side, (See Diagram I). Verify motor cooling fan at back of motor rotates counter-clockwise. While the VSUB Blower is running at a slow speed, starting up or coming to a stop, visually determine if the rotation is correct. Perform step 4 on page 10 if rotation is in the reverse direction.

STATIC PRESSURE METHOD TO VERIFY ROTATION:

1. Turn OFF the service switch to all of the heating appliances so they will not run during this test.
2. Adjust the heating appliance balancing baffle(s) or blast gate(s) to the closed position.
3. Turn the speed adjustment knob on the VFD to the 3:00 o'clock position, Hz _____. Activate the VSUB Blower by installing a jumper between positions MS3 and MS4 on the VFD terminal strip. Record the static pressure in the vent pipe using a manometer or digital pressure gauge in. W.C. _____. Disrupt power to the VFD and wait 60 seconds before continuing to avoid electrical shock.
4. Locate the two wires within the VFD enclosure that are connected with pink quick connects. Separate the quick connects and reconnect the White/Brown lead attached to the filter board to the previously unconnected lead from VFD terminated with pink quick connect. Reestablish power to the VFD.
5. Perform steps 3 & 4 above. **Important:** VFD must be at same Hz _____ (speed) as the initial test. The rotation direction that yielded the higher static pressure is the correct rotation. If the earlier static pressure result was the higher pressure result, perform step 4 to reverse the rotation. Remove jumper from the MS3 and MS4 positions on the VFD terminal strip.

FACTORY WIRING OF OPEN LOOP VFD DRIVE

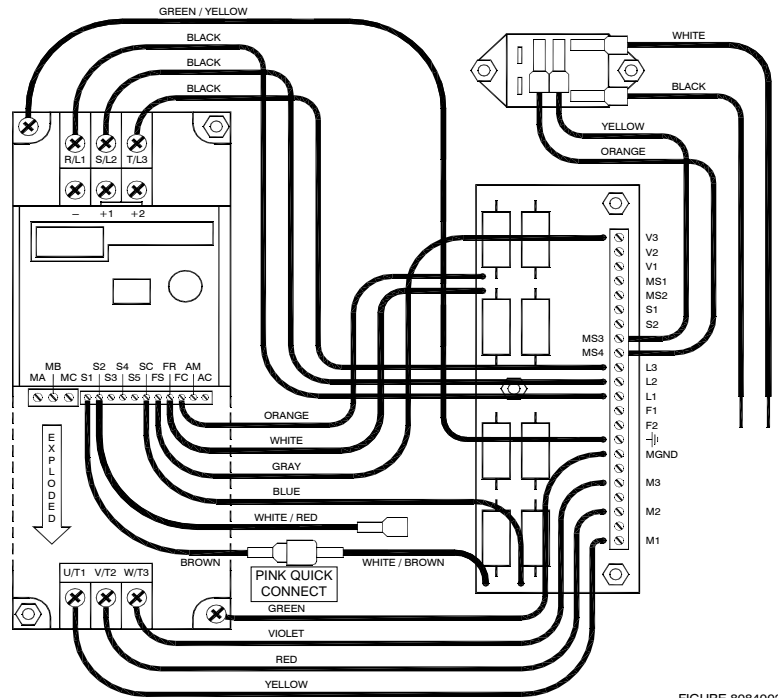


FIGURE R084002

WIRING VSUB FOR A ADJUSTABLE-FIXED SPEED APPLICATION (MANUALLY ADJUSTED WITH AN OPEN LOOP VFD)

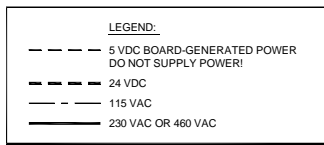


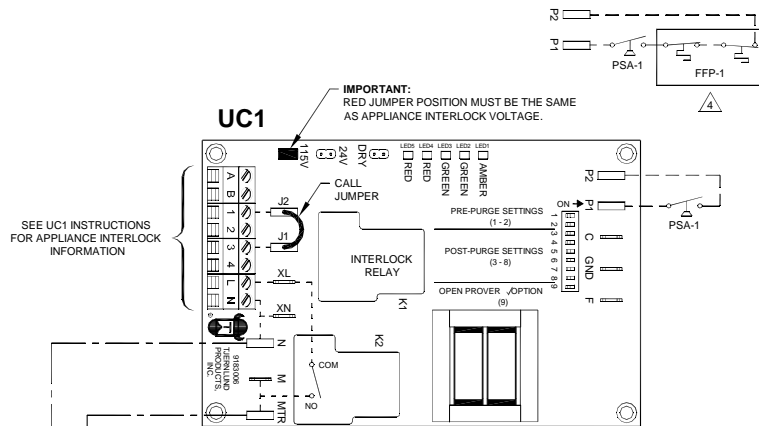
FIGURE 8089002 03/23/04

NOTES:

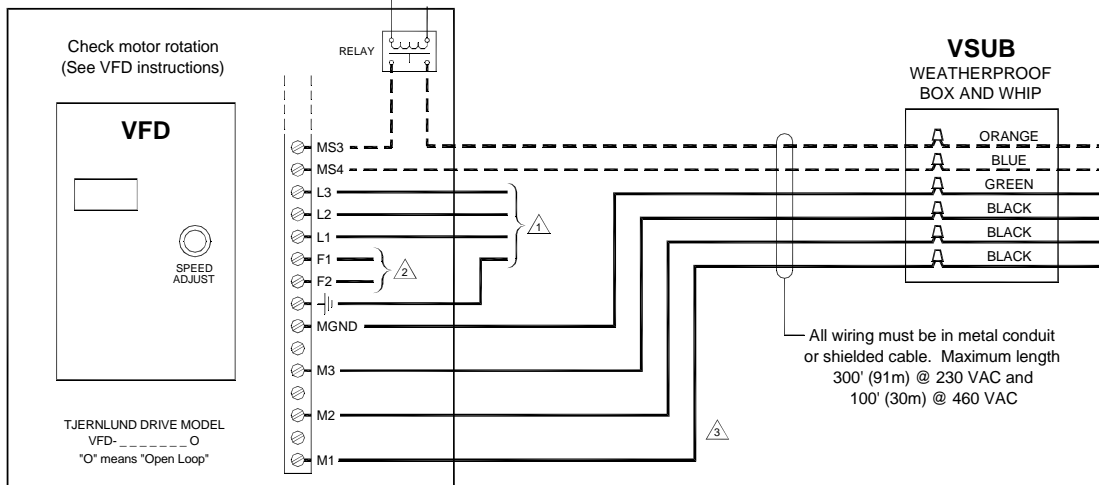
1. Verify that the input voltage matches the drive's nameplate BEFORE applying power or severe damage will result.
2. Voltage from F1 & F2 is the same as voltage to L1 & L2. Auxiliary powered devices at F1 & F2 (e.g. the included VSUB motor heater) may require a step-down transformer.
3. Verify that the VSUB motor is wired for the output voltage from the drive. If not correct, severe damage will result.
4. Use FFP-1 when using VSUB as a combustion air provider.
5. All wiring must be in metal conduit (best) or shielded cable.
6. DO NOT run input and output wiring in the same conduit.
7. For appliance interlock, use UC1 instructions.

IMPORTANT:

Perform a safety interlock and operational test as outlined in the installation manuals.



WARNING: Remove power to Universal Control when installing, servicing, or changing dip switch settings. Failure to do this may result in personal injury and/or equipment damage. LED #5 (RED) will be off if power has been removed from the control.



NOTES:

1. Verify that the input voltage matches the drive's nameplate BEFORE applying power or severe damage will result.
2. Voltage from F1 & F2 is the same as voltage to L1 & L2. Auxiliary powered devices at F1 & F2 (e.g. the included VSUB motor heater) may require a step-down transformer.
3. Verify that the VSUB motor is wired for the output voltage from the drive. If not correct, severe damage will result.
4. Use FFP-1 when using VSUB as a combustion air provider.
5. All wiring must be in metal conduit (best) or shielded cable.
6. DO NOT run input and output wiring in the same conduit.
7. For appliance interlock, use UC1 instructions.

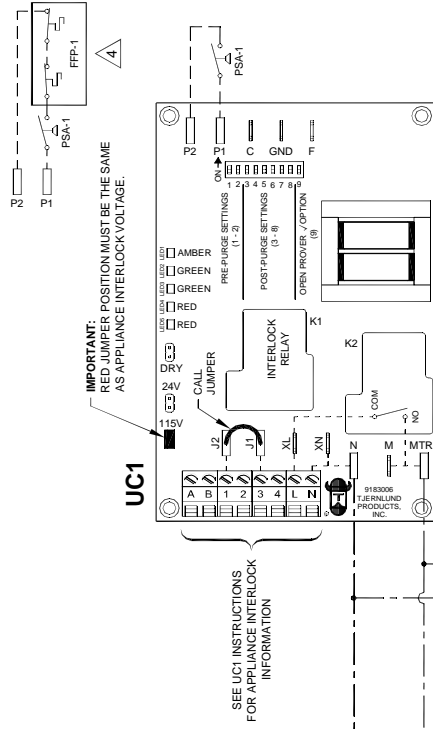
IMPORTANT:

Perform a safety interlock and operational test as outlined in the installation manuals.

LEGEND:

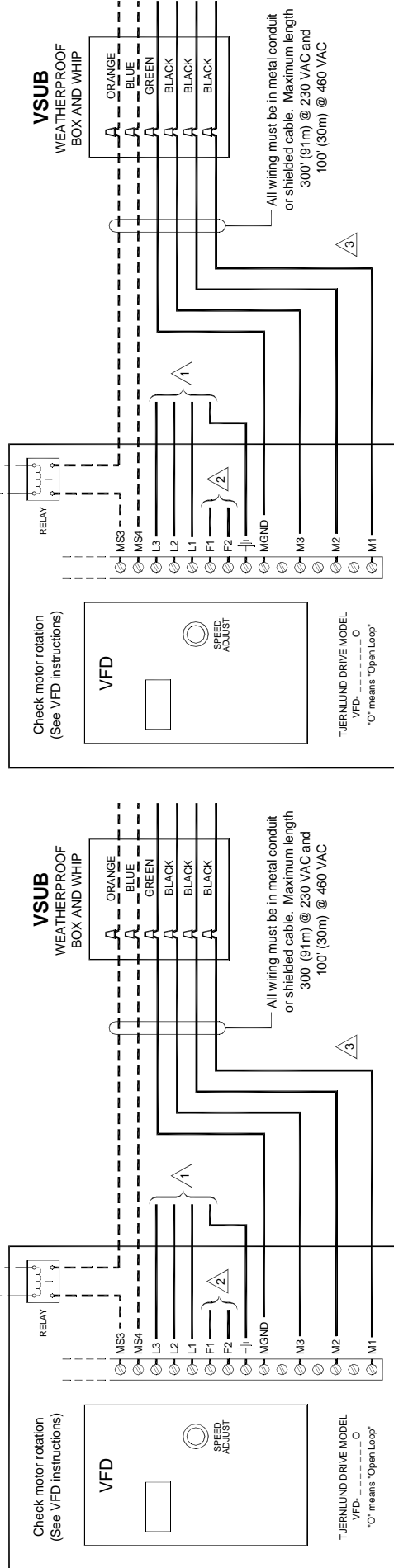
- 5 VDC BOARD-GENERATED POWER
DO NOT SUPPLY POWER!
- 24 VDC
- 115 VAC
- 230 VAC OR 460 VAC

FIGURE 8088004 03/23/04



IMPORTANT:
RED JUMPER POSITION MUST BE THE SAME AS APPLIANCE INTERLOCK VOLTAGE.

WARNING: Remove power to Universal Control when installing, servicing, or changing dip switch settings. Failure to do this may result in personal injury and/or equipment damage. LED #5 (RED) will be off if power has been removed from the control.



DRAFT ADJUSTMENT FOR MECHANICAL DRAFT INSTALLATIONS

IMPORTANT: If installation includes a CPC-2 Controller, disregard these procedures and refer to the CPC-2 & System instructions for draft and PSA-1 Fan Prover adjustment procedures.

Close all access doors and openings to the mechanical room that would typically be closed during the heating equipment operation. Fire all other heating equipment not connected to this vent system and operate exhaust fans or air consuming devices within the facility that could affect the air pressure of the mechanical room.

1. Follow the heating equipment manufacturer's instructions for sampling draft. In their absence drill a draft sampling hole in the vent riser after each draft diverter or between the flue outlet and the draft hood / barometric draft control of each appliance.
2. It is important to note that various environmental and temperature conditions will cause draft levels to fluctuate. Set draft in the middle of appliance manufacturer's acceptable range.
3. For installations with a barometric draft control: Adjust weight on draft control to minimum or most responsive "open" position (Less Draft). Turn adjustment screw on the PSA-1 counter-clockwise until it stops. Activate the VSUB Blower by installing a jumper between positions MS3 and MS4 on the VFD terminal strip. Adjust the speed control knob on the face of the VFD until approximately -0.10" W.C. is measured at the draft sampling location referenced in step #1. If multiple heaters are being vented by a single VSUB Blower, adjust balancing baffles so that approximately -0.10" W.C. is measured at each draft sampling location.
4. Remove jumper from MS3 and MS4 positions on VFD terminal strip. Activate burner farthest from the VSUB Blower at full capacity. Adjust the draft within the manufacturer's requirements by opening/closing the balancing baffle for that heater. Perform combustion test and make any adjustments necessary to the burner so that it operates efficiently. If the desired draft cannot be maintained through adjustment of the balancing baffle(s) adjust VSUB Blower speed to achieve desired draft range.
5. Fire each successive heater repeating the same procedure for each heater as outlined within step #3. Keep the previously adjusted heaters operating as each successive heater's draft is being adjusted.
6. After the draft has been adjusted for all heaters, and with all heaters operating, reverify that the draft on all heaters is within the manufacturer's specified range. Make any slight adjustments necessary to the balancing baffle, draft control or VSUB Blower speed to allow all heaters to operate within the range specified. Record the final Hz _____ (speed) setting as referenced on the VFD display.

SIDEWALL TERMINATIONS: It is normal for the draft control damper to be nearly wide open. This will allow the VSUB Blower to respond to high wind loads.

PSA-1 FAN PROVER SET POINT ADJUSTMENT FOR MECHANICAL DRAFT INSTALLATIONS

1. Activate all heaters at full fire for 5 minutes.
2. Reduce the VSUB Blower speed slowly to the point that a negative draft cannot be maintained or flue gas spillage is detected at any of the heaters.
3. Turn PSA-1 adjustment screw clockwise in 1/4 turn steps waiting 30 seconds between each turn until the PSA-1 switch opens, causing the heaters to be disrupted. Turn the PSA-1 adjustment screw 1/4 turn counter-clockwise and replace electrical box cover.
4. Increase the VSUB Blower speed back to its original setting that was recorded in step #6 above. Hz _____ (speed)
5. Cycle all heaters and verify proper light-off and operation. Return all non-connected heaters, exhaust fans and air consuming devices to their previous condition.

PSA-1 FAN PROVER SET POINT ADJUSTMENT FOR COMBUSTION AIR INSTALLATIONS

IMPORTANT: If installation includes a CPC-2 Controller, disregard these procedures and refer to the CPC-2 & System instructions for draft and PSA-1 Fan Prover adjustment procedures.

Close all access doors and openings to the mechanical room that would typically be closed during the heating equipment operation. Fire all other heating equipment not connected to this vent system and operate exhaust fans or air consuming devices within the facility that could affect the air pressure of the mechanical room.

1. Follow the heating equipment manufacturer's instructions for sampling draft. In their absence drill a draft sampling hole in the vent riser after each draft diverter or between the flue outlet and the draft hood / barometric draft control of each appliance.
2. Turn adjustment screw on the PSA-1 counter-clockwise until it stops. Turn the speed control knob on the face of the VFD completely clockwise (maximum Hz).
3. Activate all heating equipment within mechanical room at full fire and allow to reach steady state operation. Steady state operation is achieved when flue gas temperatures stabilize.

- Slowly turn VFD speed control knob counter-clockwise in 5 Hz increments every 5 minutes until a decrease in the draft in the heater furthest from the chimney termination is measured or when any of the heaters starts to spill flue gases. Turn PSA-1 adjustment screw clockwise in 1/4 turn steps waiting 30 seconds between each turn until the PSA-1 switch opens, causing the heaters to be disrupted. Turn the PSA-1 adjustment screw 1/4 turn counter-clockwise and replace electrical box cover.
- Note the frequency displayed Hz _____ (speed) on the VFD display and turn VFD speed control knob clockwise until 5 additional Hz. is displayed Hz _____ (speed). Verify that all heater's draft falls within the manufacturer's recommended range. Increase VSUB Blower speed if necessary to help achieve desired draft range.

SAFETY INTERLOCK TEST

- Adjust the appliance thermostat(s) or aquastat(s) to call for heat.
- Determine that the VSUB Blower operates before the gas valve or burner becomes energized.
- With the appliance(s) and VSUB Blower operating, disrupt power to the VSUB Blower and determine that the appliance gas valve(s) or burner motor(s) shut off.

WARNING

Do not operate an appliance that does not shut off with the VSUB Blower disabled.

COMBUSTION AIR

Adequate combustion air is vital for proper combustion and for safe venting. Likewise, for proper inducer performance, adequate combustion air must be available to the appliance. Many installers assume adequate combustion air is present, especially in older structures. In some cases this is a false assumption because many structures have been made "tight" due to weatherization. Size the combustion air opening(s) into the equipment room as outlined in NFPA 31, 54 & 211. Tjernlund's IN-FORCER™ or Auto-Draft® VSUB combustion air intake systems provide a convenient, automated way to supply combustion air to the equipment room. When installing the VSUB Blower as a draft inducer, it is not necessary to supply any more combustion air than normally required when conventional venting.

MAINTENANCE, SERVICE & HOUSING ROTATION

WARNING

Disconnect the power supply when making wiring connections or when working around the fan impeller and motor. Failure to do so can result in electrical shock, personal injury, death or property damage.

The Tjernlund VSUB Blower is designed for continuous use. The motor is equipped with permanently lubricated sealed ball bearings which do not require regreasing.

A vent/duct pipe inspection must be performed annually. The inspection should include checking all vent/duct pipe and connections for blockage and leaks. A safety interlock test must also be performed.

Inspect impeller after (3) months and set up a periodic inspection and cleaning routine as necessary.

Intake Hood and prefilters when Using VSUB as a combustion air intake:

Intake Hood screen, prefilters and blower impeller should be clear of any foreign material such as leaves, lint or other items.

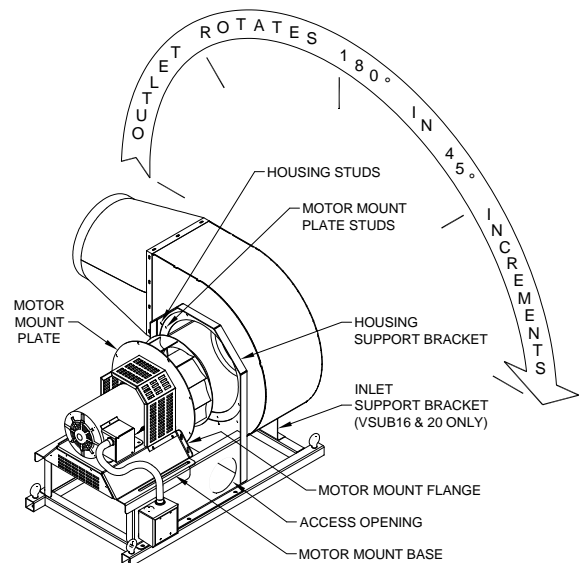
SLIDE-OUT SERVICE & HOUSING ROTATION

The VSUB Blowers feature a slide out motor/blower impeller assembly for easy servicing. The blower housing can be rotated 180° in 45° increments so the discharge orientation best matches the job requirements. The motor/blower impeller assembly must be completely slid out prior to rotation of the housing.

TO SLIDE OUT MOTOR/BLOWER IMPELLER ASSEMBLY:

NOTE: Nuts on bottom can be removed through access openings.
Do not overtighten stainless steel fasteners.

- Remove (8) nuts and washers from motor mount plate.
- Remove (2) nuts and washers from the bottom stud of each side of the motor mount flange.
- Loosen nuts on motor mount base and slide motor/blower impeller assembly out of housing.



TO ROTATE HOUSING:

VSUB16 & 20 ONLY:

1. Remove bottom (3) nuts that secure inlet support bracket onto the blower inlet collar.
2. Separate the entire inlet support bracket from the base by removing (4) additional nuts.
3. Refasten the (3) nuts to the inlet collar to keep inlet collar factory centered.

ALL VSUB-SERIES BLOWERS:

1. Remove (8) nuts and washers from housing support plate. NOTE: Leave top housing nut hand tight until ready to rotate housing.
2. Rotate housing to desired orientation.
3. Refasten blower housing to the housing support bracket.

VSUB16 & 20 ONLY:

1. Remove bottom three nuts and washers from the inlet support bracket.
2. Refasten inlet support bracket to the inlet collar.
3. Tighten remaining nuts on the inlet support bracket so that the housing remains level horizontally.

TO REINSTALL MOTOR/BLOWER IMPELLER ASSEMBLY:

1. Slide motor/impeller assembly back into housing and secure (8) nuts and washers to all studs on motor mount plate.
2. Retighten (2) nuts on the motor mount base.

IMPORTANT: With power removed to VSUB Blower, rotate blower impeller by hand to verify that it rotates freely. Make necessary adjustments if impeller does not rotate freely.

VSUB16 & 20 ONLY: Readjust inlet support bracket if blower impeller does not rotate freely.

HOW TO OBTAIN SERVICE ASSISTANCE

1. If you have any questions about your VSUB Blower or if it requires adjustment, repair or routine maintenance, we suggest that you initially contact your installer, contractor or service agency.
2. If you require technical information contact Tjernlund Products, Inc. at 1-800-255-4208.

When contacting Tjernlund Products, Inc., please have the following information available:

1. Model and Lot # of the VSUB Blower
2. Name and address of installer and service agency
3. Date of original installation and dates any service work was performed
4. Details of the problem

LIMITED PARTS WARRANTY AND CLAIM PROCEDURE

Tjernlund Products, Inc. offers a two year mechanical warranty on the VSUB Blower. This warranty covers defects in material and workmanship. This warranty does not cover labor, normal maintenance, transportation or installation charges for replacement parts or any other service calls or repairs. Products that are tampered with, damaged or defective due to malfunctioning appliances or misapplication are not covered under this warranty. This warranty DOES NOT cover the complete VSUB Blower if it is operative, except for the defective part.

Tjernlund Products, Inc. will issue credit to your VSUB provider or provide a free part to replace one that becomes defective during the two year warranty period. All receipts should include the Lot # of the VSUB Blower to ensure that the defective component corresponds with the complete unit. This will help preclude possible credit refusal.

- 1.) Determine defective component. If unable to determine faulty component, contact your VSUB provider or Tjernlund Products Technical Customer Service Department at 1-800-255-4208 for troubleshooting assistance.
- 2.) After the faulty component is determined, return it to your VSUB provider for replacement. Please include VSUB Lot # component was taken from. The Lot # is located on the VSUB nameplate on the Inducer housing. Credit or replacement will only be issued to your VSUB provider after the defective part has been returned prepaid to Tjernlund.

REPLACEMENT PARTS COVERED BY WARRANTY

MOTOR KIT

VSUB8 MOTOR KIT	950-8500
VSUB12 MOTOR KIT	950-8501
VSUB16 MOTOR KIT	950-8502
VSUB20 MOTOR KIT	950-8503

MOTOR SHAFT EXTENSION W/ SEAL KIT

VSUB8	950-8516
VSUB12 & 16	950-8517
VSUB20	950-8518

MOTOR SHAFT SEAL KIT

VSUB8	950-8519
VSUB12	950-8520
VSUB16	950-8521
VSUB20	950-8522

IMPELLER KIT

IMPELLER KIT VSUB8	950-8504
IMPELLER KIT VSUB12	950-8505
IMPELLER KIT VSUB16	950-8506
IMPELLER KIT VSUB20	950-8507

HOUSING KIT

HOUSING KIT VSUB8	950-8508
HOUSING KIT VSUB12	950-8509
HOUSING KIT VSUB16	950-8510
HOUSING KIT VSUB20	950-8511

HOUSING TRANSITION KIT

TRANSITION KIT VSUB8	950-8512
TRANSITION KIT VSUB12	950-8513
TRANSITION KIT VSUB16	950-8514
TRANSITION KIT VSUB20	950-8515

WHAT IS NOT COVERED

- Product installed contrary to our installation instructions
- Product that has been altered, neglected or misused
- Product that has been wired incorrectly
- Product that has been damaged by a malfunctioning or maladjusted burner
- Any freight charges related to the return of the defective part
- Any labor charges related to evaluating and replacing the defective part

TJERNLUND LIMITED TWO YEAR WARRANTY

Tjernlund Products, Inc. warrants to the original purchaser of this product that the product will be free from mechanical defects due to faulty material or workmanship for a period of (2) years from the date of original purchase or delivery to the original purchaser, whichever is earlier. Remedies under this warranty are limited to repairing or replacing, at our option, any product which shall, within the above stated warranty period, be returned to Tjernlund Products, Inc. at the address listed below, postage prepaid. THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE DESCRIPTION ON THE FACE HEREOF, AND TJERNLUND PRODUCTS, INC. EXPRESSLY DISCLAIMS LIABILITY FOR INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING FROM THE USE OF THIS PRODUCT. THIS WARRANTY IS IN LIEU OF ALL OTHER EXPRESS WARRANTIES AND NO AGENT IS AUTHORIZED TO ASSUME FOR US ANY LIABILITY ADDITIONAL TO THOSE SET FORTH IN THIS LIMITED WARRANTY. IMPLIED WARRANTIES ARE LIMITED TO THE STATED DURATION OF THIS LIMITED WARRANTY. Some states do not allow limitation on how long an implied warranty lasts, so that limitation may not apply to you. In addition, some states do not allow the exclusion or limitation of incidental or consequential damages, so that above limitation or exclusion may not apply to you. This warranty gives you specific legal rights and you may also have other rights which may vary from State to State. Send all inquiries regarding warranty work to Tjernlund Products, Inc. 1601 9th Street, White Bear Lake, MN 55110-6794. Phone (651) 426-2993 • (800) 255-4208 • Fax (651) 426-9547 or email us at fanmail@tjfans.com.