FläktGroup SEMCO

SPECIALIZED HEALTHY AIR SOLUTIONS

ENERGY RECOVERY WHEEL

OWNER'S MANUAL

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INTRODUCTION AND DEFINITIONS

This manual describes the installation and maintenance of the True 3Å Energy Recovery Wheel. The descriptions include all optional equipment and devices for the unit currently available from FläktGroup® SEMCO®. If optional equipment is required after receiving the unit, please contact:

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Before proceeding with handling and installing the Energy Recovery Wheel Unit, review **FIGURES 1 and 2** on page 4 showing the location of important features and devices on the unit. Some of the electronic devices are not shown, as they are located away from the wheel. Each item is described and explained in the following pages of this manual.

PLEASE BECOME FAMILIAR WITH THE FOLLOWING DEFINITIONS:

ADSORPTION — The process of bonding of water vapor on the surface of the solid desiccant coating of the Energy Recovery Wheel media.

BUILDING SIDE — The face of the Energy Recovery Wheel unit that always faces the inside air ducts (supply and return air.) The purge sector is always located on the building side of the wheel. (See **FIGURE 1**.)

CASSETTE — The stationary framework supporting the wheel. (See wheel.)

DESICCANT — A naturally occurring or man-made material with a high affinity for water vapor. SEMCO uses a highly efficient 3Å desiccant material that minimizes cross contamination.

ENTHALPY WHEEL — A common term used to describe all rotating, wheel-shaped devices that transfer sensible (temperature) and latent (water vapor) energy from one air stream to another. The word enthalpy means heat content or total heat. The term enthalpy exchanger may also be used.

EXHAUST AIR — The indoor air that has passed through the Energy Recovery Wheel and is being ducted outdoors.

TRUE 3Å ENERGY RECOVERY WHEEL UNIT — The complete, ready to install assembly consisting of motor, cassette seals, drive hub assembly controller(s) and sensors. Also referred to as a unit.

HEAT WHEEL — This generally describes all rotation devices that transfer sensible-only energy.

HOUSING — The steel frame, sheet metal and flanges that surround and support the enthalpy wheel.

INVERTER — See variable frequency drive.

GEAR REDUCER — A device mounted on the motor to reduce the output rpm's.

LABYRINTH SEAL — A four-pass, rubber seal that closely surrounds the rotor and effectively limits the amount of air that might bypass the media inside the rotor. To prevent binding, the specifically designed seal should not touch the rotor.

MEDIA — The fluted material inside the wheel. The media used in the True 3Å Energy Recovery Wheel is unique and proprietary. The patented desiccant coating on the aluminum surface adsorbs only water vapor, which is transferred to the other air stream.

Outdoor air (OA) — The fresh outside air that passes through the Energy Recovery Wheel unit and is supplied to the inside space of the building.

OUTDOOR SIDE — See weather side.

PURGE — The narrow, triangular metal piece extending from the center of the wheel to its edge. It is located on the building side of the unit. The purge allows a small amount of outdoor air to pass through the media. This

effectively removes all exhaust air trapped inside the wheel as a wheel segment moves from the exhaust airside to the supply air side. It prevents contamination of the fresh outdoor air with pollutants contained in the exhaust air stream.

RETURN AIR (RA) — Indoor air that is pulled through the Energy Recovery Wheel unit and then exhausted outdoors.

ROTATION DETECTOR — A device located outside the unit that allows maintenance personnel to determine whether or not the wheel is turning without opening the access panels.

ROTATION SENSOR — A probe located inside the unit that detects whether or not the wheel is turning and transmits that information by electrical pulse to the controller.

ROTOR — The media-filled wheel that rotates and transfers heat energy and water vapor from one ducted air stream to the other. Also referred to as a wheel.

SEALING RING — The sheet metal located between the rotor and the mask panels. The ring's surface surrounds the rotor without touching it. Also referred to as a seal shelf.

SCRUBBER — See purge.

SEAL — See labyrinth seal.

SENSOR — See temperature sensor.

SPOKES — Extruded aluminum supports radiant from the hub of the rotor. Spokes provide the rotor's structural integrity.

SUPPLY AIR (SA) — Outside air that passes through the Energy Recovery Wheel unit and is provided to the indoor space.

TEMPERATURE CONTROLLER — A pre-programmed electronic device that delivers a signal to the variable frequency controller. It receives and compares temperature information from temperature sensors located inside the air ducts.

TEMPERATURE SENSOR — A device that senses the air temperature in the duct, then transmits the information to the temperature controller. Depending on the configuration, an Energy Recovery Wheel unit has at least three or four temperature sensors in the ducting of the four air streams.

UNIT — Used frequently throughout this manual referring to the True 3Å Energy Recovery Wheel and its accompanying components such as casing, motor, variable frequency controller, temperature controller and others that work together to make an effective energy recovery product. See True 3Å Energy Recovery Wheel.

VARIABLE FREQUENCY DRIVE (VFD) — A programmable electronic device that increases or decreases the electrical supply to the wheel's drive motor, thus speeding or slowing the motor and wheel's rotation. Also referred to as Variable Frequency Controller and Adjustable Speed Drive.

WEATHER SIDE — The face of the Energy Recovery Wheel unit with the intake opening for outside air and the exhaust outlet. The words OUTDOOR AIR SIDE are stenciled on this side. The unit's purge section is never located on the outdoor side. (See **Figure 2**.)

WHEEL — Refers to the rotating wheel containing the coated media. The wheel's cassette is the stationary framework supporting the wheel.

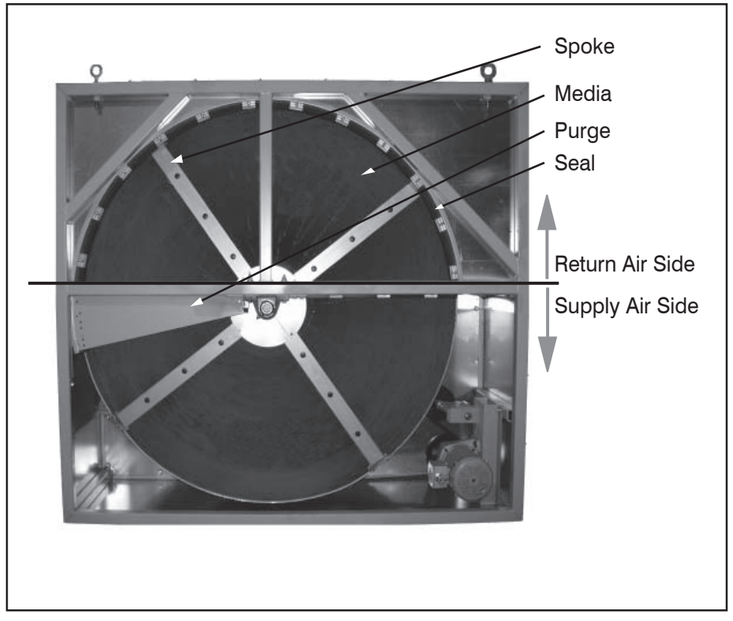


FIGURE 1. Building side view of the wheel.

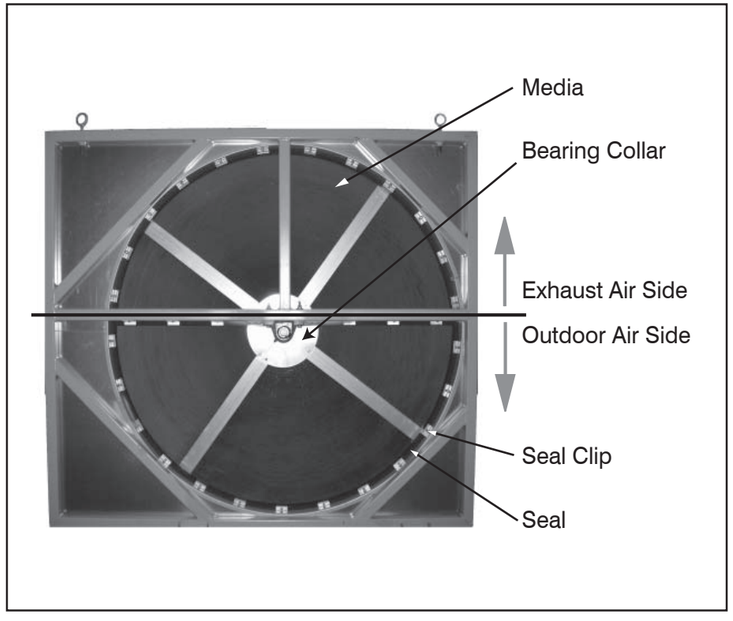


FIGURE 2. Weather side view of the wheel.

PRINCIPLE OF OPERATION

RECOVERING "TOTAL" ENERGY

FläktGroup® SEMCO® True 3Å enthalpy exchanger recovers both sensible (temperature) and latent (moisture) energy, and does so far more effectively than other competitive offerings.

This performance edge is a result of True 3Å's unique transfer core. This "honeycomb-like" media utilizes an aluminum substrate coated with a fast acting, 3Å molecular sieve desiccant.

As the transfer core slowly rotates between the outdoor and return air stream, the higher temperature air stream gives up its sensible energy to the aluminum. This energy is then transferred to the cooler air stream during the second half of the revolution.

Just as the temperature is captured and released, so is the moisture (latent energy). This is accomplished by the wheel's desiccant coating, which has an enormous internal surface area and a strong attraction for water vapor. Since the opposing air streams have different temperatures and moisture contents, their vapor pressures differ. This vapor pressure differential is the driving force necessary for the transfer of water vapor. (See **FIGURE 3**.)

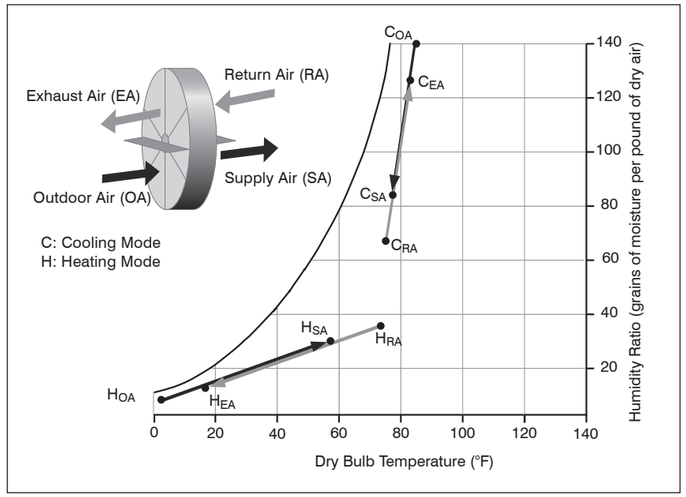


FIGURE 3. Typical operating conditions encountered in the cooling and heating mode of a total energy recovery unit.

The ability to recover latent energy provides important benefits in both the heating and the cooling season. During the cooling season, the outdoor air is dehumidified. (See **Figure 3**.) In the heating season, the costly humidification load is reduced through moisture recovery. Latent recovery doubles the energy savings potential recognized with the use of sensible-only technology. It also allows for sizable cuts to be made in chiller and boiler capacity, which offsets the initial cost of the total energy recovery addition. Since the exhaust air stream is dried as it is cooled, frost formation can be avoided with latent recovery.

RECOVERING "SENSIBLE ONLY" ENERGY

The FläktGroup SEMCO TS series of sensible only energy wheels is specifically designed to recover temperature only. The transfer media is not desiccant coated but is polymer coated to avoid oxidation over time. Oxidation reduces the structural integrity of the media over time and can also cause some modest latent transfer, which is usually undesirable in sensible only applications.

As shown in **FIGURE 4**, the air streams entering and leaving the sensible only wheel are heated or cooled. Since no latent recovery is accomplished, the moisture content of each air stream remains the same. A comparison of the processes in **FIGURES 3 AND 4** reveals two key advantages offered by total energy recovery. First, the total energy wheel recovers far more energy due to the latent component. Second, the sensible wheel will approach moisture saturation far more easily in the heating mode. This can cause frost formation.

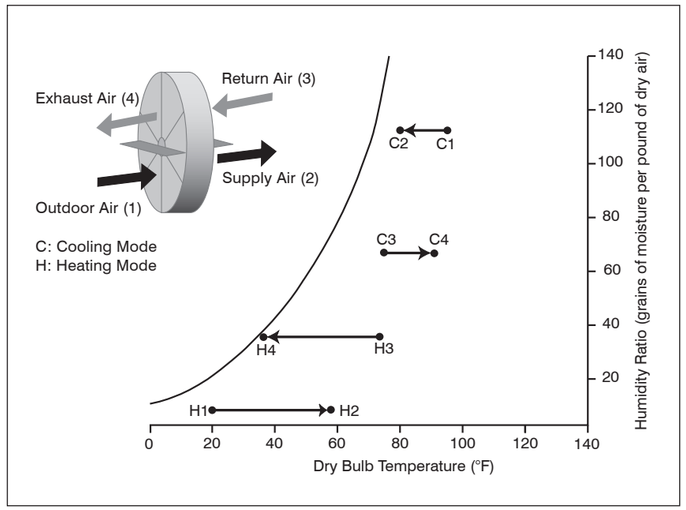


FIGURE 4. Typical operating conditions encountered in the cooling and heating mode of a sensible only energy recovery unit.

For these reasons, sensible wheels should only be used in applications where moisture transfer is undesirable. Examples of such applications include indirect evaporative cooling systems, desiccant cooling systems and reheat wheels as used in the SEMCO Fresh Air Dehumidification systems.

In every other way, the FläktGroup SEMCO TS wheel is similar to the True 3Å wheel and shares the benefits of superior performance, quality construction, and compact design.

RECEIVING & INSPECTING

LIFTING AND HANDLING

True 3Å Wheel units, which are designed to be mounted vertically, are equipped with four lugs for lifting (See **FIGURES 5 and 6**). To off load the True 3Å Wheel unit, lift only with the lugs located on top of the unit. DO NOT lift the unit from the bottom with a forklift or any other device.

Units that mount horizontally should be lifted by the four lugs plus a strap attached to the unit's center beam (See **FIGURE 7**).

When lifting and handling the unit, be sure that lifting pressures are applied uniformly to all four or five lifting points. **DO NOT** twist or bend the unit.

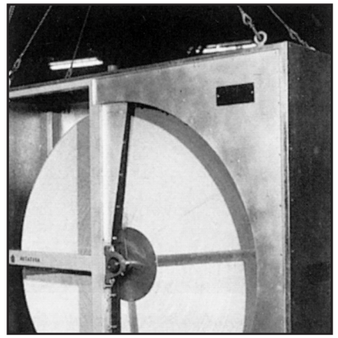


FIGURE 5. Vertically oriented units are equipped with four permanently attached lift lugs.

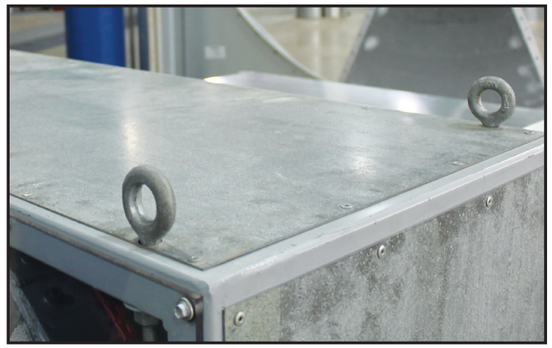


FIGURE 6. True 3Å units should only be lifted with lugs located atop the unit.

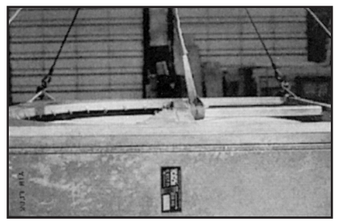


FIGURE 7. Horizontally oriented units should be lifted with the four lugs plus a center strap.

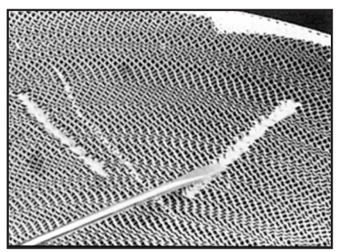


FIGURE 8. The relatively thin aluminum in the media can be marred quite easily. Exercise caution when using tools, etc. near the media.

RECEIVING

1) Ensure the crate is stored in a dry location until installation.

2) A packing list is supplied with each unit. The list should be compared with the arriving shipment to ensure that all parts have been delivered and are in good condition.

3) If the unit is to be stored for more than three days before it is un-crated, a visual inspection of all parts listed on the packing list is necessary. Freight claims are difficult–if not impossible– to justify long after delivery.

4) Exception: All crates for retrofit parts are labeled, "To be opened by SEMCO personnel only." If the outside of the crates has been visibly damaged, then and only then should the crates be opened on receipt.

INSPECTION

The wheel's face, the housing, and other larger parts of the assembled unit can be visually inspected for possible damage while still crated on the skid.

Check the media for damage. Some nicks and scratches are normal and will not affect the wheel's operation. However, the relatively thin aluminum in the media can be marred quite easily (See **FIGURE 8**). Workers should be warned to be careful when working around the face of the wheel.

Even with cautious handling, some damage may occur. As long as the damage affects no more than 5% of the wheel's surface, no significant loss of effectiveness will occur. If damage is estimated to be greater than 5%, please contact SEMCO immediately.

Inspect the unit's casing and sheet metal for structural damage. Inspect the drive belt, gear reducer, temperature controller, and drive motor for visible damage.

STORAGE

If the unit is to be stored for more than 3 months, remove the shipping restraint located on the supply side of the wheel near the drive motor (see **FIGURES 9 and 10**), grease the bearing and rotate the wheel at least three turns in the direction indicated by the rotation arrow in **FIGURE 16**.

To prevent the possibility of condensation and corrosion, air should be circulated through the unit. If this is not feasible, the unit should be stored in a dry place indoors. If the unit is to be stored outdoors, the unit must be protected from the elements.

If the unit is to be stored for more than 6 months, pump a high quality NLGI No.2 lithium based grease into both wheel bearing grease points (See **FIGURE 12**).

If you have any questions or concerns regarding long-term storage, please contact SEMCO.

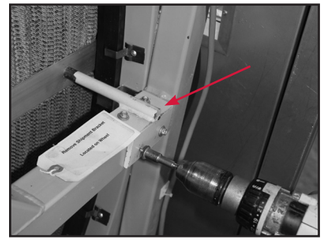


FIGURE 9. Shipping restraint for flat rim wheel.

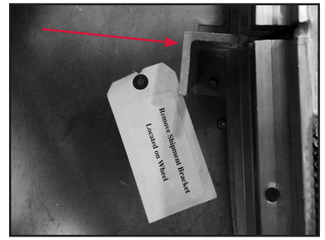


FIGURE 10. Shipping restraint for ribbed rim wheel.

FIGURE 11. Rotate the rotor at least three turns in the direction indicated by the rotation arrow.

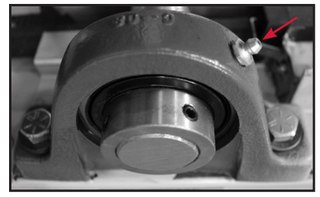


FIGURE 12. Pump grease into two rotor bearing grease points, one on each side of the rotor.

INSTALLATION

PLANNING FOR INSTALLATION

Before proceeding with installation, carefully review the following guidelines. Consult **FIGURES 13 THROUGH 21** as you plan the installation.

1) Units can be mounted in any of six different positions. Each unit is designed to operate in one of the arrangements (See **FIGURE 13**).

2) Be sure to locate the unit's purge in the building side supply air stream.

3) The installation will require four ducts: two ducts on the outdoor side of the unit (OA and EA,) and two on the building side (RA and SA.)

4) Note the EA and OA locations and the RA and SA locations. Also note the location of the airflow arrows. Be sure that ductwork will correctly match direction and locations of airflow (See **FIGURES 18A THROUGH 18C** on **PAGE 11** for required duct sizes).

5) Plan to include access doors immediately adjacent to the unit on all four ducts. Each opening should be large enough for body entry to access all seals and bearings. On smaller ducts, plan access doors that easily permit hand and arm movement and allow for visual inspection of the wheel (See **FIGURE 14**).

6) Ensure that ductwork will not cover or hide airflow arrows and rotation arrows (See **FIGURES 15 and 16**).

7) Ductwork must be attached to the unit's frame only. **DO NOT** attach ducts to the unit's sheet metal (See **FIGURE 17** for correct duct attachment locations).

8) All ducts must be self-supporting. **DO NOT** use the unit as structural support for the ductwork.

9) Air filters should be incorporated into the outside and return air streams. Filters aid in the efficient operation of the unit and help prevent dust and airborne contaminants from accumulating in the media. Filters must have restraints to keep them from blowing out should they become wet. A filter coming loose could destroy the entire wheel media. Filters should be changed regularly.

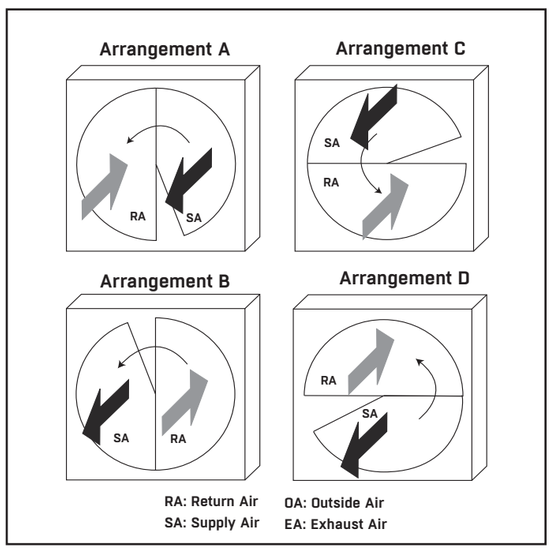


FIGURE 13. True 3Å Wheels can be mounted in any of these six arrangements. Each unit is pre-engineered to perform in the required arrangement.

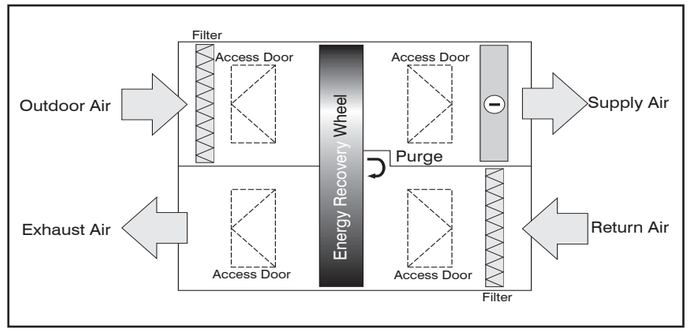


FIGURE 14. Typically, access doors are located in each duct close to the rotor.

FIGURE 15. Be sure that unit airflow arrows conform to duct airflow.

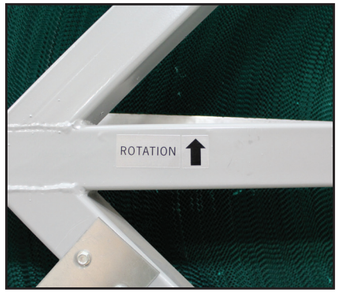


FIGURE 16. Don't let ductwork hide rotation or airflow arrows.

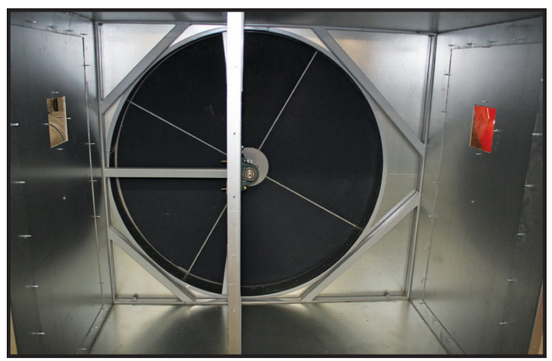


FIGURE 17. Attach ducts to unit frame only.

WHEEL DIMENSIONS

TE WHEEL SIZES 3, 5, 9

FIGURE 18A. Arrangements A and B, as referenced on page 9, Figure 13.

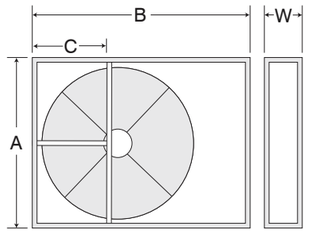
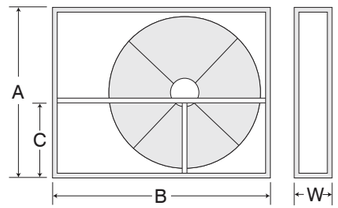


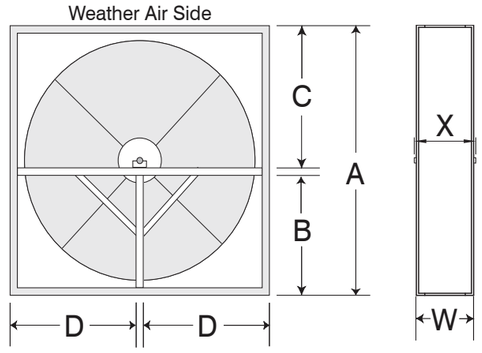
FIGURE 18B. Arrangements C and D as referenced on page 9, Figure 13.



WHEEL SIZE	DIMENSIONS (INCHES)				NET WEIGHT (lbs.)	FLOW AREA/SIDE (ft^2)	NOMINAL CFM
	A	B	C	W			
3	39.8	48.8	16.9	20.0	380	2.8	2000
5	51.8	58.2	22.9	20.0	520	5.3	4000
9	63.8	70.2	28.9	20.0	700	8.6	7000

TE WHEEL SIZES 13 - 70

FIGURE 18C. All arrangements for wheel sizes 13 through 70.



WHEEL SIZE	DIMENSIONS (INCHES)						NET WEIGHT (lbs.)	FLOW AREA/SIDE (ft^2)	NOMINAL CFM
	A	B	C	D	W	X			
13	75.8	33.8	40.0	36.9	21.0	21.4	1070	13.1	10,500
18	87.8	39.8	46.0	42.9	21.0	21.4	1300	18.1	15,500
24	99.8	45.8	52.0	48.9	21.0	21.4	1640	23.8	19,500
28	111.8	49.8	59.0	54.4	23.0	24.5	2640	28.3	22,500
35	123.8	55.8	65.0	60.4	23.0	24.5	3000	35.2	28,000
43	135.8	61.8	71.0	66.4	23.0	24.5	3390	42.9	34,000
46	141.0	64.4	73.6	69.0	23.0	24.5	3570	46.2	37,000
56	154.0	70.9	80.1	75.5	23.0	24.5	4030	56.0	45,000
70	171.5	79.6	88.9	84.3	23.0	24.5	4680	70.4	56,000

INSTALLING THE UNIT

1) After moving the unit to the installation site, check bearing bolts and set screws for tightness. If any bolts are loose, tighten them according to torque values shown on **PAGE 37**. Tighten any loose setscrews.

2) Check the installation site. Vertical units should be provided with continuous bottom support (See **FIGURE 19**). Horizontal units should be provided with support under all four sides, plus support across the center (See **FIGURE 20**).

3) Units may be lifted into place easily with a crane or hoist. Attach lifting cables to the unit's lugs and to the center beam on horizontal units. After ensuring that lifting pressure is applied equally to all points, lift the unit into place. (See **FIGURES 5 THROUGH 8** on **PAGE 7**).

4) Removing lugs is not recommended. However, if it is necessary to remove the large eyelet lugs, shown in **FIGURE 21**, then be sure to replace each removed lug with a bolt. The bolt holes must be closed.

ATTACHING DUCTWORK

5) Before securing ducts to the units, ensure that airflow arrows conform to duct airflow (See **FIGURE 15**). Also make sure that ductwork will not cover or hide airflow and rotation arrows (See **FIGURES 15 and 26** on **PAGE** 10).

6) **DO NOT** force ductwork to fit to the unit housing. Units must stand-alone and should NOT be used to support ductwork or other members.

7) Attach ducts to tube frame only (See **FIGURE 17** on **PAGE 10**). **DO NOT** attach ducts to sheet metal on the unit's sheet metal housing.

8) Verify that an access door close to the unit has been provided in each of the four ducts.

9) Inspect finished ductwork for air leakage and pay particular attention to the partition seal.

10) Pump grease into the two rotor bearing grease fittings using a high quality NLGI No. 2 grease.

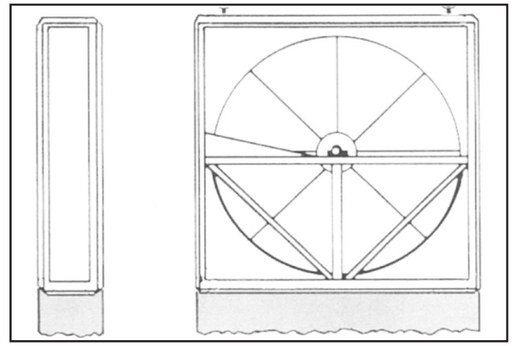


FIGURE 19. Vertical units require continuous bottom support.

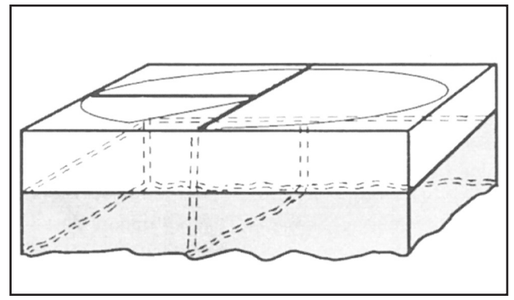


FIGURE 20. Horizontal units need support under all four sides, plus across the center.

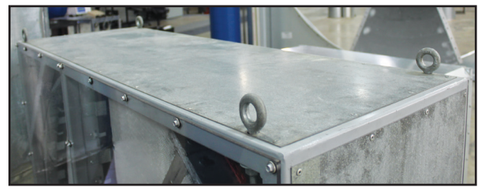


FIGURE 21. Large eyelet lugs atop vertical units should remain attached permanently. However, if they must be removed, be sure to replace the lug with a bolt.

FIGURE 22. Shipping restraint for flat rim wheel.

FIGURE 23. Shipping restraint for ribbed rim wheel.

FIGURE 24. To make sure that the rotor does not bind, turn it by hand in the direction indicated by the rotation arrow.

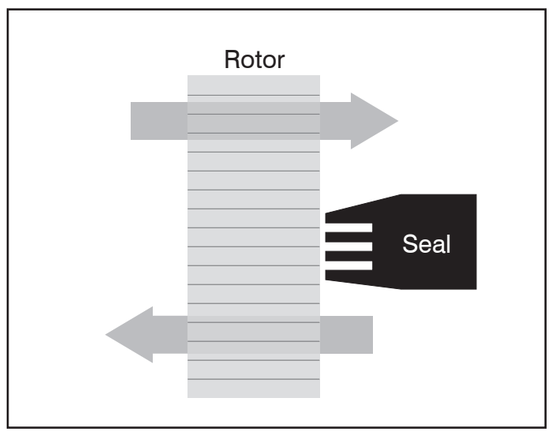


FIGURE 25. Air flowing between the rotor and labyrinth seal expands repeatedly, creating a pressure loss that forms an effective seal and prevents air from bypassing the rotor. The labyrinth seal never touches the rotor.

CHECKING THE ROTOR

11) Remove shipping restraint located in the supply air side of the wheel near the drive motor. Remove all bolts and discard. The shipping restraint prevents the rotor from turning during shipment (See **FIGURES 22 and 23**).

12) Turn rotor by hand in the direction indicated by rotation arrows to verify that the rotor does not bind. (See **FIGURE 24**.) If binding occurs in a new unit, it is usually caused by the labyrinth seal or freight damage. Instructions for adjusting the seals are provided later in this section.

13) Inspect the rotor visually. It should be well centered in its casing and should not tilt in any one direction. If alignment is not suitable, call SEMCO.

14) Inspect the bearing bolts, rim bolts and the Allen screws on the bearing collar to ensure that all are tight. Tighten any loose screws and bolts according to torque values described on **PAGE 37**.

ADJUSTING THE SEALS

The True 3Å unit uses a specially designed, four-pass labyrinth seal. Although the seal itself never touches the unit's rotor, it controls the air that attempts to pass between the seal and the rotor. The labyrinth seal causes air to expand repeatedly in the space between the seal and rotor, forming eddy currents. These currents create a pressure loss that forms an effective seal, therefore limiting air bypass and allowing the rotor to perform its heat transfer function (See **FIGURE 25**, **PAGE 14**). Maintaining correct seal adjustment is vital to the effective operation of the unit.

15) Use the seal gauges provided with the unit or make a gauge from 16 and 22 gauge sheet metal. Use 22 gauge sheet metal for perimeter seals and 16 gauge sheet metal for seals across the wheel partition.

16) Every rotor has a high point on the face of the wheel. Locate the high point visually by rotating the rotor by hand and note the point at which it is closest to the seal.

17) Place the gauge at the rotor's high point and move the rotor slowly by hand. Adjust the seal at locations where the seal does not meet gauge depth by loosening the screw holding the nearest clip. After setting the seal to the correct gauge depth, tighten the screw. (See **FIGURES 26 and 27**.)

18) Pay special attention to the seals across the wheel partition, which could possibly bind causing wheel damage.

19) Once the seals are set, caulk needs to be applied to the following areas as shown in **FIGURES 28-30** to prevent leakage through any gaps. Apply caulk on the weather side of the wheel to the face seal at each end where it contacts the perimeter seal. On building side of the wheel apply caulk to the purge seal at the perimeter and where the seal ends near the center of the wheel. Caulk the face seal next to the purge where the seal meets the base of the purge and at the perimeter.

FIGURE 26. Loosen clip and insert gauge. Adjust seal to correct gauge depth.

FIGURE 27. Tighten the screw.

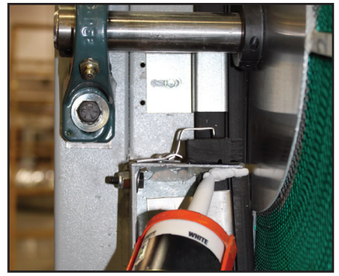


FIGURE 28. Caulk gap where purge seal abuts sheet metal end wall at the base of the purge.

FIGURE 29. Caulk purge seal where it meets perimeter seal.

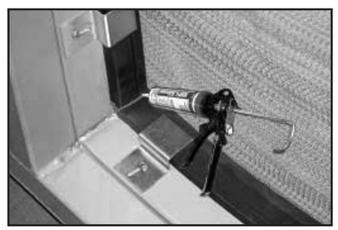


FIGURE 30. On the weather side of the wheel caulk where face seal meets perimeter seal at both ends.

TEMPERATURE CONTROLLER

UNIT DESCRIPTION

The temperature controller is a programmable controller for HVAC applications. This controller will command the wheel speed by providing an analog signal to the variable frequency drive (VFD.)

The standard single wheel program controls the supply air stream temperature based on feedback from four temperature sensors. The sensors are located in the outdoor, supply, return and exhaust air stream.

The supply air stream temperature is maintained by sending a 0-10 volt control signal from the temperature controller to the variable frequency drive (VFD.)

The VFD is used to control the speed of the enthalpy wheel, which determines the supply temperature. The speed of the wheel is proportional to the 0-10 volt signal generated by the temperature controller. When the temperature controller generates a 0 volt signal, the wheel spins at a minimum speed of 1/4 rpm. When the temperature controller is sending a 10 volt signal, the maximum speed is 20 rpm for an enthalpy wheel and 10 rpm for a sensible wheel.

The following diagram illustrates the control modes of the temperature controller and analog output signal associated with each mode.

FIGURE 31. Schematic of the control modes of the temperature controller.

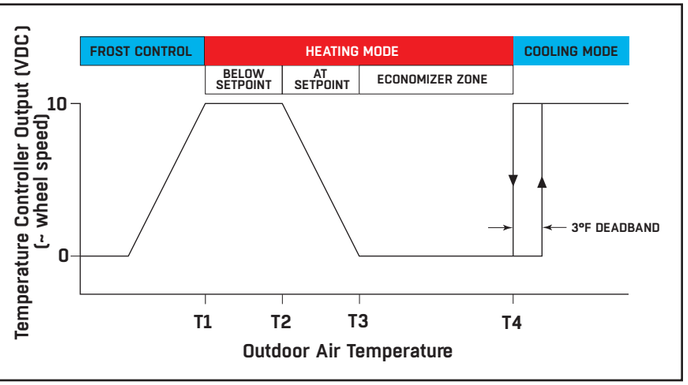
Legend

T1: Outdoor air temperature which produces an exhaust temperature equal to the frost set point.

T2: Outdoor air temperature at which wheel supply air temperature equals heating set point with wheel at full speed.

T3: Outdoor air temperature equals heating set point; no recovery required.

T4: When the outdoor air exceeds the return (space) air temperature, the wheel runs at full speed (summer changeover.)



SEQUENCE OF OPERATION

ENTHALPY WHEEL SPEED CONTROL: The enthalpy wheel modulates to maintain the wheel supply temperature set point in heating mode, rotates at 1/4 RPM in economizer mode, and rotates at 20 RPM in summer cooling mode.

COOLING MODE: If the outdoor temperature is greater than return temperature, the mode is summer cooling and the wheel speed is 20 RPM.

HEATING MODE: If the outdoor temperature is less than return temperature the wheel is in heating mode and the wheel modulates to maintain the supply temperature set point. If the outdoor temperature is less than the EWFullSpdT setpoint (15°F, adj.) the wheel is forced to full speed.

ECONOMIZER MODE: If the outdoor temperature is less than the return temperature, and the supply temperature is greater than the supply setpoint the wheel is in economizer mode. The VFD receives a 0% demand signal, and the wheel rotates at minimum speed (1/4th RPM.) Digital Output #4 (DO-4) is energized when the wheel is in economizer mode. This output can be used to power a pilot relay to control wheel bypass dampers, if desired. Wheel bypass dampers should be open during economizer mode, and otherwise closed.

FROST CONTROL: The enthalpy wheel modulates to prevent the exhaust temperature from dropping below the wheel exhaust temperature set point. As the exhaust temperature nears the setpoint, the wheel speed is reduced. The exhaust temperature set point can be auto calculated or a fixed set point. If the auto calculated setpoint is used, either the BAS must write the return/space RH to the controller or the design return RH is used to calculate the setpoint.

INPUTS:
IN-1 = Outdoor air temperature
IN-2 = Supply air temperature
IN-3 = Return air temperature
IN-4 = Exhaust air temperature
IN-5 = Wheel start/stop (optional, for field wiring)
IN-6 = Rotation detector alarm (optional, for field wiring)

OUTPUTS:
DO-1 = Wheel VFD start/stop
DO-4 = Wheel economizer mode status
AO-1 = 0-10 VDC Wheel VFD signal

SETPOINTS:
Supply temperature setpoint
Frost control exhaust temperature setpoint
Auto/manual frost control temperature set point
Additional advanced setpoints are also accessible via the keypad. See **KEYPAD NAVIGATION GUIDE** on **PAGE 20** for more information.

DISPLAY: Inputs, outputs, and set points may be viewed at the unit mounted two-row LCD display or remotely using communications software. Set points may be adjusted either at the unit or remotely through the BAS.

CONTROL HARDWARE: The wheel controller is an Automated Logic I/O Zone 583 Controller.

COMMUNICATION CAPABILITIES: Available 2-wire RS-485 communication protocols are: BACnet MS/TP, Modbus, or Johnson N2.

HOW TO INSTALL THE TEMPERATURE CONTROL PACKAGE

Physical installation: The temperature controller and rotation detector (where applicable) are factory installed in a NEMA 1 enclosure, which ships loose for field installation. Mount the control panel in a suitable indoor location free from excessive amounts of moisture or dust. The temperature controller is provided with probe style temperature sensors with plenum rated leads that are long enough to eliminate the need for splicing in many installations. Therefore it is recommended that the control panel be located a short distance from the wheel to reduce the need for splices.

Terminal blocks have been provided to aid in connection of control wiring between the temperature controller and the VFD. See the electrical schematic on **PAGE 24** for details.

I/O ZONE 583 SPECIFICATIONS	
POWER	24VAC ± 10%, 50-60Hz, 18VA power consumption (24VA with BACview attached)
INPUTS	Eight inputs. 2 inputs, jumper configurable for 0-5VDC, 10K ohm thermistor, or dry contact; 2 inputs that support thermistor or dry contact only; 2 inputs that support thermistor, dry contact, or LogiStat; 2 inputs that support 1K to 10K ohm potentiometers only.
INPUT RESOLUTION	10 bit A/D.
DIGITAL OUTPUTS	Five digital outputs, relay contacts rated at 1A resistive @ 24VAC. Configured as dry contact, normally open.
ANALOG OUTPUTS	Three analog outputs rated as 0-10VDC, 5mA (max.)
OUTPUT RESOLUTION	8 bit D/A.
COMMUNICATION	One network port (Comm port) configurable for BACnet-over-ARC156 or EIA-485 BACnet MS/TP, (9600 bps, 19.2k bps, 38.4k bps, or 76.8k bps,) Modbus (9600 bps, 19.2k bps, or 38.4k bps,) or N2 (9600 bps;) one Access port (115.2k bps via Rnet passthrough;) one Rnet port (EIA-485, 115.2k bps). Baud rates DIP switch selectable.
OPERATING RANGE	0° to 130°F (-17.8° to 54.4°C;) 10 to 90% relative humidity, non-condensing.
STATUS INDICATION	Visual (LED) status of network communication, running, errors, power, and all digital outputs.
MEMORY	1MB Flash memory and 512KB non-volatile battery-backed RAM (does not lose information that was stored before a power failure.)
PROTECTION	Built-in surge and transient protection circuitry. The module is protected by internal solid state Polyswitches on the incoming power and network connections. These Polyswitches are not replaceable and will reset themselves if the condition that caused the fault returns to normal.
BATTERY	Lithium 3V coin cell battery, CR2032, provides data retention during power outages.
LISTED BY	FCC Part 15 - Subpart B - Class A. Pending listings at the time of publishing this document: UL 916 (PAZX,) cUL C22.2 No. 205-M1983 (PAZX7,) CE (1997.)

TEMPERATURE SENSORS

1) Four temperature sensors (See **FIGURE 32**) are shipped loose for field installation as shown in **FIGURE 33**.

2) The standard sensors are 1-1/4" stainless steel probes with plenum rated cable and are supplied for field mounting. Optional SA and EA Averaging Sensor - Averaging sensor is available for use in the supply and exhaust airstreams. Sensors should be arranged for uniform coverage of wheel face.

3) Mount each sensor no closer than six inches to the rotor in each duct to be monitored, no further than the next item of equipment in the duct, and oriented to the face of the rotor as shown on the inset in **FIGURE 33**.

4) Wire each sensor to the temperature controller (See wiring diagram on **PAGE 26**).

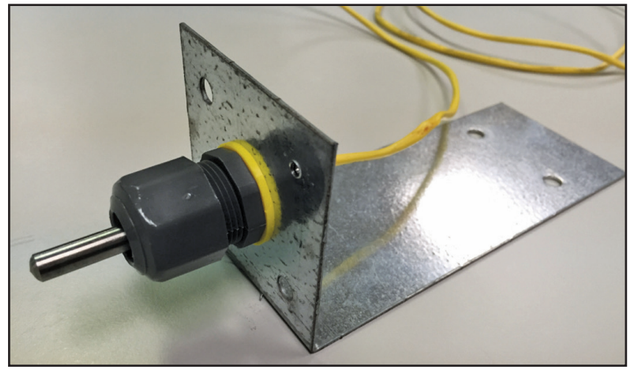


FIGURE 32. Example of point temperature sensor mounted to bracket with compression fitting.

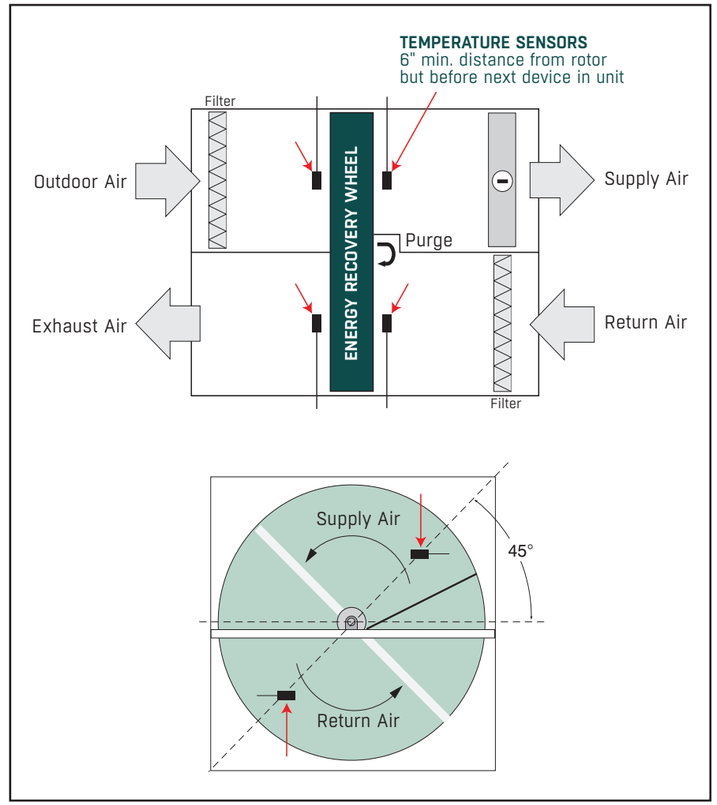


FIGURE 33. Typical locations of sensors in ducts.

BACVIEW KEYPAD:
OPERATING INSTRUCTIONS/USER INTERFACE

STEP 1. Press the **HOME** key to take you to the standby option screen.

STEP 2. Use the **LEFT** and **RIGHT** arrow keys to scroll through the menu. Pressing the **ENTER** key will take you to the selected option, indicated by the brackets [ ] around it.

STEP 3. After entering a selected menu option, use the **LEFT** and **RIGHT** arrow keys to scroll through the available parameters. Parameters with editable settings will have brackets **[ ]** around them when selected.

STEP 4. To change a parameter setting use the **LEFT** and **RIGHT** arrow keys to scroll to the desired selection, then press the **ENTER** key.

STEP 5. For numeric settings, use the **LEFT** and **RIGHT** arrow keys to move the cursor (_) to the desired digit. Use the **INCR** and **DECR** keys to scroll through the available parameter settings.

STEP 6. When the parameter setting has been changed to the desired value, press the **ENTER** key to lock in the new setting. If you do not wish to lock in the setting, press the **CANCEL** key.

KEYPAD MENU NAVIGATION GUIDE

HOME		
INPUTS		
StartSwitch	ON / OFF	Status of controller enable input(IN-5.)
BAS Start	ON / OFF	Status of controller enable via BAS communications.
EW RotDet	ALARM / OK	Status of wheel rotation detector alarm(when applicable.)
OutdoorT		Temperature (°F) of outdoor air entering enthalpy wheel (IN-1.)
Supply T		Temperature (°F) of supply air leaving enthalpy wheel (IN-2.)
Return T		Temperature (°F) of return air entering enthalpy wheel (IN-3.)
ExhaustT		Temperature (°F) of exhaust air leaving enthalpy wheel (IN-4.)
OUTPUTS		
EWvfdEnable	ON / OFF	Start / Stop command to enthalpy wheel VFD (DO-1.)
EW Mode	Summer /Winter	Enthalpy wheel operation mode.
EWvfdSig%	0-100%	Enthalpy wheel VFD output signal % (AO-1.)
EWvfdSigV	0-10	Enthalpy wheel VFD output VDC (AO-1.)
Whl RPM	0-20	Enthalpy wheel speed (RPM)
WhlEffcy%	0-100%	Enthalpy wheel effi ciency (%)
EconoMode	ON / OFF	Enthalpy wheel economizer mode status (DO-4)
SETPOINTS		
SP Source	BAS / KPD	Setpoint source determines whether the setpoints come from the BAS communications (BAS) or from the keypad (KPD.)
KPDTempSP		Keypad supply temperature setpoint (°F.) This setpoint is active if the SP Source is set to (KPD.)
BASTempSP		BAS supply temperature setpoint (°F.) This setpoint is active if the SP Source is set to (BAS.)
ADVANCED SETPOINTS		
SetptLoLimit		Temperature setpoint low limit (°F.) This sets the low limit for the supply temperature setpoint.
CONDENSATION CONTROL SETTINGS		
CC Enable	ON / OFF	Enthalpy wheel condensation control. ON = control program monitors the exhaust temperature and will modulate the wheel to prevent frosting. OFF = wheel is not monitored for frost prevention.
CC Mode	AUTO / MANUAL	Use of manual condensation control setpoint (AUTO/MANUAL.) MANUAL - Condensation control loop uses the manual setpoint. AUTO - Condensation control loop uses a calculated setpoint.
ManCCSetpt		Manual condensation control setpoint (°F.) This setpoint is active when CC Mode is (MANUAL)
AutoCCSetpt		Auto condensation control setpoint (°F.) This setpoint is active when CC Mode is (AUTO)
CC SpaceRH		Design return relative humidity setpoint (%rh.) This setpoint is used to calculate the automatic condensation control setpoint. A design return relative humidity can be set from the keypad or updated with the building return relative humidity from the BAS (requires BAS communications).
ENTHALPY WHEEL CONTROL SETTINGS		
EW Cntrl	AUTO / MANUAL	Enthalpy wheel speed signal control setting. AUTO = automatic control of enthalpy wheel speed, enthalpy wheel speed analog signal output (AO-1) set by control program. MANUAL = manual control of enthalpy wheel speed, enthalpy wheel speed analog signal output (AO-1) set by EWMan RPM setpoint.
EW ManRPM		Manual enthalpy wheel speed setting (RPM). When EW Cntrl is set for MANUAL, this setting controls the enthalpy wheel speed analog signal output (AO-1.) 0-20 RPM = 0-10 VDC output.
EW LpSpd		Wheel PID control loop speed. Higher values increase responsiveness but can reduce stability; lower values decrease responsiveness but can increase stability. Default value = 1.0
EWFullSpdT		Wheel Full Speed. Low ambient temperature (°F) that forces the enthalpy to full speed.

BACnet POINTS LIST

Standard Energy Recovery Wheel Control Package

NAME	TYPE	OBJECT ID	DEVICE ID	OBJECT NAME	EXP:NUM	I/O TYPE
exhaust temp	BAI	AI:1	DEV:2401	eat_1	0:04	Thermistor
outdoor temp	BAI	AI:2	DEV:2401	oat_1	0:01	Thermistor
return temp	BAI	AI:3	DEV:2401	rat_1	0:03	Thermistor
supply temp	BAI	AI:4	DEV:2401	sat_1	0:02	Thermistor
enth whl rotation alarm	BBI	BI:1	DEV:2401	ew_rot_1	0:06	Universal Input
temp controller s/s	BBI	BI:2	DEV:2401	start_sw_1	0:05	Universal Input
auto cc sp	BAV	AV:1	DEV:2401	auto_cc_setpt_1		
BAS temp setpt	BAV	AV:3	DEV:2401	bas_t_setpt_1		
cond ctrl space rh setpt	BAV	AV:4	DEV:2401	cc_space_rh_1		
enth wheel efficiency	BAV	AV:5	DEV:2401	ew_effcy_1		
enth wheel RPM	BAV	AV:6	DEV:2401	ew_rpm_1		
enth wheel Volts	BAV	AV:7	DEV:2401	ew_vdc_1		
keypad temp setpt	BAV	AV:8	DEV:2401	kpd_t_setpt_1		
low oat setpt (forces full speed)	BAV	AV:9	DEV:2401	full_spd_oat_1		
Manual cc temp spw	BAV	AV:10	DEV:2401	man_cc_setpt_1		
ManualSpeedRPM	BAV	AV:11	DEV:2401	ew_man_rpm_1		
setpt low limit	BAV	AV:12	DEV:2401	t_setpt_lowlim_1		
Program Version	BAV	AV:13	DEV:2401	prog_ver_1		
WheelLoopSpeed	BAV	AV:14	DEV:2401	ew_lpspd_1		
whl vfd sig	BAV	AV:15	DEV:2401	ew_vfd_sig_1		
auto/manual cond ctrl (on=manual)	BBV	BV:1	DEV:2401	cc_mode_1		
BAS auto com start	BBV	BV:2	DEV:2401	bas_start_1		
enable cond ctrl	BBV	BV:3	DEV:2401	cc_enbl_1		
enth whl mode (1=summer, 0=winter)	BBV	BV:4	DEV:2401	ew_opmode_1		
ManualSpeedCtrl	BBV	BV:5	DEV:2401	ew_man_ctrl_1		
Use BAS Setpoints	BBV	BV:6	DEV:2401	use_bas_1		
alarm relay	BBV	BV:7	DEV:2401	alarm_1		
economizer mode	BBV	BV:8	DEV:2401	econo_1		
wheel start relay	BBV	BV:9	DEV:2401	ew_vfd_enbl_1		
allow schedule	BBV	BV:10	DEV:2401	allow_schedule_1		

CHECKING THE CONTROLLER OPERATION

IF IT IS COLD OUTSIDE AND THE CONTROLLER IS IN WINTER MODE (OAT<RAT):

1) **CHECK FOR FROST PROTECTION:** Using the keypad, raise the frost protection set point above the exhaust air temperature. The analog output of the controller should decrease in order to bring the exhaust air temperature above the new set point. After confirming this operation, reset the EAT set point back to the previous setting.

2) **CHECK FOR PROPER RESPONSE TO TEMPERATURE INPUTS:** Set the supply set point to 95° F, the controller should respond by modulating the control output (AO-1) to 10 VDC. Now lower the set point to 35° F. The output of (AO-1) should modulate down toward zero.

3) **CHECK FOR PROPER WINTER TO SUMMER CHANGEOVER:** Warm the outdoor air sensor with your hand until it is at least 10° F greater than the return temperature. The controller should change to summer-dehumidification mode as evident by the cooling ramp shown on the display. The output of the controller should be 10 VDC.

IF IT IS WARM OUTSIDE AND THE CONTROLLER IS IN SUMMER MODE (OAT>RAT):

1) **FULL RECOVERY:** The controller should have an output of 10 VDC.

2) **CHECK FOR PROPER SUMMER TO WINTER CHANGEOVER:** Warm the RA sensor with your hand and observe the changeover as indicated on the keypad display.

TROUBLESHOOTING THE TEMPERATURE CONTROLLER

ARE ALL CONNECTIONS TIGHT?

The best way to check connection tightness is to pull on each wire. A wire might have come loose in shipment or due to vibration.

IS THE CONTROLLER POWERED UP AND TURNED ON?

Verify that the controller has 24VAC power across the HOT and GND terminals in the upper right corner of the controller. There should be two LEDs on during normal operation, Power' and 'Run'. If the red 'Error' LED is on contact SEMCO for more information.

ARE THE CONTROLLER JUMPERS IN THE CORRECT POSITION?

There are four jumpers located at the top center portion of the control board, just right of the battery. The legend for the jumpers is printed on the right side of the controller. The jumper locations below are for standard temperature based wheel control only. Jumper settings may change with more specialized programs.

- The top jumper location has three pins in line. The jumper should be across the two rightmost pins.
- The jumper immediately below has only two pins and the jumper should be in place across these two.
- The final two jumpers are set to the input type for IN-5 and IN-6. These locations have four pins each (2 x 2.) The jumpers should be positioned on the top two pins on each set.

IS THE UNIT WIRED CORRECTLY?

This pertains to a new installation or an installation that has recently been modified. The 24VAC hot power lead goes to the top right terminal on the controller marked "HOT". The 24VAC common/neutral power lead goes to the terminal marked "Gnd". IN-1 through IN-5 are analog input terminals. For the SEMCO standard wheel application, the outdoor air sensor wires to IN-1 and Gnd, the supply air wires to IN-2 and Gnd, the return air (exhaust intake) to IN-3 and Gnd, and the exhaust air (exhaust discharge) to IN-4 and Gnd. The temperature sensors are not polar. The wiring can be traced or the sensors can be individually warmed or cooled to make sure that the sensors are wired to the correct terminals. The sequence will definitely not work correctly if sensors are wired to the wrong terminals.

ARE THE SENSORS FUNCTIONING PROPERLY?

One way to check is to measure resistance across the sensor and sensor wire. At 77°F, the resistance should be about 10K ohms. A very low value would suggest a bad sensor, bad connection or broken wire. Evaluate whether the displayed value is reasonable. If the displayed value is way high or low, considering swapping two sensors to determine if the sensor or the wiring is at fault.

ARE THE CORRECT SIGNAL OUTPUTS BEING GENERATED?

Use the up and down arrows on the keypad to cycle through the display. Find the wheel speed output value in VDC. Verify with an ammeter than this voltage is correct across AO-1 and Gnd terminals on the controller. Check that the wining from AO-1 and the VFD input FR and FC has been completed as required and has not been damaged.

IS THE WHEEL RESPONDING CORRECTLY TO THE CONTROLLER OUTPUT?

If the output is 10 or more volts, the wheel should rotate at full speed. This would be about 20 rpm for an enthalpy wheel and 10 rpm for a sensible wheel. If the output is 0 or less volts, the wheel should rotate at a minimum speed of 1/4 rpm or less. If the signal is correct but the wheel speed is wrong, the problem could either be in the variable frequency drive programming, or possible there is a drive failure and the rotor is freewheeling, being driven by airflow.

WHEEL ROTATION DETECTOR

DESCRIPTION OF FUNCTION

The rotation detector assembly consists of a proximity sensor, target magnet, and circuit (See **FIGURE 34**). The target magnet is mounted to the wheel, and the proximity sensor is mounted to the wheel frame and wired to the circuit board, which will provide an alarm contact and alarm LED light when rotation has not been detected within a preset amount of time. The proximity sensor causes the yellow motion LED on the circuit board to come on when the target magnet is nearby, which also resets the timer. The south pole of the magnet (marked with a dot) must face the proximity sensor, and be within approx. ¼" for proper detection. If wheel motion is not detected within 15 minutes, the red alarm LED on the circuit board comes on, and the alarm contacts close. The alarm condition is latched and can only be cleared by a 3-second "press and hold" of the selector or a power cycle.

INSTALLATION INSTRUCTIONS

TARGET MAGNET PROXIMITY SENSOR

The target magnet will need to be mounted to the wheel. The proximity sensor needs be mounted to the adjacent wheel frame close enough to detect the target (within ¼") and still not rub on any part of the wheel or magnet. If the magnet has a hole in the middle, mount to the rim with a screw or pop rivet. For magnets without a hole, use an epoxy adhesive such as JB Weld.

IMPORTANT: Polarity of the magnet is important to proper operation. The south pole of the magnet must face out (towards the proximity sensor). This is typically marked with a dot on one side of the magnet. If the magnet is not marked, test it by holding it against the proximity sensor (after it is wired & powered). The proximity sensor will detect the south pole side of the magnet much better than the other side.

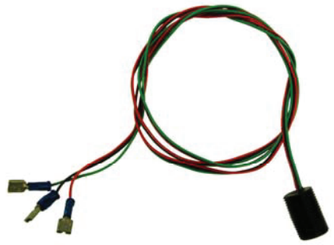
PROXIMITY SENSOR

The proximity sensor must be mounted on the adjacent wheel frame and lined up with the position of the magnet. It will need to be within ¼" of the magnet and should NOT be in line with any bolts or other high spots that could strike and damage the sensor. The sensor is threaded to allow for some depth adjustment. When finished, rotate the wheel by hand to make sure that there are no obstructions.

CIRCUIT BOARD

Mount the circuit board (equipped with din-rail mount) in a nearby enclosure in a convenient location that is reasonably close to the wheel that is being monitored. Wire the proximity sensor to the circuit board using 3-conductor minimum 20awg shielded plenum cable. Use female spade connectors to land the wires on the terminal board, making sure to connect them properly according to the sensor's wire colors. Power wiring and alarm wiring must also be completed. 24VAC +/-10% is required, power draw is less than 10VA. Refer to the wiring schematic on **PAGE 26**.

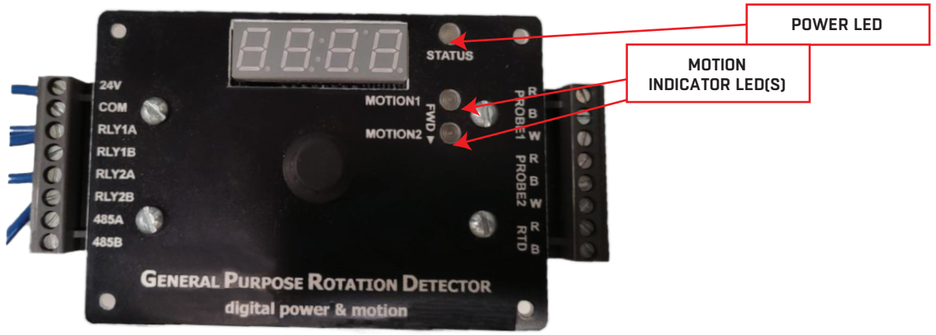
PROXIMITY SENSOR



TARGET MAGNET

Important: South Pole dot must face outwards towards proximity sensor.

STANDARD ROTATION DETECTOR



Status LED Codes		
Color	**Flash Code**	**Description**
Green	0 (no flash)	G0 - Normal operation for all three modes. Power good and microcontroller running.
Green	1 (one flash then pause)	G1 - SMX mode in Stop/Jog operation. SMX mode controller displays G0 when outside of Stop/Jog temperature range.
Red	1 (one flash then pause)	R1 - Motion alarm.
Red	2 (two flashes then pause)	R2 - Reverse alarm.

INSTALLATION SPECIFICATIONS FOR THE WHEEL VFD

Install the inverter in the vertical position on a metal or other nonflammable surface capable of holding the weight of the inverter. The temperature range of the inverter is 14ºF to 122ºF. The maximum relative humidity should be less than 95 percent. The inverter should be located away from the combustible or corrosive gases and condensing atmospheres. The inverter should have a clearance of 4 inches along the top and bottom edges and 1.25 inches along each side for proper cooling of the internal drive components.

ELECTRICAL REQUIREMENTS FOR THE YASKAWA V1000

YASKAWA MODEL	LINE POWER	MAX. INPUT MCCB RATING	RATED OUTPUT AMPS	RATED INPUT AMPS	HP
CIMR-VU-2A0006FAA	200-230/3/60	15A	6	7.3	1
CIMR-VU-4A0002FAA	460/3/60	15A	2.1	2.1	1

ELECTRICAL CONNECTIONS FOR THE YASKAWA V1000

Connect three phase line power to terminals R, S, and T. Connect single phase line power to terminals R and S. Connect the motor leads to terminals U, V, W. If wheel rotation is backwards, disconnect power, and switch any two of the U, V, W leads. The drive is programmed by SEMCO to accept a 0-10 VDC control input signal and a dry contact start/stop signal. The 0-10 VDC signal positive lead is connected to terminal "A1" and the signal common to "AC". The start/stop signal is not polar and is connected to terminals "S1" and "SC". If this start/stop signal is not used, a jumper is required. See the Yaskawa V1000 drive technical manual for other control signal and start/stop options(e.g. 4-20mA or preset speeds.) A nearby service disconnecting means on the line side of the inverter is recommended.

MOTOR

The motor provided for the True 3Å Energy Recovery Unit is an inverter duty motor.

NOTE: In some special applications, a different motor may be supplied to power the unit. If so, separate instructions will be provided. See the submittal data to verify the type of motor provided.

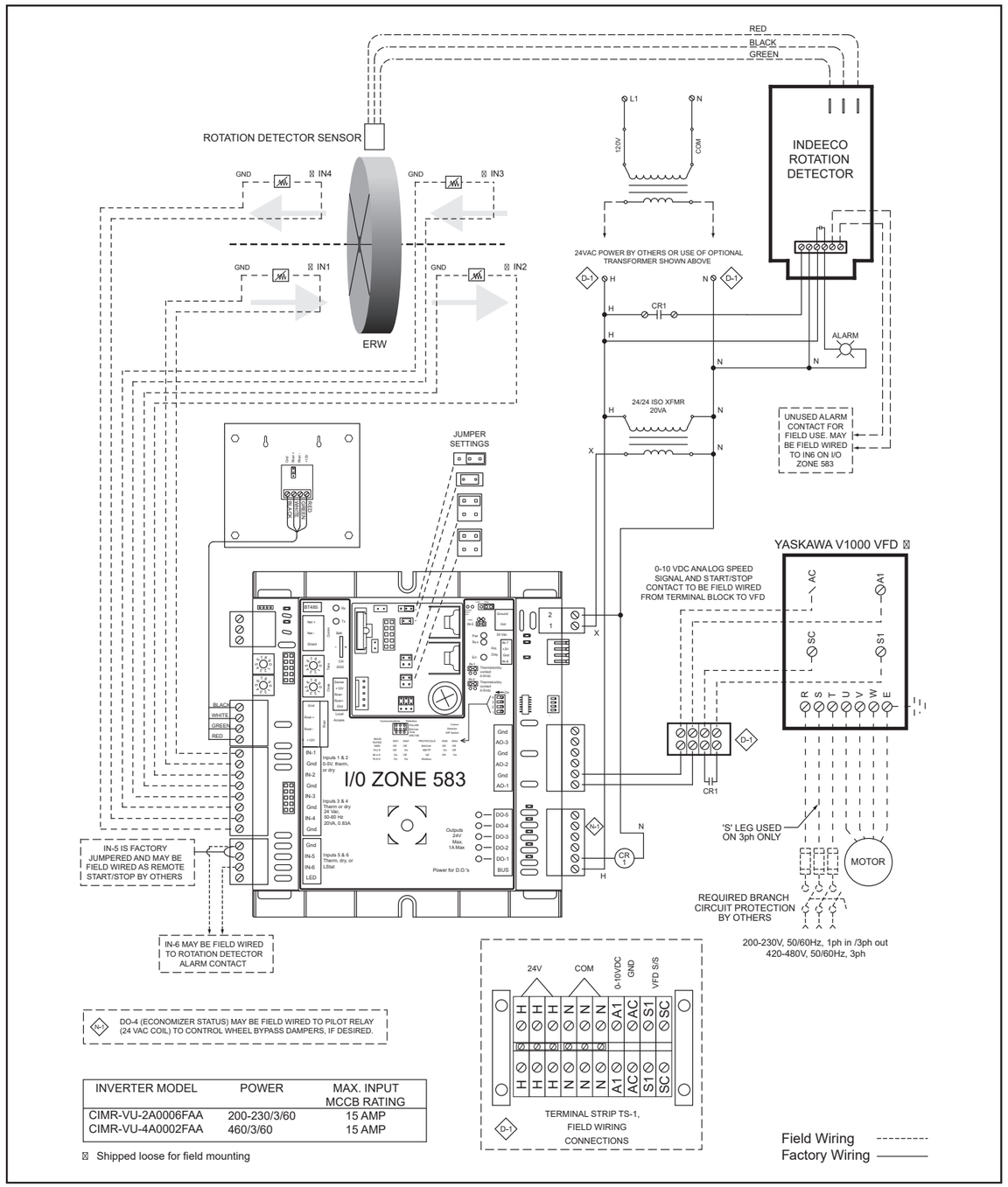
BROTHER GEAR MOTOR

SEMCO uses the Brother mid-series gear motors. Horsepower and drive ratio is shown on the gear motor nameplate and vary with wheel size. The gear motors use a maintenance free, lifetime lubricant synthetic grease.

ROTATION DETECTOR

The True 3Å wheel has a rotation sensor placed at the wheel rim. The rotation detector consists of a printed circuit board mounted in a Nema 1 box with an alarm indicator light and push button reset switch on the face of the box. A set of normally open (N.O.) dry contacts is provided for field connection to a remote alarm (to be provided by others.) The Nema 1 box is shipped loose for customer mounting. The rotation detector requires 24V, 50/60Hz power.

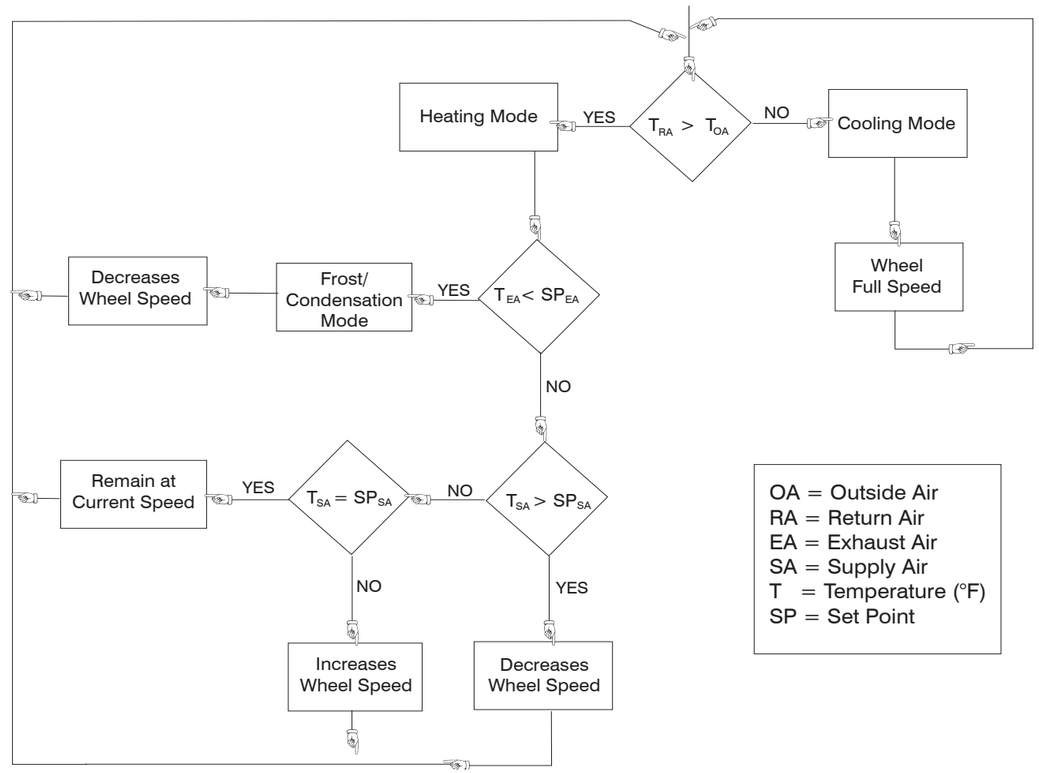
WIRING SCHEMATIC



INVERTER MODEL	POWER	MAX. INPUT MCCB RATING
CIMR-VU-2A0006FAA	200-230/3/60	15 AMP
CIMR-VU-4A0002FAA	460/3/60	15 AMP

⊠ Shipped loose for field mounting

FIGURE 35. Operational flow chart for proper temperature and wheel speed operation.



START-UP AND OPERATION

1) Before starting the True 3Å Energy Recovery Wheel Unit, check the following:

- Are the shipping braces, brackets and restraints removed? If not, remove them (See **STORAGE** on **PAGE 8**).
- Does the rotor rotate freely by hand? If not, recheck the seal to determine whether or not it is binding and ensure that shipping brackets are removed (See **PLANNING FOR INSTALLATION** on **PAGE 9**).
- Pull back the seal in several places. Does the rotor clear the sealing ring? If it's too close, adjust the seal (See **ADJUSTING THE SEALS** on **PAGE 13**).
- Do the airflow arrows conform to the installed ducts? If not, ducting will have to be corrected (See **PLANNING FOR INSTALLATION** and **ATTACHING DUCTWORK** on **PAGES 9** and **12**).
- Does the power supply match the supply required by the electrical equipment? If not, the electrical equipment or the power supply must be changed (See **TEMPERATURE CONTROLLER** on **PAGE 15**).

2) Determine drive sheave rotation to make sure that the motor will rotate the rotor in the correct direction. If the rotor is turning backward, reverse the rotation by switching any two motor leads on the motor side (terminals U, V, and W) of the variable frequency controller.

3) Attach the belt and check for adequate tension.

FIGURE 36. The purge section on the wheel.

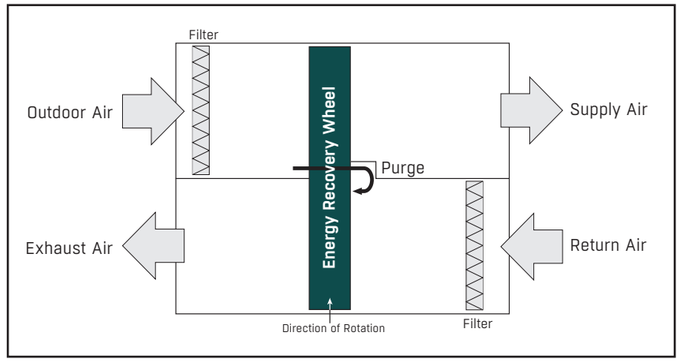


FIGURE 37. The purge uses outdoor air to clean the media before the rotor turns into the outdoor air stream.

ADJUSTING THE PURGE

As the wheel turns from the exhaust to the supply air stream, a small amount of the outdoor air is sent through the flutes for the media to clean it as it passes the purge (See **FIGURES 36** and **37**). If exhaust air were permitted to mix with clean supply air, cross-contamination would occur. The small amount of outdoor air directed through the purge prevents this from happening.

The purge utilizes the pressure differential between the outdoor and return air streams to clean the media before the rotor turns into the outdoor air stream (See **FIGURE 35**).

Adjusting the purge to local conditions requires that the air pressure be measured in the two crucial air streams, the outdoor and return air streams. Install a pressure tap close to the rotor surface in the outdoor and return air stream as indicated in **FIGURE 35**. Connect the pressure taps to a differential pressure gauge and record the difference.

For proper operation, the pressure difference between the outdoor and the return air stream (POA - PRA) must be greater than 1 inch water gauge. If the pressure difference is less than 1 inch w.g. consult SEMCO.

Referring to **TABLE 1**, determine the range where the measured pressure difference falls. For example, if you measure a pressure difference of 1.25 in. w.p., then the appropriate range would be 1.0 - 1.5.

Read the corresponding purge index setting in the same row. In our example, the corresponding purge index setting is 6.

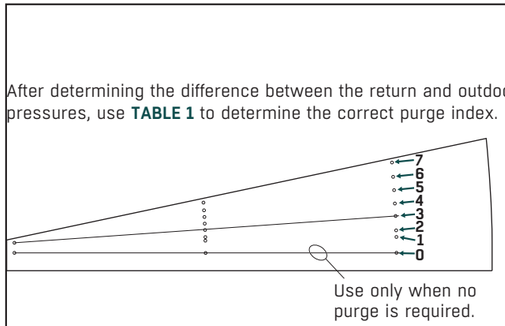


FIGURE 38. Purge index detail.

PRESSURE DIFFERENCE RANGE (in. w.g.)	PURGE INDEX SETTING: ENTHALPY WHEEL	SENSIBLE WHEEL	PASSIVE DEHUMIDIFICATION WHEEL
0.00 - 0.99	Consult SEMCO		
1.00 - 1.5	6	3	3
1.6 - 2.0	5	3	2
2.1 - 3.0	4	2	1
3.1 - 6.0	3	2	1
6.1 - 10.0	2	1	1
> 10.0	1	1	1

TABLE 1. Purge index setting.

TUBE FRAME WHEEL PURGE ADJUSTMENT

1) Remove the adjusting bolt(s) from the line of holes at the top (and middle if applicable) of the purge (See **FIGURE 39**).

2) Loosen the bottom pivot bolt (See **FIGURE 40**).

3) Close or open the wiper located between the wheel and the purge plate.

4) Locate the appropriate index hole and align purge wiper. The first hole from the rotor center line is "0", the second hole is "1", and so on.

FIGURE 39. To adjust the purge, remove the adjusting bolt.

5) Tighten both the adjusting bolt and the pivot bolt after setting the purge. Be sure to reseal the purge with silicone caulk after completing the adjustment (See **FIGURE 41**). A bead of caulk should be laid where the purge wiper joins the purge front plate.

6) Check the seal adjustment on the rim and the purge wiper. The seal should be adjusted as described on **PAGE 13**, Adjusting the Seals.

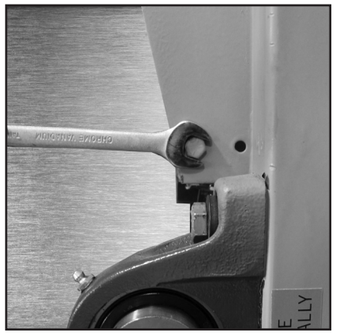


FIGURE 40. After removing the adjusting bolt(s), loosen the bottom pivot bolt.

FIGURE 41. After adjusting the purge and tightening the adjusting and bottom pivot bolts, apply silicone caulk where the purge wiper joins the purge front plate.

SHEET METAL FRAME WHEEL PURGE ADJUSTMENT

1) Remove the screws that connect the purge plate assembly to the support beam as shown in **FIGURE 42**.

2) After screws are removed, slide assembly out from behind support beam as shown in **FIGURE 43**.

3) After removing the assembly, loosen the pivot bolt (**FIGURE 44**) and remove the adjusting bolt (**FIGURE 45**).

4) With adjusting bolt removed, adjust purge wiper to the appropriate index hole and re-install adjusting bolt using a thread locking compound. The hole closest to the bend is "0", the second is "1" and so on.

5) Slide the assembly back under the support beam and re-attach assembly.

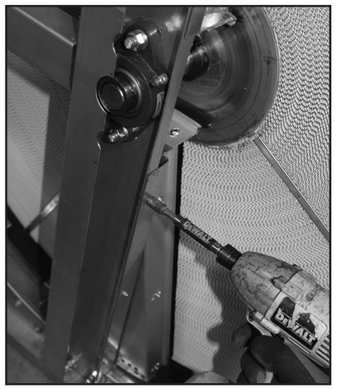


FIGURE 42. Remove screws from Sheet Metal Frame purge section.

FIGURE 43. Sheet Metal Frame purge section removal.

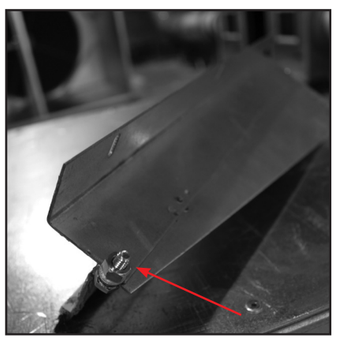


FIGURE 44. Purge wiper pivot bolt.

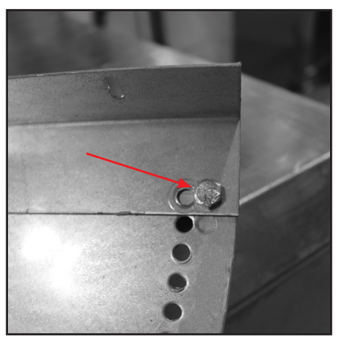


FIGURE 45. Purge wiper adjusting bolt.

PROGRAMMING THE WHEEL MOTOR VFD

LEDS FOR THE YASKAWA V1000

LED	ON	FLASHING	OFF
ALM	A fault has occurred	When an alarm occurs	Normal state (no fault or alarm)
REV	Motor is rotating in reverse	-	Motor is rotating forward
DRV	Drive Mode / Auto-tuning	When DriveWorksEZ is used	Programming mode
FOUT	Displays output frequency (Hz)	-	-
LO/RE	When run command is selected from LED operator (LOCAL)	-	Run command is selected from REMOTE device
RUN	During run	During deceleration to stop Run command is present but the frequency reference is zero	During stop

Functions for the Yaskawa V1000

The drive functions are accessible using the up and down arrows from the main menu:

FUNCTION	DISPLAY	DESCRIPTION
Frequency Reference Display	F 0.00	Allows user to monitor and set the frequency reference while the drive is running.
Forward/Reverse	For / rEv	Indicates if motor is rotating forward or in reverse.
Output Frequency Display	0.00	Monitors the frequency output by the drive.
Output Current Display	0.00A	Monitors the output current of the drive.
Output Voltage Reference	0.0v	Monitors the output voltage of the drive.
Monitor Display	Mon	Monitor parameters are displayed.
Verify Function	vrFY	Lists all parameters that have been edited or changed from default settings.
Setup Group Parameters	STUP	A select list of parameters necessary to get the drive operational quickly.
All Parameters	Par	Allows the user to access and edit all parameter settings.
Auto-Tuning	ARUn	Motor parameters are calculated and set automatically.

START/STOP CONTROL OF THE YASKAWA V1000

TOGGLE BETWEEN REMOTE AND LOCAL CONTROL.

NOTE: Drive **MUST** be in a **STOP** condition before control can be switched.

1) Pressing "LO/RE" key will toggle between LOCAL/REMOTE Control. LOCAL Control is active when LO/RE key's LED is GREEN.

FOR REMOTE CONTROL, choose REMOTE (RE) control. "START/STOP" contact closure between S1-SC and 0-10V analog input at terminals A1-AC will control Drive.

1) Press "ESC" key until left-most part of Drive's display shows "F". "DRV" LED will also be lit. Frequency Reference is displayed.

2) Press "UP" arrow twice to view Drive's Output Frequency. "FOUT" LED will also be lit. This is not required to run Drive.

3) To RUN, close contact between S1-SC. Drive's Output Frequency is defined by 0-10Vdc input at terminals A1-AC.

4) To STOP, open contact between S1-SC.

FOR MANUAL CONTROL, choose LOCAL (LO) control. (LOCAL is active when LO/RE key's LED is GREEN.) "RUN", "STOP" and keypad entered Frequency Reference setpoint will control Drive.

1) Press "ESC" key until left-most part of Drive's display shows "F". "DRV" LED will also be lit. Frequency Reference is displayed.

2) Using ARROWS, adjust Frequency. Change is automatic when Parameter (02-05=1) otherwise ENTER key must be pressed

3) To RUN, simply press RUN key. To view actual Output Frequency, press "UP" arrow twice. "FOUT" LED will also be lit.

4) To STOP, simply press STOP key.

PROGRAMMING PARAMETERS

PROGRAMMING THE WHEEL MOTOR VFD:

(**NOTE:** For most V1000 parameters, the Drive must be in a **STOP** condition while programming.)

1) Press "ESC" key until left-most part of Drive's display shows "F". "DRV" LED will also be lit.

2) Press "DOWN" arrow twice to display "PAr" then Press "ENTER" key. (Parameters are now accessible)

3) Using "UP/DOWN/RIGHT" ARROWS, select parameters to be read and/or changed starting with A1-01.

4) If required, use "RIGHT" ARROW or "ENTER" key to scroll to right-most digits of parameter name. Digits will flash.

5) Press "ENTER" key to read value.

6) Using "UP/DOWN/RIGHT" ARROWS, set desired value then press "ENTER" key to store value. (Drive will accept value, if valid, then re-display parameter number (i.e. B1-01, C1-02, etc.)).

7) Start wtih Parameter A1-01. Make sure A1-01=2 to allow access to **ALL** parameters.

8) Repeat steps 3 - 6 to program remaining parameters per application requirements.

9) When complete, press "ESC" key until left-most part of Drive's display shows "F". "DRV" LED will also be lit.

V1000 Drive is now ready to run.

PROGRAMMING PARAMETERS

PARAM. TITLE	FUNCTION	OPTIONS	DEFAULT SETTING	SEMCO SETTING	COMMENTS
B1-01	Frequency Reference Selection 1	0: Operator - Digital preset speed d1-01 to d1-17. 1: Terminals - Analog input terminal A1 or A2. 2: MEMOBUS communications 3: Option PCB 4: Pulse Input (Terminal RP)	1	1	Selects the frequency reference input source.
B1-02	Run Command Selection 1	0: Operator - RUN and STOP keys on the digital operator. 1: Digital input terminals 2: MEMOBUS communications 3: Option PCB	1	1	Selects the run command input source.
B1-04	Reverse Operation Selection	0: Reverse enabled. 1: Reverse disabled.	0	1	Permits or prohibits reverse operation.
B1-07	Local / Remote Run	0: Run command must be cycled 1: Continue running	0	1	Drives runs if run command is active in new controller.
B1-17	Run Command at Power Up	0: Run command must be cycled 1: Run command issued	0	1	Drive runs if run command is active at power up.
C1-01	Acceleration Time	0.0 to 6000.0	10	60	Acceleration time
C1-02	Deceleration Time	0.0 to 6000.0	10	60	Deceleration time
C4-01	Torque Compensation	Gain 0.00 to 2.50	1	0	Compensates for added load by increasing output voltage.
C6-01	Normal/Heavy Duty Selection	0: Heavy Duty (HD) for constant torque applications. 1: Normal Duty (ND) for variable torque applications.	1	1	Selects the load rating for the drive.
C6-02	Carrier Frequency Selection	1 : 2.0 kHz 2 : 5.0 kHz 3 : 8.0 kHz 4 : 10.0 kHz 5 : 12.5 kHz 6 : 15.0 kHz 7 : Swing PWM1 (Audible sound 1) 8 : Swing PWM2 (Audible sound 2) 9 : Swing PWM3 (Audible sound 3) A : Swing PWM4 (Audible sound 4) B to E: No setting possible F : User defined (determined by C6-03 through C6-05)	3	1	Lower carrier frequencies increase torque and audible noise.
D2-02	Frequency Reference Lower Limit	0.0 to 110.0	0	1.2	Sets the frequency reference lower limit as a percentage of maximum output frequency (E1-04). Output speed is limited to this value even if the frequency reference is lower. This limit applies to all frequency reference sources.
E1-03	V/f Pattern Selection	0 to FF	FF	FF	Allows custom voltage frequency curve.
E1-04	Max Output Frequency	40.0 to 400.0	60	120	Maximum frequency
E1-05	Max Output Voltage		230 460	230 460	Maximum output voltage.
E1-06	Base Frequency	0.0 to E1-04	60	60	Frequency at which maximum output voltage occurs
E1-07	Mid Output Frequency	0.0 to E1-04	3	3	Frequency for midpoint voltage
E1-08	Mid Output Voltage		18.4 36.8	See table	Output voltage at corresponding midpoint frequency

Param. title	Function	Options	Default setting	SEMCO setting	Comments
E1-09	Minimum Output Frequency	0.0 to E1-04	1.5	1.4	Minimum frequency
E1-10	Minimum Output Voltage		13.8 27.6	See table	Output voltage at minimum frequency.
E2-01	Motor Rated Current	10 to 200% of drive rated current	kVA dependent	See table	Motor nameplate FLA
E2-03	Motor No-Load Current	0 to [E2-01]	kVA dependent	See table	Motor No-Load Current
L1-01	Motor Overload Protection	0: Disabled 1: Std. Fan Cooled (speed range < 10:1) 2: Std. Blower Cooled (speed range ≥ 10:1) 3: Vector Motor (speed range 100:1)	1	3	Overload function based on motor type
L2-01	Momentary Power Loss Operation Selection	0: Disabled - Drive trips on (Uv1) fault when power is lost. 1: Power Loss Ride-Thru Time - Drive restarts if power returns within the time set in L2-02. 2: CPU Power Active - Drive will restart if power returns as long as the CPU is working.	0	2	Allows drive to restart after power loss without a fault
L3-01	Stall Prevention Level during Acceleration	0: Disabled 1: Enabled 2: Intelligent Stall Prevention	1	0	Disables stall prevention during acceleration
L3-04	Stall Prevention Level during Deceleration	0: Disabled 1: General Purpose Stall Prevention 2: Intelligent Stall Prevention 3: Stall Prevention with Braking Option 4: Overexcitation Braking	1	0	Disables stall prevention during deceleration
L3-05	Stall Prevention Level during Run	0: Disabled 1: Decelerate Using C1-02 2: Decelerate Using C1-04	1	0	Disables stall prevention during run
L5-01	Number of Auto Restart Attempts	0 to 10	0	5	Selects number of automatic restart attempts after fault.
L8-07	Output phase loss protection	0: Disabled 1: Enabled 2: Enabled	0,1	0	Selects the output Phase loss detection

MOTOR DEPENDENT PARAMETERS FOR BROTHER GEARMOTORS*

	1/4 Hp		1/2 Hp		1 Hp	
BROTHER P/N	G3***N***-BMK4**		G3L22N***-BML4**		G3L28N***-BMM4**	
MOTOR VOLTAGE	208-230/3/60	460/3/60	208-230/3/60	460/3/60	208-230/3/60	460/3/60
E1-08	15.3	31	15.3	28.5	16	35
E1-10	12.5	25	12.3	25	12.8	20
E2-01	1.0	0.5	1.8	0.9	3.1	1.6
E2-03	0.6	0.3	1.1	0.5	1.9	1.0

*SEMCO does not recommend use with motors other than those listed. Consult Yaskawa for assistance in programming for use with other motors.

TROUBLESHOOTING THE YASKAWA V1000

A failure in the drive can fall into one of two categories, Alarm or Fault.

WHEN THE DRIVE DETECTS A FAULT:

- The digital operator displays text that indicates the specific fault and the ALM indicator LED remains lit until the fault is reset.
- The fault interrupts drive output and the motor coasts to a stop.
- It will remain inoperable until that fault has been reset.

WHEN THE DRIVE DETECTS AN ALARM (MINOR FAULT):

- The digital operator displays text that indicates the specific alarm or minor fault and the ALM indicator LED flashes.
- The motor does not stop.
- The digital operator displays text that indicates the specific alarm or minor fault and the ALM indicator LED flashes.
- Remove the cause of an alarm or minor fault to automatically reset.

In the event of an alarm or fault consult the Yaskawa V1000 Technical Manual, available at www.drives.com, or contact SEMCO DWP Technical Service at (573) 443.3636 for assistance.

MAINTENANCE

The True 3Å Energy Recovery Wheel Unit will operate efficiently and reliably for many years with minimum maintenance and service. Most maintenance activities require little more than checking various devices and parts to make sure they are tight or functioning properly.

Daily Maintenance – It is recommended that the unit be visually inspected daily. Taking a few moments each day to make sure that the unit is functioning will save many future hours, dollars and headaches. Each day, ensure that:

- the rotor is rotating under power;
- the motor is running;
- and all devices are on and operating (the variable frequency controller, temperature controller and rotation detector.)

All other maintenance activity should be conducted monthly, quarterly, semiannually or annually as described on the following pages. All essential maintenance services are summarized in a chart printed at the end of this section.

ROTOR BEARING

The rotor bearing's anticipated average life is 20 years. The bearing was greased prior to shipment. However, lubrication just prior to start-up is recommended. Recommended lubrication – The bearing's lubrication cycle depends upon the range of temperatures normally experienced by the unit 24 hours a day. For a typical temperature range of -20°F to 130°F, lubrication every 6 months is adequate. If higher temperatures are experienced, 130°F to 170°F, lubrication every 3 months is recommended. For environments with temperatures above 170°F, consult SEMCO.

Grease should be pumped into the 2 bearing grease points - one located on each side of the rotor (See **FIGURE 46**). A high grade NLGI No. 2 grease is recommended.

NOTE: If a rotor bearing requires replacement, contact SEMCO for detailed instructions. The bearing bolts normally require checking at start-up only. For torque values, see **TABLE 2**.

BEARING SET SCREWS

1) The bearing set screws should be checked periodically for tightness. A bearing set screw is located on each side of the rotor (See **FIGURE 47**). Recommended checking frequency – Bearing set screws should be checked at start-up, one month after start-up, then every 6 months thereafter.

2) The bearing set screws should be torqued to 15 ft-lbs.

MOTOR

The motor has deep grooved, double-shielded bearings with sufficient lubricant packed into the bearings by the manufacturer for "life lubrication." The initial lubricant is supplemented by a supply packed into larger reservoirs in the end shield at the time of assembly. No grease fittings are provided as the initial lubrication is adequate for up to 10 years of operation under normal conditions. No lubrication is required.

VARIABLE FREQUENCY CONTROLLER

1) The variable frequency controller is cooled by air flowing through the heat sink slots. The slots must never be allowed to become obstructed with dirt or foreign material. Periodically check and clean the heat sink slots with compressed air or a vacuum. Airflow must never be restricted in any way.

2) Check and clean the variable frequency controller annually.

FASTENER TYPE		TORQUE ft-lb.
Bearing bolts	1/2"	50
	5/8"	80
	3/4"	120
Bearing set screws		15
Rim bolts		35
Taper locks (bushing bolts)		15

Table 2. Torque values for various bolts

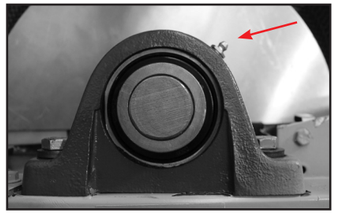


FIGURE 46. Grease should be pumped into two rotor bearing grease points, one located on each side of the rotor. Lubrication frequency depends upon operating temperatures normally experienced around the rotor.

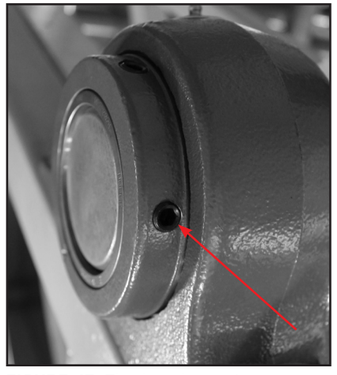


FIGURE 47. The bearing set screws, one on each side of the rotor, should be checked for tightness every six months.

SEALS

Properly adjusted seals are an important element for effective, efficient unit operation. The seals must be adjusted to gauge depth prior to the startup. Subsequently, seals should be checked in several places with the seal gauge after the first month of operation, and every 3 months thereafter.

NOTE: If seals give any sign of binding the rotor, they should be adjusted immediately. To adjust the seals, see complete instructions on page 13 under "Adjusting the Seals." The rotor should be checked periodically to ensure the continued integrity of the bushings, shaft, spokes, media and rim.

THE ROTOR AND MEDIA

1) Checking for rotor run out – Shut off the unit. Has any media loosened from the spokes? Are the rims securely bolted to the spokes? Are the spokes tight? Is the rotor well centered? Examine the shaft closely for any indication that the bushings have moved. Note whether or not the rotor has moved closer to the seals on one side of the unit or the other. Has the rotor moved closer to the seals at the right or the left of the rotor or has it moved closer to seals at the top or bottom? If so, call SEMCO. Check the rotor for flatness. Using a machinist's scale or a dial indicator, measure the distance between the media and a main support. Rotating the rotor by hand, measure distances at three positions on each media wedge and in the center of each spoke. (See **FIGURE 46**.) All measurements should be within 1/16 inch. If not, call SEMCO. Rotor run out checks should be conducted at start-up, after 3, 6 and 12 months of operation, and at least once a year thereafter.

2) Checking for media tightness – Shut off the unit. Select an area of media near the hub and place your hands flat against the media. Attempt to move the media to either side and up and down. Perform this test on each wedge of media. If any movement is detected, call SEMCO immediately. Check for media tightness at start-up, after the first month of operation, and every 3 months thereafter.

3) Media cleaning – The FläktGroup SEMCO True 3Å energy recovery wheel has been designed so that a laminar flow is maintained within the transfer media at all operating conditions. This means that the air and all other particles in the air stream pass straight through the wheel. Due to the laminar flow profile through the True 3Å energy wheel, any collection of dust or particulate matter will occur at the entering and leaving edges of the transfer media. Such buildup can usually be vacuumed, purged with compressed air or wiped from the rotor surface. In rare cases where a more thorough cleaning is required, low temperature steam or hot water and detergent may be used. Follow the instructions on the following page when using cleaning methods other than compressed air or vacuuming.

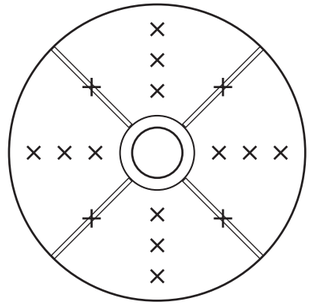


FIGURE 46. To check the rotor for flatness, measure the distance from main frame support to media and spokes at location marked by an "X" in this illustration. If the rotor contains more than four wedges, the same measurement locations should be used for the additional wedges and spokes.

SEMCO ENERGY RECOVERY WHEEL CLEANING PROCEDURE

TOOLS & MATERIALS REQUIRED:

- Air compressor capable of sustaining 90 psi
- Air spray nozzle without OSHA relief
- Wet dry vacuum
- 409 spray cleaner, approx (8) 1-quart bottles per average size wheel
- 2-3 soft 2” sash paint brushes
- Several large canvas drop cloths, and materials to hang cloth vertically
- Step ladder 6-8 ft
- Stand lighting
- Safety goggles

CLEANING PROCESS:

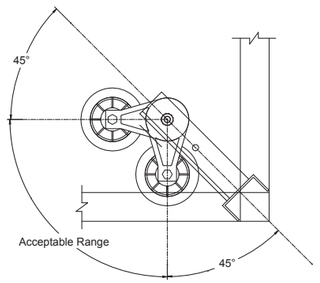
Turn off the air handler & wheel (wheel must be stopped and airflow off).

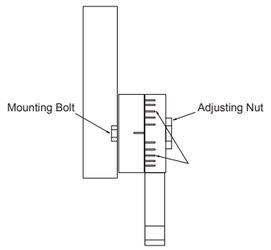
Liberally spray 409 cleaner on a small section of media (onto the dirty return air side) and let it foam, softening debris and dirty residue.

After the cleaning liquid is absorbed into the residue, use approx. 90 psi of compressed air and blow from the opposite side (exhaust air side), catching the blown off material on pre-placed drop cloths.

Next, lightly sweep the soft sash brush across the face of the media to remove any leftover residue or film, which should leave a clean media edge. Use stand lighting to shine light on one side of the wheel, so you can look through the other side and check on your progress. The wet-dry vacuum can be used to clean up any residue blown off that missed the drop cloths. A slight cleaner smell will be present for a short time when the airflow is turned back on, but should evaporate and clear out quickly.

The cleaning is a slow process, and an average size wheel of 8-10 ft in diameter will probably take one man at least an 8-hour shift total to clean. To minimize downtime, a wheel could be cleaned a few pie sections at a time, so the air handler could be brought back on when required, then shut down later and the cleaning continued on the remaining pie sections at the next opportunity.





DRIVE BELTS

The belts should be checked periodically for wear and correct belt tension after start-up and semi-annually thereafter.

BELT TENSION DETAIL

The tensioner must be positioned so that after final tensioning it is at no less than a 45 degree angle with the centerline of the mounting bracket. Anything less will limit the effectiveness of the tensioner and may cause premature belt failure. If, due to belt wear, the standard mounting position and belt length cannot meet this requirement the belt tensioner may need to be moved on the mounting bracket.

TENSIONER ADJUSTMENT

1) Loosen the tensioner by accessing the mounting bolt from the back side of the mounting bracket.

2) Adjust the tensioner base by using a wrench on the adjusting nut to load the tension spring.

3) Tighten until belt is snug and preload tensioner spring to approximately 50%-75%. Utilize tick marks on the tensioning arm and base as a guide. After final tensioning the tensioner should be able to move one full tick mark when pulled to compress the spring (removing belt tension).

MAINTENANCE SCHEDULE

SERVICE	MONTH												
	Startup	1	2	3	4	5	6	7	8	9	10	11	12
Rotor bearing lubrication	X						X						X
Bearing bolts tightness	X												
Bearing set screw tightness	X	X					X						X
Sheave set screw tightness	X	X					X						X
Motor and gear reducer bolt tightness	X	X					X						X
Belt wear	X						X						X
Adjust seals	X	X		X			X			X			X
Rotor runout & flatness*	X			X			X			X			X
Media tightness	X	X		X			X			X			X
Check/ recalibrate temperature controller													X
Check/clean variable frequency controller													X

***NOTE:** Rotor runout and flatness checks should be accomplished annually after the first year of operation.

APPLYING THE V-BELT FASTENER

1) **STRAIGHTEN BELT END** Reverse-bend end of belt as shown to remove curl.

2) **INSERT BELT IN HOLDER** Press against flat surface to square belt end with end of holder. Tighten holder screw.

3) **INSERT FASTENER IN HOLDER** tight against end of belt. Be sure belt stays flush with end of holder.

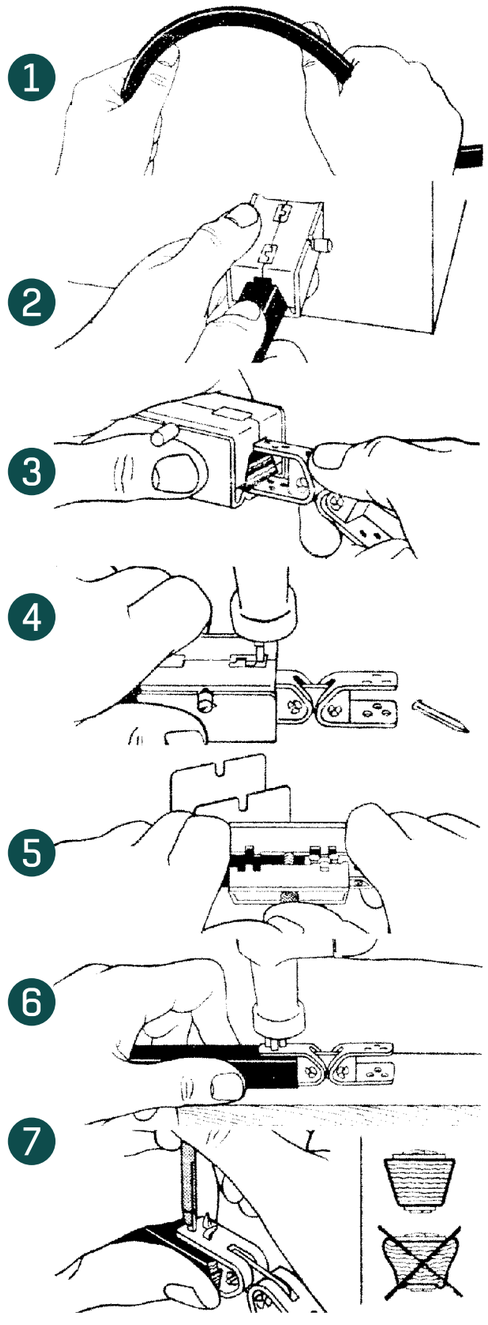
4) **DRIVE NAILS** one at a time, with light hammer blows. Work on a solid surface.

5) **REMOVE BELT** from holder.

6) **DRIVE NAILS** all the way through fastener into soft wood. (do not crush fastener)

7) **BEND NAILS AND CLINCH** (do not crush fastener)

NOTE: For line shafts or outboard bearings, wrap belt around shaft before applying second half of fastener.

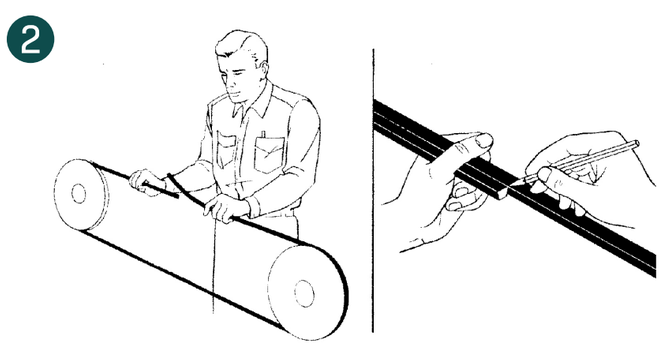


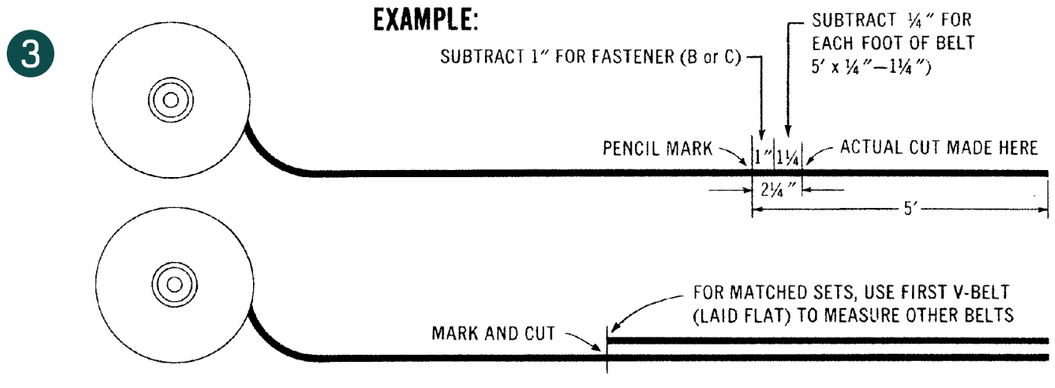
Adjusting Belt Length

1) Set motor using 1/3 of its take-up.

2) Wrap belt around sheaves, pull tight, and mark.

3) Correct the length.





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