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Energy Recovery Mini-Systems

Installation, Operation and Maintenance Manual

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GENERAL SAFETY INFORMATION

1) Follow all local electrical and safety codes, as well as the National Electrical Code (NEC), the National Fire Protection Agency (NFPA), where applicable. Follow the Canadian Electric Code (CEC) in Canada.
2) Only qualified personnel should install this system.
3) All moving parts must be free to rotate.
4) Unit must be securely and adequately grounded.
5) Adjustments to fan speed significantly effect motor load. If the fan RPM is changed, the motor current should be checked to make sure it is not exceeding the motor nameplate amps.
6) Never open access doors to the unit while it is running.
7) Verify that the power source is compatible with the equipment.

DANGER

Always disconnect power before working on or near this equipment. Lock and tag the disconnect switch or breaker to prevent accidental power up.

CAUTION

When servicing the unit, the internal components may be hot enough to cause pain or injury. Allow time for cooling before servicing.

The Carnes WM Energy Recovery Ventilator is shipped as a factory assembled factory-wired and run-tested unit. This includes an air-to-air rotary exchanger, supply and exhaust fans, supply and exhaust filters as well as an electrical control panel. The system is housed in a weather tight cabinet. In addition, optional reheat and/or cooling coils as well as supplementary dampers, controls and safety devices may be provided in the system depending on individual requirements.

This manual describes basic installation, operation and maintenance requirements for the common system features. Non-cataloged features may be covered by the Equipment Submittal or separate Carnes Instructions.

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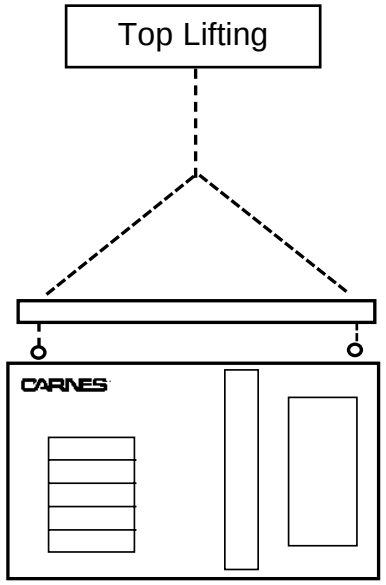
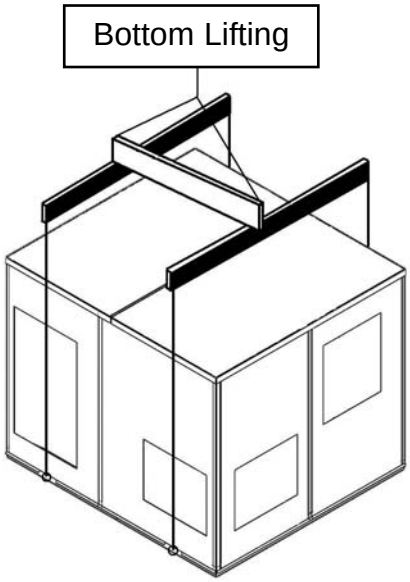
RECEIPT and STORAGE

1) The unit must be thoroughly inspected before accepting delivery from the carrier. Inspect for:
   a) Impact damage or serious scratches to the exterior.
   b) Damage to the interior components such as energy recovery wheel, fan and motor mountings or wiring.
2) Any discrepancies in equipment or condition as received must be reported in writing to the carrier and Carnes Company immediately. In particular note: the optional roof curb is shipped in advance for installation as part of the building roof.
3) The system is weather tight. However, if extended storage without operation is expected:
   a) Any special unit roof penetration not connected to operating ductwork should be covered with rainproof coverings.
   b) All access panels should be tightly closed.
   c) Store the unit indoors, under roof. Moisture and high and low temperature extremes may harm the unit. If stored more than 3 months, rotate the rotor, and fans, at least 3 turns by hand. Repeat every 3 months.





PLACEMENT and INSTALLATION

1) Hoist the ventilator only with the lifting brackets provided. Attach a suitable chain or strap and spreader bar. Access panels/doors must be in place during lifting to prevent damage.
2) Before lifting for final placement, confirm the duct locations are correctly oriented to the building connections. Install the foam gasket provided with the optional curb on the top flange of the curb to seal against the under side of the system. The lifting brackets ARE NOT to be used for hanging the unit. Support the unit from below if it is installed in a hanging position.
3) After all items have been completed, lift the system into position on the curb. Carnes optional curb allows a tolerance of 1” (25mm) to 2” (51mm) on each axis when positioning the system, so care must be taken accurate placement to match with ductwork and utility connections through the curb.
4) After removing shipping covers from airflow openings, fasten and seal the connecting ductwork. No specific provisions are made for fastening the unit base to the curb. If this is required, use caution to maintain the weather tightness of the unit, curb and roof.
5) The electrical diagram for the energy recovery system is found inside the control panel located outside the unit. Verify that the available power matches the unit. Then, incorporating applicable **NEC** and local code requirements, run the power supply to the main disconnect switch.
6) Damper motor and safety controls are wired by Carnes. Verify from the project plans and specifications, or Carnes electrical diagram which controls or equipment within the system are to be “field wired” or “provided and wired in the field.”
7) In specific instances, other building controls (i.e., master time clocks or fire protection systems) may interface with the Carnes energy recovery system. Verify that building controls are compatible with the controls on the Carnes electrical diagram.

MOUNTING INTAKE WEATHER HOOD

1) This only applies if the unit was shipped with the intake weather hood not attached.
2) If the intake opening are covered for shipment, remove the cover before installing the weather hood. The weather hood comed with gaskets already installed.
3) For weather hoods with gravity back draft dampers, center the weather hood over the intake hole. Then mount the weather hood onto the cabinet with sheet metal screws using the pre-made holes in the weather hood flanges. If self drilling sheet metal screws are not used it may be necessary to mark and pre-drill holes in the cabinet for the sheet metal screws.

START-UP and OPERATION

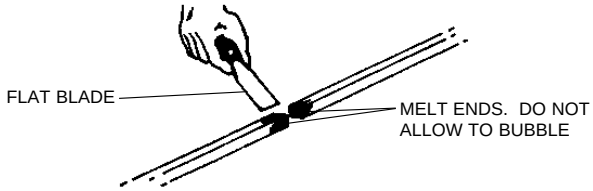
1) Verify that all Placement and Installation tasks have been completed, including the removal of all airflow opening/damper shipment covers.
2) Verify that the tensions on all fan belts (adjusted by motor location) are proper. “A” belts when properly adjusted on typical fan drives require 8-1/4 pounds (3.75 Kg) [+10%] to deflect the midpoint on the belt 1/64 of the distance between sheave centers. The belts should be tight enough not to “squeal” audibly on start-up. If they are allowed to squeal on start-up, accelerated belt and sheave wear will result.
3) Check all fasteners and set screws on the fans, motors and motor plates for tightness and security before powering up the unit.
4) Verify fan rotation is correct. This can be viewed with access panels removed, or looking through the discharge duct openings.
5) Forward-curved fans used with this unit will overload severely if operated without all access panels/doors in place. Therefore, any run inspections made with an access panel/door removed **MUST** be brief (less than 2 minutes) to avoid tripping motor starter thermal overloads and/or damaging the motor and wiring.

> **CAUTION:** *Avoid operating the fans for extended periods unless the wheel is also operating. During rotation the wheel is self-cleaning, but when stopped debris can accumulate on the wheel surface over an extended period of time. This accumulation increases the static pressure drop across the wheel, and can result in damage to the wheel surface whenever wheel rotation is resumed.*

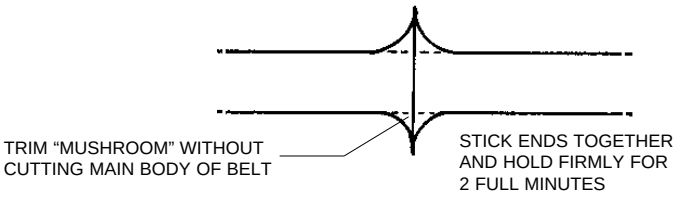
6) If unable to start the unit above, check for -
   a) Proper electrical power supplies, control power and supplemental utility supplies.
   b) All fuses and circuit breakers within the unit and on power supply to unit are in good condition and properly sized.
   c) Reset of thermal overload(s) on the fan motors. The reset button is part of the motor starter(s) typically located in the main electrical panel. Verify that an overload condition or ambient temperature above motor nameplate is not causing recurring tripping of the overload device.
   d) All disconnect switches and circuit breakers within the unit are on the power supplied to the unit when power is switched on.
   e) All “field wired” and/or “provided and wired in the field” controls are properly installed and compatible with unit equipment and controls. DDC controls may require jumpers between terminals or providing a proper control signal to operate system components. See Carnes electrical diagram.
7) After balancing the ductwork and control system served by the unit--including any unit fan speed changes made with the variable pitch sheaves provided--verify acceptable wheel seal adjustment, wheel start following shutdown and fan motor currents.

MAINTENANCE and TROUBLESHOOTING

1) Inspect filter conditions quarterly and replace with equivalent panel filters.
2) ***The wheel reduction drive is a permanently sealed unit and requires no maintenance.***
3) Inspect and, if necessary, adjust the fan belt tension as discussed under Start-Up and Operation. If the belts are frayed, slip after tension adjustment or require frequent adjustment to maintain tension, replace with equivalent belts. After years of operation (particularly if belt tension has not been properly maintained) the contact surfaces of the drive or driven sheaves may exhibit "cutting" from the belts wear. If this happens, replace the sheave(s) with equivalent unit.
4) Lubricate the fan, motor and energy recovery wheel bearings with a quality general purpose lithium or aluminium based grease suited for the operating temperatures involved. These bearings are factory-lubricated with heavy duty multi-purpose lithium grease.
5) The very "stretchy" urethane wheel drive belt should ***not*** require belt tension adjustment. If cracks appear or belt breakage occurs, it may be repaired or replaced by the following fusing procedure:
   a) *Tools Required -*
      1. Razor blade (or sharp knife).
      2. Propane torch or spade-tipped soldering gun.
      3. Flat blade tool (such as putty knife).
   b) *Preparation -*
      1. Route the belt so the closed loop will be properly located with no twists.
      2. Arrange the belt so it is not under tension while welding. The finished belt should stretch 6-8 percent [about 7/8" (22mm) per foot] beyond its relaxed length when in operation. Note the relaxed length of a new rotor belt is nearly tight to the outer rim of the rotor itself.
      3. Cut both ends of the belt squarely using the razor blade.
      4. Weld the belt in an open or ventilated area to minimize inhalation of the fumes.
   c) *Welding -*
      1. Heat the putty knife or flat tool to approximately 300°F (149°C). **DO NOT OVER HEAT**. Hold both ends of the belt against the tool until belt material starts to flow out of the point. The urethane belt melts at 200°F (93°C).

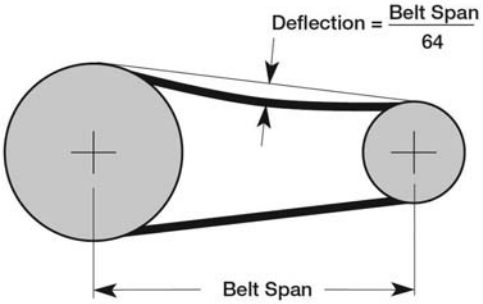


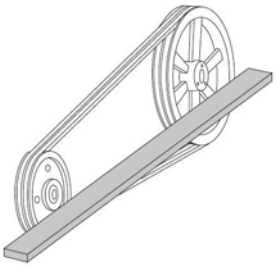
      2. Remove the tool and immediately push the belt ends together. The softened material should flow slightly out of the joint, but do not squeeze all of the melted material out. Hold together for 3 minutes. If the material bubbles, it is too hot and will not maintain the bond. Re-trim and re-weld at a lower temperature.
      3. Allow the belt to cool for a minimum of 30 minutes prior to installing, tensioning or straining the belt weld.



   d). *Verify that -*
      1. Wheel face is free of dirt and debris.
      2. Access doors and seals close tightly. All access panels are secured tightly and sealed.

6) Fan belt maintenance:
   a) Fan belts must be checked on a regular basis for wear, tension, alignment and dirt accumulation.
   b) Both loose and tight belts can cause fan vibration and fan failure. The proper tension for belt setting is the lowest tension at which the belt will not slip under peak load. For initial tensioning, set the belt deflection at moderate thumb pressure to 1/64-inch for each inch of belt span. Check the tension twice in the first 24 hours and periodically after that.
   c) When replacing belts do not pry belts on or off the sheave. Loosen belt tension until belts can be removed easily. On multiple groove drives, all belts should be replaced at the same time to provide uniform drive loading. Do not install new belts on worn sheaves. Replace the worn sheaves with new ones before new belts are installed.
   d) Check fan and motor shafts for parallel and angular alignment. Make sure motor and fan sheaves are aligned properly and if needed use a straight edge to align the sheaves properly.





7) If trouble occurs and the energy recovery ventilator operation is suspected, check the following items as well:
   a) Confirm that all interlocks (i e., motor starter, auxiliary contacts or damper motor end switches) are operating.
   b) Confirm that all field-provided safety devices (i.e., fire stat, freeze stat or smoke detector) are operating.
   c) Verify that all fuses, circuit breakers, switches and motor starter overloads within and serving the unit, are in running condition.
   d) Verify that all dampers and linkages operate properly.
   e) Measure static pressures to and from the unit and verify agreement with original operation and values for which the unit was designed.

ROTOR REMOVAL PROCEDURE

Under normal operating conditions the rotor should never have to be removed unless for replacement of rotor or rotor bearings.

1) Step #1 (see photo below)
   a) Make sure power to the unit is turned off before servicing.
   b) On the exhaust side of the wheel, remove the middle side plate on the recovery wheel frame.
   c) Support under the rotor with a piece of wood or equivalent.
2) Step #2 (see photo below)
   a) On the supply side of the wheel remove the shaft mounting Allen bolts from both sides of the wheel.

Step #1

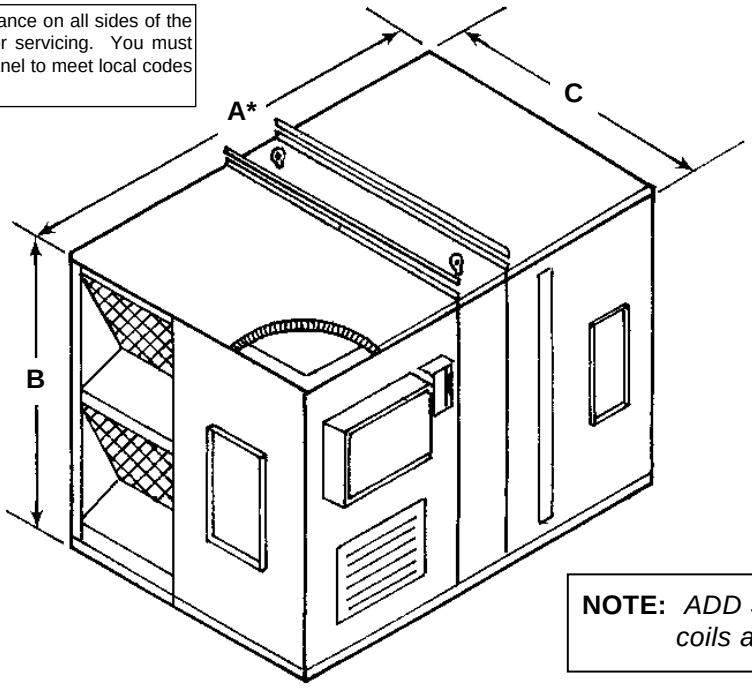
Step #2

3) Step #3 (see photo below)
   a) Roll wheel a few inches out of the frame on the supply side. The motor should not get in the way but if needed remove the wheel motor from the frame.
   b) Remove the snap ring from one side of the rotor shaft as seen below.
   c) Remove the shaft from the rotor.
   d) Roll the rotor out the exhaust side of the frame.

Step #3

DIMENSIONS and WEIGHTS

NOTE: Allow at least 24" (610mm) clearance on all sides of the unit, except for the control panel side for servicing. You must allow enough room around the control panel to meet local codes concerning serviceability.



NOTE: *ADD 32" (813mm) to* ***"A"*** *if coils are included in unit.*

BASIC DIMENSIONS IN INCHES ***(Millimeters)***

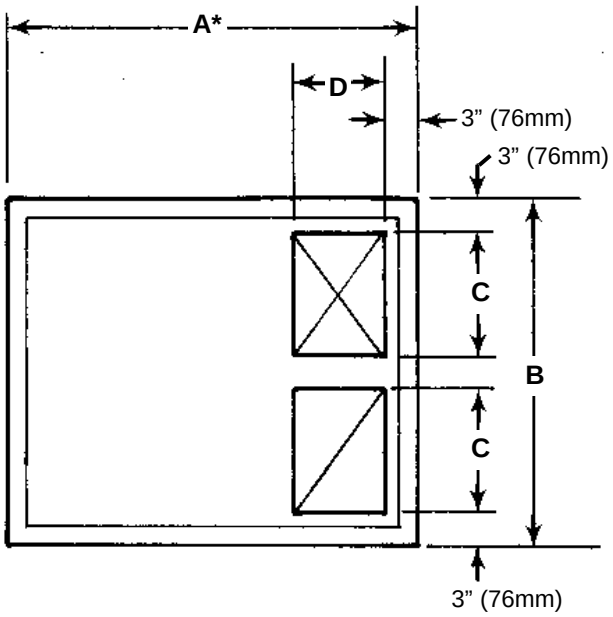
UNIT	A*	B	C
03	60 (1524)	47-1/2 (1209)	44 (1118)
06	72 (1829)	57-1/2 (1463)	54 (1372)
09	80 (2032)	69-1/2 (1768)	66 (1676)
14	102 (2590)	83-1/2 (2124)	80 (2032)

WEIGHTS

UNIT SIZE	03	06	09	14
POUNDS	1260	1550	2050	2400
KILOGRAMS	572	703	930	1089

NOTES: *1. Add approximately 200 lbs. (91 kg.) for crating.*
2. All weights are without coils. Contact factory for a additional weight.

MINI-SYSTEM CURB & ROOF OPENING



NOTE: Allow at least 24" (610mm) clearance on all sides of the unit, except for the control panel side for servicing. You must allow enough room around the control panel to meet local codes concerning serviceability.

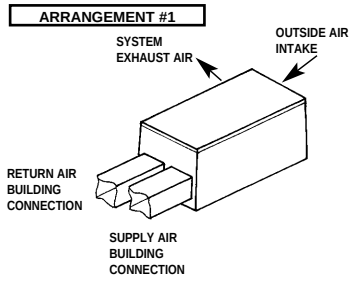
BASIC DIMENSIONS IN INCHES *(Millimeters)*

UNIT SIZE	A*	B	C	D
03	58 (1473)	42 (1067)	16 (406)	14 (356)
06	70 (1778)	52 (1321)	20 (508)	18 (457)
09	78 (1981)	64 (1626)	24 (610)	20 (508)
14	100 (2540)	78 (1981)	30 (762)	24 (610)

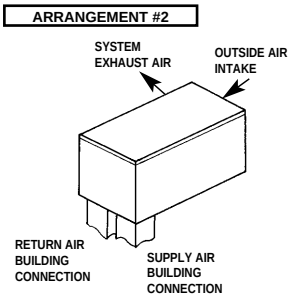
NOTE: *ADD 32" (813mm) to **"A"** if coils are included in unit.*

MINI-SYSTEM STANDARD DUCT ARRANGEMENTS

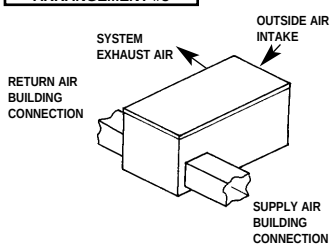
ARRANGEMENT #1



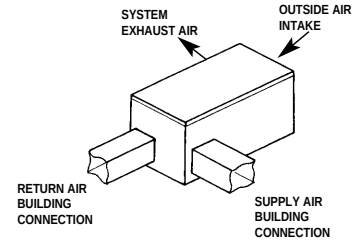
ARRANGEMENT #2



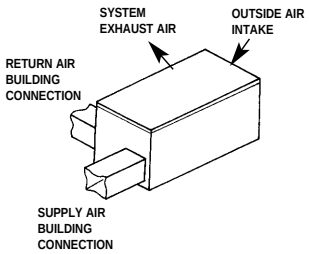
ARRANGEMENT #3



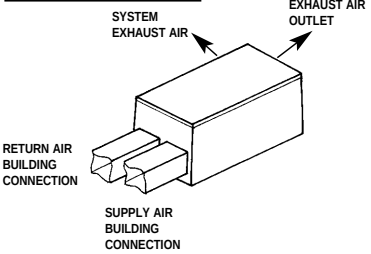
ARRANGEMENT #4



ARRANGEMENT #5



ARRANGEMENT #6



EXHAUST FAN ONLY DEFROST

1) Operation
   a) When frost forms on the wheel media (normally at an outside air temperature less than 0°F), the supply air temperature leaving the wheel will typically drop from the predicted supply air temperature as shown on the wheel submittal performance (typically 45°F to 55°F) to a temperature approaching freezing. The supply air thermostat will then trigger a defrost cycle, shutting off the supply fan for a length of time determined by the setting of the “OFF” knob of the timing relay, while the energy recovery wheel and exhaust fan continue to operate. This time should be long enough to allow the warm exhaust air to defrost the wheel media, but as short as possible to avoid creating a significant negative pressure within the building. The building should have pressure relief dampers or other means to prevent excessive negative pressure. Carnes recommends an initial “OFF” time of 30 to 60 seconds, with adjustments made from observed performance. The “ON” knob setting prevents the defrost cycle from being initiated again for the length of the setting. Carnes recommends the maximum setting of 10 minutes to minimize start-stop cycles for the supply fan.
2) Checkout and setting
   a) Turn main unit disconnect off. Turn supply fan and exhaust fan disconnects off.
   b) Locate supply air thermostat in supply fan compartment.

   c) Set supply air thermostat set point to the maximum temperature setting, which must be above ambient temperature. Adjust the timing relay “ON” knob clockwise to the maximum setting, then increase to approximately the 2nd or 3rd mark from minimum. The settings should look like this.

   d) Turn main unit disconnect on, and if required, enable unit to operate.
   e) The energy recovery wheel should start to operate, and the exhaust fan motor starter should pull the contactor in. Time the interval until the supply fan motor contactor pulls in. This time should be 30 to 60 seconds. Shut the unit off, adjust the “OFF” knob appropriately, and continue trying until the “OFF” cycle time is between 30 to 60 seconds.
   f) Initiate the defrost cycle, wait for the “OFF” cycle to end, then time the “ON” cycle until the “OFF” cycle initiates again. This should be approximately 10 minutes.
   g) Turn the unit off. Reset the fan disconnects. Set the supply air thermostat set point to approximately 36°F (2.2°C). Restore power to the unit.

VARIABLE SPEED DEFROST

1) Operation
   a) When frost forms on the wheel media, the supply air temperature leaving the wheel will drop from the predicted supply air temperature as shown on the wheel submittal performance (typically 45°F to 55°F) to a temperature approaching freezing. The defrost thermostat will then trigger a defrost cycle, slowing the energy recovery wheel to approximately 25% of full speed for a length of time determined by the setting of the “OFF” knob of the timing relay while the supply fan and exhaust fan continue to operate. This will reduce the energy recovery effectiveness, reduce the supply air temperature and allow a warmer exhaust air temperature to exit the wheel, thus defrosting the wheel media. Defrost cycle time should be long enough to allow the warm exhaust air to defrost the wheel media, but as short as possible to minimize the amount of colder supply air entering the building. The recommended initial Defrost Cycle time is 30 to 60 seconds, with adjustments made as desired from observed operating performance.

      The “ON” knob setting prevents the defrost cycle from being initiated again for the length of the time setting. Carnes recommends the maximum setting of 10 minutes to minimize the amount of time the recovery effectiveness is reduced.
2) Checkout and setting

   The adjustments for this unit were set and checked before shipment. To check for proper operation:

   a) Turn main unit disconnect off. Manually trip off the supply fan and exhaust fan overloads so that the fans do not operate. Locate the defrost thermostat in the supply fan compartment.

   b) Set defrost air thermostat set point to a setting below ambient temperature.
   c) If necessary, adjust the timing relay “ON” knob clockwise to the maximum setting (10 minutes). Adjust the timing relay “OFF” knob counter-clockwise to the minimum setting, then increase to approximately the 2nd or 3rd mark from minimum. The settings should look as follows:

1. On mini-systems: check that when the energy recovery wheel is operating normally, the speed readout on the VFD display is 100 Hz. When the defrost cycle is activated, the speed readout should be 25 Hz. If speed changes are required, consult the VFD manual.

d) Turn the units main disconnect on and, if required, enable the time clock for the unit to operate. The energy recovery wheel should start to operate at a normal speed of approximately 15 to 20 RPM.
e) Initiate the defrost cycle by adjusting the Defrost Thermostat to a setting well above ambient temperature.
f) After a short delay, the wheel speed should slow down to approximately 3 to 4 RPM for 30 seconds to 1 minute to allow the wheel to defrost.
g) The wheel should then return to its normal speed of 15 to 20 RPM for approximately 10 minutes.
h) The wheel should slow down for another defrost cycle of 30 seconds to 1 minute.
i) Shut the unit off. If modifications to the operating cycle are desired, adjust the timing and wheel speed settings. Then restart the unit and check that the operating cycle works as desired.
j) **When the wheel speed and defrost cycle time settings are as desired, turn the unit off. Reset the fan overloads. Set the Supply Air Defrost Thermostat set point to approximately 32°F (0°C) to 36°F (2.2°C). Restore power to the unit and check for normal operation**.

VARIABLE SPEED WHEEL CONTROL

1) Operation
   a) When a certain supply temperature needs to be maintained during the heating mode, the thermostat in the supply airstream (provided by others or Carnes) will provide the VFD with a proportional signal. This signal will set the VFD to drive the wheel motor between 100 Hz and 25 Hz, or 15-20 RPM to 3-4 RPM. The reduction in wheel RPM will lower the efficiency of the wheel and reduce the supply temperature. The increase in wheel RPM will increase the efficiency of the wheel and raise the supply temperature. When the supply temperature reaches the frost temperate of the wheel the VFD will go to its lowest setting of 25 Hz to reduce the efficiency of the wheel and allow the exhaust air to defrost the wheel. In a cooling mode the VFD will go to its highest setting of 100 Hz to increase the efficiency of the wheel and get as much cooling of intake air as possible.
2) Setting
   a) The minimum and maximum speed limits have already been pre-programmed at the factory. THere should be no need to change the preset limits, however, if modifications are required, follow the VFD instruction manual provided with the unit.
   b) Refer to the VFD instruction manual provided with the unit for adjustment of settings.

ON-OFF FROST CONTROL

1) Operation and setting
   a) When frost forms on the wheel media the outside air temperature is typically between -5°F and 5°F. When this occurs the outdoor air thermostat, will trigger a defrost cycle. The defrost cycle will shut down the unit until the air in the intake plenum rises above the outdoor air thermostat setting. Carnes recommends setting the outdoor air thermostat to the predicted frost temperature found on the wheel performance submittal, typically between -5°F and 5°F. Outdoor air thermostat is located in the intake compartment.
   b) This is the simplest way to control frost on the energy recovery wheel but it has its drawbacks. The building will go without the fresh air while the frost control is activated until the temperature in the outdoor air stream rises above the thermostat setting. In some cases it is not acceptable to shut down the supply air to the building. The other consideration is that on-off frost control is not the best solution when the unit is located indoors. When the unit shuts off due to the incoming outdoor air below the thermostat setting, the air that is not moving will slowly rise above the thermostat setting because the unit is in a warm indoor environment. The unit will turn back on and when the cold air from outside reaches the thermostat again the unit will shut off. This cycle will cause excessive on-off cycling of the unit and may cause damage to the fan motor.

TEMPERATURE ECONOMIZER

1) Operation and setting
   a) When the outside air falls within a set range of temperatures between the high limit and low limit thermostats the energy recovery wheel is shut down while the exhaust and supply fans remain running. This means that no energy is being transferred from the exhaust and supply air stream which allows free cooling of the building to occur. The high limit thermostat is typically set to the return air temperature found on the wheel submittal (~75°F). The low limit thermostat is typically set to 45°F. Both the high and low limit thermostat can be found in the intake plenum.
2) Checkout

   To check for proper operation:
   a) Turn the main unit disconnect off. Turn the supply fan and exhaust fan disconnects off.
   b) Set the high limit thermostat to above the ambient temperature. Set the low limit thermostat well below ambient temperature.
   c) Turn the main unit disconnect on, run the unit for a few seconds, verify the energy recovery wheel is not rotating, and then turn the main unit disconnect off.
   d) Set the low limit thermostat above ambient temperature, but below the high limit setting.
   e) Turn the main unit disconnect on, run the unit for a few seconds, verify the energy recovery wheel is rotating, and then turn the main unit disconnect off.
   f) Set the low limit thermostat well below ambient temperature.
   g) Set the high limit thermostat below ambient temperature, but above the low limit setting.
   h) Turn the main unit disconnect on, run the unit for a few seconds, verify the energy recover wheel is rotating, and then turn the main unit disconnect off.
   i) Return the high limit thermostat back to its original setting, typically the return air temperature found on the wheel submittal (~75°F).
   j) Return the low limit thermostat back to its original setting, typically 45°F.
   k) Turn the supply fan and exhaust fan disconnects on. Replace all access panels/close the doors. Turn the unit disconnect on.

ENTHALPY ECONOMIZER

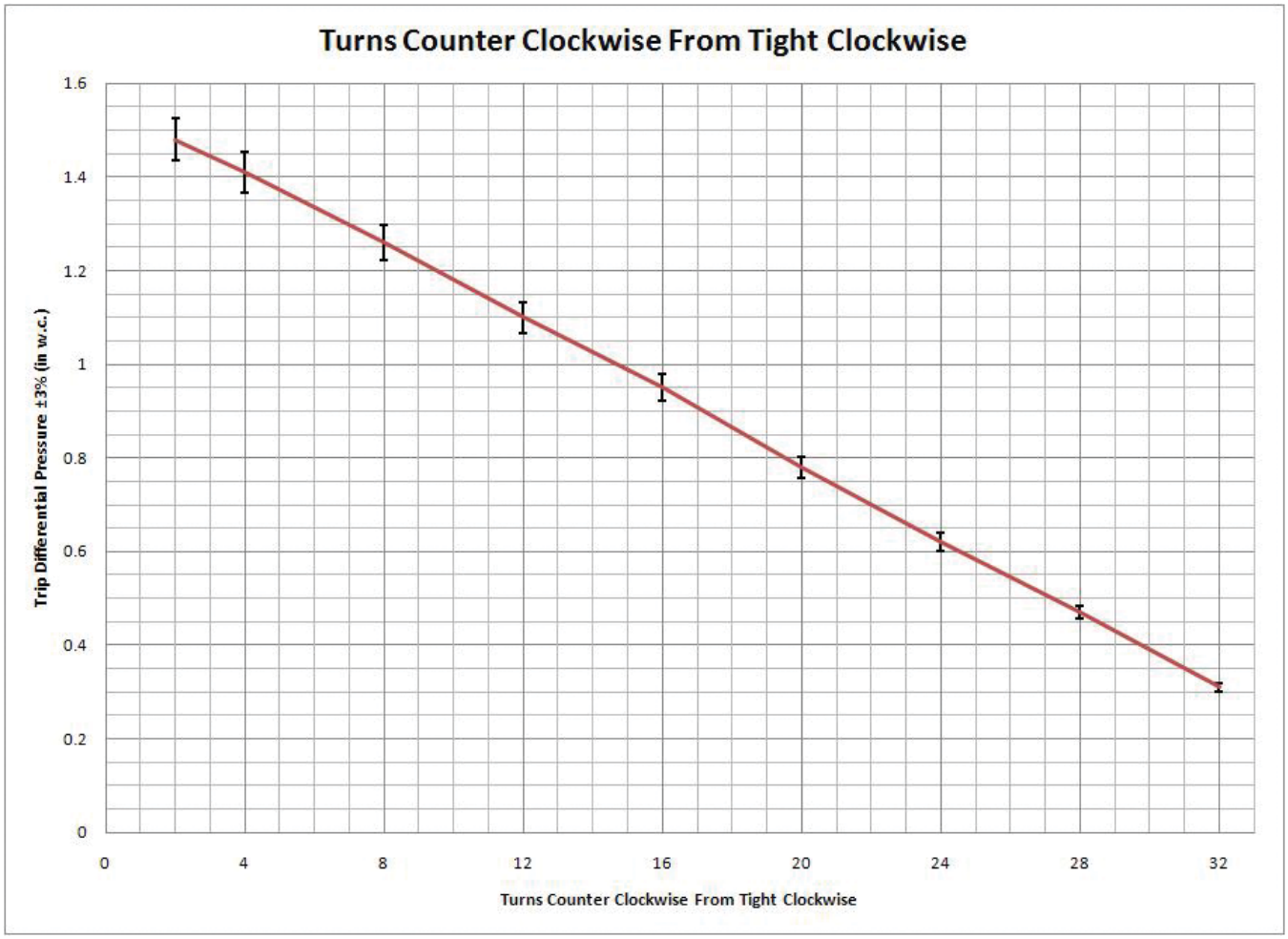
1) Operation
   a) When the outside air falls within a set enthalpy (temp & humidity) band the energy recovery wheel will shut down while the exhaust and supply fans remain running. This means that no energy is being transferred from the exhaust and supply air stream which allows free cooling of the building to occur.
2) Checkout
   a) While checking for proper operation turn the supply fan and exhaust fan disconnects off.
   b) See additional instruction manual included with the unit for settings and operational instructions.

ROTATION DETECTOR

1) Operation and setting
   a) When the energy recovery wheel is rotating the rotation detector will sense the reflection of reflective tape placed at several spots around the wheel. As long as the rotation detector senses a reflection from the rotating wheel within the specified time period it will NOT generate a wheel rotation fail signal. The time period should be adjusted to maximum setting of 90 seconds by turning the pot fully clockwise. The time adjustment pot is located on a small circuit card plugged into the main circuit board.
   b) This device yields strictly an alarm signal (alarm device provided by others) not an interlock of the wheel motor. See additional instructions included with unit for further information.
2) Checkout
   a) To operate properly the lenses on the detector and reflector must be clean. The mounting of the detector and reflector must be properly aligned using the following procedure: Turn the sensitivity control (pot located inside detector) fully clockwise to maximum and align until the red LED indicated glows brightest. Decrease the sensitivity and align for brightest glow at the low sensitivity setting. Upon completion of the alignment securely mount the control and increase the sensitivity to maximum.

FILTER SWITCHES

1) Operation and setting
   a) As the filters become clogged with dust and debris over time the differential pressure across the filters will increase. When the pressure difference reaches the set limit on the filter switch the filter switch will trip. The filter switch can either be normally open or normally closed. The switch can be used to turn on or off a signal device provided by others to indicate dirty filters.
   b) To properly calibrate the switch trip pressure a monometer and a “T” tubing setup are needed as described in the Dwyer series 1900 IOM provided with the unit. To adjust the trip pressure, remove the snap cover to expose the adjustment screw at the top of the switch. Below is a graph that can be used to approximate the trip pressure based on the number of counter clockwise turns of the adjustment screw from tight clockwise. This is not a guaranteed value but may get close to the trip pressure desired. Turn the adjustment screw clockwise until it is tight. Then use the graph below to find the number of counter clockwise turns needed to get the approximate desired trip pressure for dirty filters.



2) Checkout
   a) To properly calibrate the switch trip pressure a monometer and a “T” tubing setup are needed as described in the Dwyer series 1900 IOM provided with the unit.

REPLACEMENT PARTS

WM_A Energy Recovery Mini-Systems	WM_A03	WM_A06	WM_A09	WM_A14
Rotar Replacement Bearing	999-8575	999-8575	999-8575	999-8575
AHRI Certified Wheel & Frame	998-2036	998-2037	998-2038	999-2039
Intake Damper (Motorized)**	999-6890	999-6891	999-6892	999-6893
Exhaust Damper (Backdraft)	999-6811	999-6812	999-6813	999-6814
Exhaust Damper (Motorized)**	999-9894	999-6899	999-6896	999-6900
Damper Motor	999-9341	999-9341	999-9341	999-9341
Wheel Motor (Constant Speed)	999-8436	999-8436	999-8436	999-8436
Wheel Motor Sheave (Constant Speed)	999-8279	999-7665	999-8395	999-8396
Wheel Motor (Variable Speed)	999-8433	999-8433	999-8433	999-8433
Wheel Motor Sheave (Variable Speed)	999-7765	999-7765	999-7766	999-7788
Wheel Drive Belt	389-2031	389-1829	389-2032	389-2033
Wheel Motor Relay	999-2675	999-2675	999-2675	999-2675
Wire Harness	998-7015	998-7015	998-7015	998-7015
120-240 VAC Transformer	999-9268	999-9268	999-9268	999-9268
Enthalpy Controller	999-7245	999-7245	999-7245	999-7245
Rotation Detector	999-2896	999-2896	999-2896	999-2896
Thermostat	999-7422	999-7422	999-7422	999-7422
Control Relay (Frost Control)	999-2647	999-2647	999-2647	999-2647
Filter Switch	999-7300	999-7300	999-7300	999-7300
Filter Switch Tube Kit	999-7360	999-7360	999-7360	999-7360
Wheel Motor Thermal Unit	999-9531	999-9531	999-9531	999-9531
Air Filter Part Number (Qty) Air Filter Size	999-8961 (4) 18x20x2	999-8911 (4) 24x24x2	999-8961 (6) 18x20x2	999-8996 (12) 18x25x2
Air Filter Part Number (Qty) Air Filter Size			999-8962 (6) 12x20x2	
Blowers, G7-5 x 3/4	999-2590	N/A	N/A	N/A
Blowers, 907 x 3/4	999-2591	999-2591	N/A	N/A
Blowers, 909-7 x 3/4	999-2592	999-2592	N/A	N/A
Blowers, 909 x 3/4	N/A	999-2593	999-2593	N/A
Blowers, 910 x 1	N/A	999-2594	999-2594	N/A
Blowers, 912-9 x 1	N/A	999-2598	999-2598	N/A
Blowers, 912 x 1	N/A	N/A	999-2595	999-2595
Blowers, 915 x 1-3/16	N/A	N/A	N/A	999-2596
Blowers, 918 x 1-7/16	N/A	N/A	N/A	999-2597
Blower Isolator (4 per Blower)	999-9748	999-9748	999-9748	999-9748

ADDITIONAL INFORMATION

For more details on the installation or the operation of your unit, contact your dealer. We will be glad to help you.

CARNES COMPANY
448 S. Main Street, P.O. Box 930040, Verona, WI 53593-0040
Phone: 608-845-6411 Fax: 608-845-6504

PRODUCT INFORMATION

Date of purchase _____

Serial Number _____

Maintenance Sheet (Description of Work Done)	Date

START-UP PROCEDURE

- ☐ **VERIFY THAT ALL PLACEMENT AND INSTALLATION TASKS HAVE BEEN COMPLETED, INCLUDING THE REMOVAL OF ALL AIRFLOW OPENING DAMPER SHIPMENT COVERS.**
- ☐ **INSTALL FILTERS OBSERVING THE AIRFLOW DISCHARGE ARROWS.**
- ☐ **VERIFY TENSION ON FAN BELT IS PROPER. THE BELTS SHOULD BE TIGHT ENOUGH NOT TO "SQUEAL" AUDIBLY ON START-UP.**
- ☐ **CHECK UNIT ELECTRICAL DIAGRAM FOR SETTINGS ON OPTIONAL THERMOSTATS, TIMERS AND MOTOR CONTROLS THAT ARE INCLUDED.**
- ☐ **VERIFY FAN ROTATION. REMOVE ACCESS PANELS TO VIEW THIS PROCEDURE. THIS MAY ALSO BE ACCOMPLISHED BY LOOKING THROUGH THE EXHAUST DISCHARGE DAMPER.**
- ☐ **DO NOT OBSERVE RUN INSPECTIONS WITH THE ACCESS PANEL REMOVED FOR MORE THAN 2 MINUTES. FORWARD-CURVED FANS WILL OVERLOAD SEVERELY IF OPERATED WITHOUT ALL ACCESS PANELS IN PLACE. IF LONGER THAN 2 MINUTES, TRIPPING MOTOR STARTER, THERMAL OVERLOADS AND/OR DAMAGE TO THE MOTOR COULD OCCUR.**
- ☐ **IF YOU ARE UNABLE TO START THE UNIT, CHECK FOR:**
  - ☐ Proper electrical power supplies, control power and supplemental utility supplies.
  - ☐ Reset the thermal overload(s) on the fan motors.
  - ☐ All disconnect switch(es) within the unit are on the power supplied to the unit when power is switched on.
  - ☐ All "Field Wired" and/or "Provided" controls are properly installed, compatible with unit equipment and controls, and set to the proper settings for unit operation.

CAUTION: ***Avoid operating the fans for extended periods unless the wheel is also operating. During rotation the wheel is self-cleaning, but when stopped, debris can increase the static pressure drop across the wheel, and can result in damage to the wheel surface whenever wheel rotation is resumed.***

START-UP CHECK LIST
ENERGY RECOVERY MINI-SYSTEM

CARNES COMPANY 448 S. Main St., P. O. Box 930040, Verona, WI 53593-0040 Phone: (608)845-6411 Fax: (608)845-6504 www.carnes.com

- ☐ **VERIFY THAT ALL PLACEMENT AND INSTALLATION TASKS HAVE BEEN COMPLETED, INCLUDING THE REMOVAL OF ALL AIRFLOW OPENING DAMPER SHIPMENT COVERS.**
- ☐ **INSTALL FILTERS OBSERVING THE AIRFLOW DISCHARGE ARROWS.**
- ☐ **VERIFY TENSION ON FAN BELT IS PROPER. THE BELTS SHOULD BE TIGHT ENOUGH NOT TO "SQUEAL" AUDIBLY ON START-UP.**
- ☐ **PRIME THE TRAPS ON ALL FLOOR DRAIN CONNECTIONS WITH ENOUGH WATER OR ANTI-FREEZE TO FILL THE "U-BEND."**
- ☐ **CHECK UNIT ELECTRICAL DIAGRAM FOR SETTINGS ON OPTIONAL THERMOSTATS, PRESSURE SWITCHES, TIMERS AND MOTOR CONTROLS THAT ARE INCLUDED.**
- ☐ **VERIFY FAN ROTATION. REMOVE ACCESS PANELS AND OUTSIDE AIR FILTERS TO VIEW THIS PROCEDURE. THIS MAY ALSO BE ACCOMPLISHED BY LOOKING THROUGH THE EXHAUST DIS CHARGE DAMPER.**
- ☐ **DO NOT OBSERVE RUN INSPECTIONS WITH THE ACCESS PANEL REMOVED FOR MORE THAN 2 MINUTES. FORWARD-CURVED FANS WILL OVERLOAD SEVERELY IF OPERATED WITHOUT ALL ACCESS PANELS IN PLACE. IF LONGER THAN 2 MINUTES, TRIPPING MOTOR STARTER, THERMAL OVERLOADS AND/OR DAMAGING THE MOTOR COULD OCCUR.**
- ☐ **IF YOU ARE UNABLE TO START THE UNIT, CHECK FOR:**
  - ☐ Proper electrical power supplies, control power and supplemental utility supplies.
  - ☐ Check to insure all fuses and circuit breakers within the unit power supply are in good condition and are properly sized.
  - ☐ Reset the thermal overload(s) on the fan motors.
  - ☐ All disconnect switch(es) and circuit breaker(s) within the unit are on the power supplied to the unit when power is switched on.
  - ☐ All "Field Wired" and/or "Provided" controls are properly installed and compatible with unit equipment and controls.

CAUTION: ***Avoid operating the fans for extended periods unless the wheel is also operating. During rotation the wheel is self-cleaning, but when stopped, debris can increase the static pressure drop across the wheel, and can result in damage to the wheel surface whenever wheel rotation is resumed.***

CAREFULLY READ COMPLETE "INSTALLATION, OPERATION and MAINTENANCE INSTRUCTIONS" BEFORE INSTALLING AND USING YOUR ENERGY RECOVERY MINI-SYSTEM

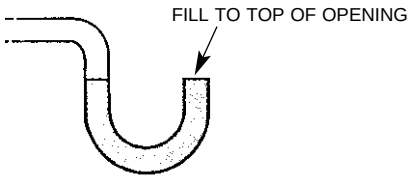
I. START-UP AND OPERATION

1. Verify that all placement and installation tasks have been completed, including the removal of all airflow opening damper shipment covers.

2. Install the filters into the frames provided observing the airflow discharge arrows. If different filter types (i.e. permanent vs.. disposal) are utilized, be sure to install the proper types in supply and exhaust.

3. Verify that the tensions on fan belts (adjusted by motor location) is proper. BX belts when properly adjusted on typical fan drives, require 8-1/4 pounds (3.7kg) [± 10%] to deflect midpoint on the belt 1/64 of the distance between sheave centers. The belts should be tight enough not to "squeal" audibly on start-up. If they are allowed to squeal on start-up, accelerated belt and sheave wear will result.

4. Prime the traps on all floor drain connections with enough water or antifreeze to fill the U-bend.



5. Refer to the unit electrical diagram for recommendations in setting optional thermostats, pressure switches, timers and motor controls that are included that specific unit.

6 Verify fan rotation is correct. This can be viewed with exhaust access panel removed, outside air filters removed or looking through the exhaust discharge damper.

7. Forward-curved fans used with this unit will overload severely if operated without all access panels in place. Therefore, any run inspections made with an access panel removed MUST be brief (less than 2 minutes) to avoid tripping motor starter thermal overloads and/or damaging the motor and wiring.

CAUTION: *Avoid operating the fans for extended periods unless the wheel is also operating. During rotation the wheel is self-cleaning, but when stopped debris can accumulate on the wheel surface over an extended period of time. This accumulation increases the static pressure drop across the wheel, and can result in damage to the wheel surface whenever wheel rotation is resumed.*

8. If unable to start the unit, check for:

a. Proper electrical power supplies, control power and supplemental utility supplies (water, refrigerant, steam, control air).
b. All fuses and circuit breakers within the unit power supply to unit are in good condition and properly sized.
c. Reset of thermal overload(s) on the fan motors. The reset button is part of the motor starter(s) typically located in the main electrical panel. Verify that an overload condition or ambient temperature above motor nameplate is not causing re-curring tripping of the overload device. Frequent motor starts (more than four per hour), particularly following periods of operation, may result in overload trips during the motor start-up.
d. All disconnect switches and circuit breakers within the unit are on the power supplied to the unit when power is switched on.
e. All "field wired" and/or "provided" controls are properly installed and compatible with unit equipment and controls. DDC controls may require jumpers between terminals or providing a proper control signal to operate system components. See Carnes system electrical diagram.

9. After balancing the ductwork and control system served by the unit--including any unit fan speed changes made with the variable pitch sheaves provided--verify acceptable wheel brush adjustment, wheel start-following shut-down and fan motor currents.

II. MAINTENANCE AND TROUBLESHOOTING

Following unit start-up, routine inspection and maintenance be made after 200 hours operation and carried out at least every three months thereafter--more frequently if dirty, hot or corrosive air is being handled.

1. Inspect and service the heat wheel as detailed in Carnes Energy Recovery Wheel Maintenance and Troubleshooting Instructions.

2. Inspect filter conditions quarterly and replace (or clean as applicable) with equivalent panel filters.

3. Lubricate the fan, motor and energy recovery wheel bearings with a quality general purpose lithium or aluminum based grease suited for the operating temperatures involved. These bearings are factory-lubricated with a heavy duty multi-purpose lithium grease.

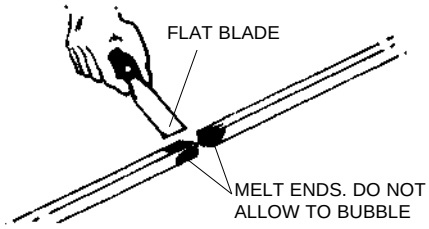
4. Inspect and if, necessary, adjust the fan belt tension as discussed under Start-Up and Operation. If the belts are frayed, slip after tension adjustment or require frequent adjustment to maintain tension, replace with equivalent belts using matched belts for multi-groove drives. After years of operation (particularly if belt tension has not been properly maintained) the contact surfaces of the drives or driven sheaves may not exhibit "cutting" from the belt wear. If this happens, replace the sheave(s) with equivalent unit.

The very "sturdy" urethane wheel drive belt should not require belt tension adjustment. If cracks or belt breakage occurs, it may be repaired by the following fusing procedure.

a. *Tools Required:*
1. Razor blade (or sharp knife).
2. Propane torch or spade-tripped soldering gun.
3. Flat blade tool (such as putty knife).

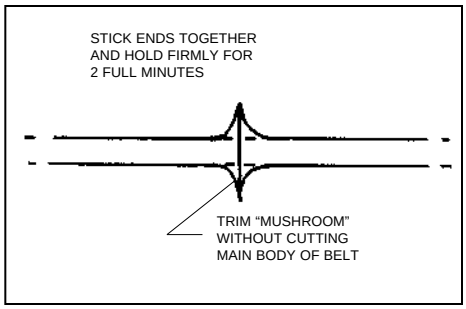
b. *Preparation:*
1. Route the belt so the closed loop will be properly located with no twists.
2. Arrange the belt so it is not under tension while welding. The finished belt should stretch 6-8 percent [about 7/8" (22mm) per foot] beyond its relaxed length when in operation. Note the relaxed length of a new rotor belt is nearly as tight to the outer rim of the rotor itself.
3. Cut both ends of the belt squarely using the razor blade.
4. Weld the belt to an open or ventilated area to minimize inhalation of the fumes.

c. *Welding:*
1. Heat the putty knife or flat tool to approximately 300° F. **DO NOT OVERHEAT**. Hold both ends of the belt against tool until belt material starts to flow out of the point. The urethane belt melts at 200° F.



5. Remove the tool and immediately push the belt ends together. The softened material should flow slightly out of the joint, but do not squeeze all of the melted material out. Hold together for 2 minutes. If material bubbles, it is too hot and will not maintain the bond. Retrim and re-weld at a lower temperature.

6. After the belt has cooled for at least 10 minutes, trim from the welded joint. If two people can pull the weld apart, repeat the process.



7. Verify that:
a. Wheel and coil faces are free of dirt and debris.
b. All floor drains/traps are clear and unfrozen.
c. Access door and seals close tightly. All access panels are secured tightly and sealed.

CARNES®
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