

**ENERGY RECOVERY WHEEL**

**INSTALLATION INSTRUCTIONS FOR ENERGY RECOVERY WHEEL(PIVOTING) USED  
WITH "L" SERIES (090-150) 7.5 TO 12 TON SERIES UNITS**

**I- SHIPPING AND PACKING LIST**

Package 1 of 1 contains:

- 1 - Energy Recovery Wheel Assembly
- 1 - Outdoor Fresh Air Hood with Filter
- 1 - Outdoor Exhaust Hood with Filter
- 1 - Bottom Support Plate
- 1 - Bag Assembly
  - a.) Gasketing 1" and 1/4"
  - b.) Wiring harness and hardware for attachment to economizer.
  - c.) Damper switch kit(s).

**II- SHIPPING DAMAGE**

Check unit for shipping damage. Receiving party should contact last carrier immediately if shipping damage is found.

**III- GENERAL**

These instructions are intended as a general guide and do not supersede local codes in any way. Authorities having jurisdiction should be consulted before installation.

**IV- REQUIREMENTS**

When installed, the unit must be electrically wired and grounded in accordance with local codes or, in the absence of local codes, with the current National Electric Code, ANSI/NFPA No. 70.

**VI- APPLICATION**

Energy Recovery Wheels (ERW) are used with "L" Series units equipped with an economizer. These wheels conserve energy by mixing warmer air with cooler air in the following manner:

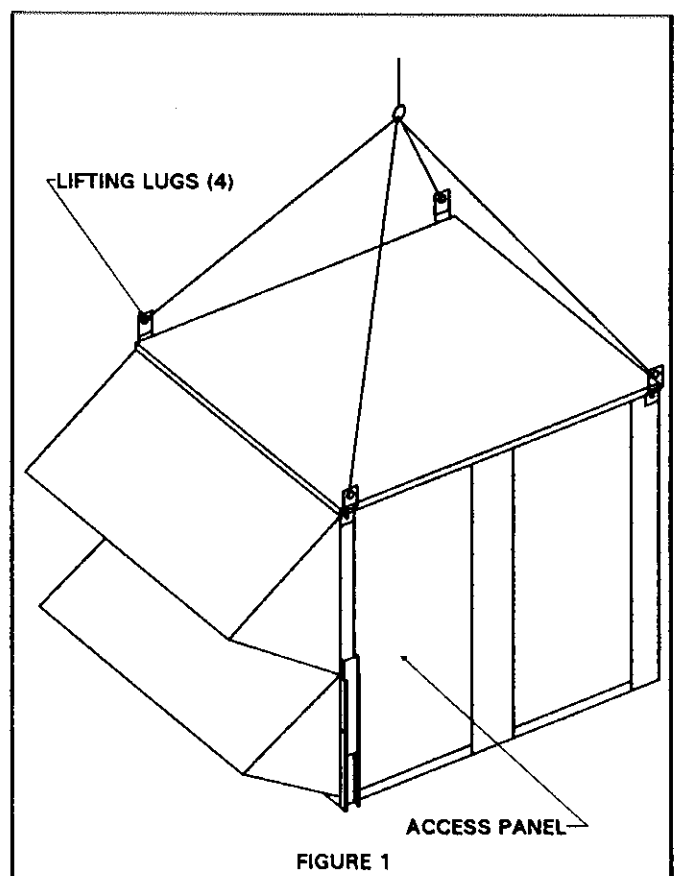
**Recovery Wheel Mode**

The Recovery Wheel mode is accomplished by two blowers providing continuous exhaust of stale indoor air and replacement by equal amount of outdoor air. Energy recovery is achieved by slowly rotating the energy recovery wheel within the cassette frame work. In winter, the ERW absorbs heat and moisture from the exhaust air stream during one half of a complete rotation and gives them back to the cold, drier intake air supply during the other half rotation. In summer, the process is automatically reversed. Heat and moisture are absorbed from incoming fresh air supply and transferred to the exhaust air stream. This process allows outdoor air ventilation rates to be

increased by factors of three or more without additional energy penalty or increase in size of heating or air conditioning systems.

**V- RIGGING UNIT FOR LIFTING**

- 1- Maximum weight of unit is --- 600 Lbs (crated).
- 2- Remove crating and retrieve bag assembly that is attached to center deck support post on open end of ERW.
- 3- All panels must be in place for rigging.
- 4- Lifting lugs are supplied with the unit. Loosen machine bolts and rotate lifting lug as shown in Figure (1).

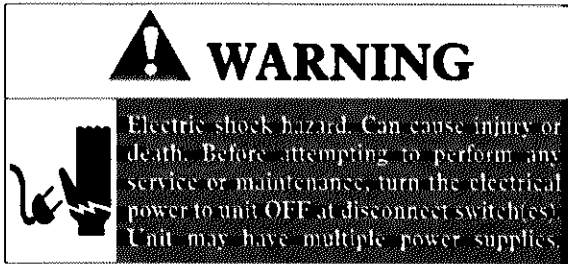


**FIGURE 1**

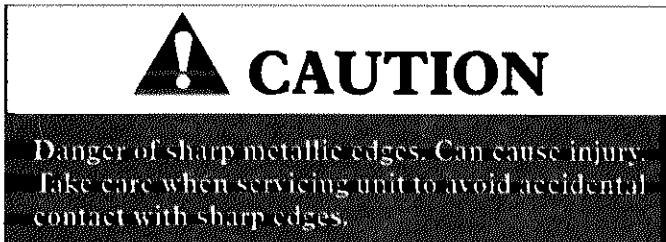
## VII- INSTALLATION

**NOTE:** The ERW unit is equipped with a support block that must be removed to allow the unit to change operating modes. This block may cause damage to system if not removed.

- 1- Disconnect all power to unit.



- 2- Remove the rooftop unit horizontal return air access panels. Also remove any hoods and/or power exhaust equipment. Discard hoods, power exhaust equipment, and horizontal return air access panels.



- 3- Open filter access door. Verify and/or install an internal modulating economizer.

- 4- Attach P153 wire harness to internal economizer damper motor using hardware provided in bag assembly. Refer to Figure (2) for field wiring diagram. Remove wire from (#2) terminal on damper motor (B7). Join removed wire with green, orange, and pink wire from P153 harness assembly; connect all wires to damper motor (B7) terminal (#2). [See illustration #1].

- 5- Remove existing wire from (#1) terminal on damper motor (B7). Join removed wire with black wire from P153 harness assembly; connect both wires to damper motor (B7) terminal (#1).

- 6- Remove enthalpy control (A7) and associated wiring from its physical position and unplug (P104) from (J104). Retain (DO NOT DISCARD) this assembly for it will be used later in these instructions. Plug in (P104) from the wire harness (Purple and Blue wires) into jack (J104).

- 7- Secure end switch(es) to the damper assembly. Damper rotation trips the end switch - installation position determines economizer and power exhaust mode.

- 8- Route excess wiring so it does not interfere with dampers and damper motor rotation. Locate wire harness plug (P153) in exhaust air stream so connection can be made with ERW after unit is set in place.

**Note-**Complete low voltage field wiring as shown in Figure (2).

- 9- Position bottom support plate with notched flange pointing away from rooftop unit. Center the plate beneath the horizontal return air opening and secure in place. See Figure (3).

- 10- Attach provided gasketing material (1") to seal front and back edge of unit division panel.

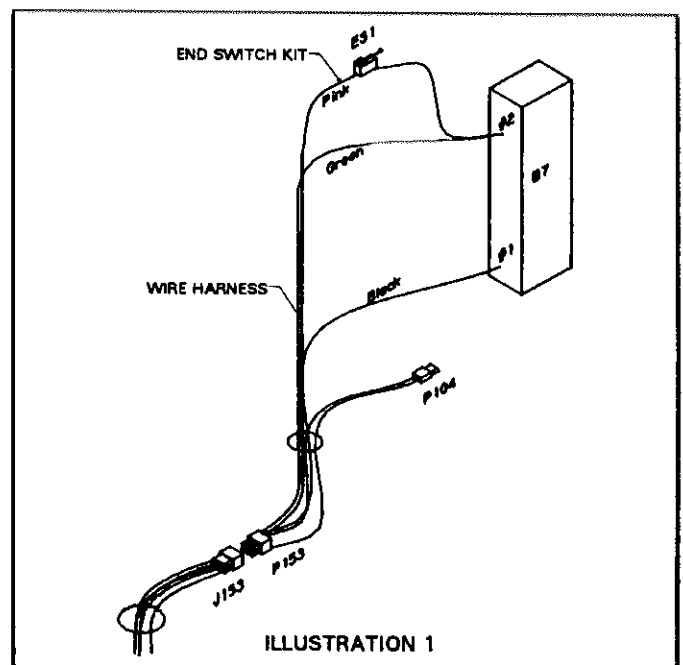
- 11- Remove screws that are attaching top panel to vertical support panels around the horizontal exhaust air opening of rooftop unit. Raise top panel to give at least 2" of clearance above vertical supports (center and corner).

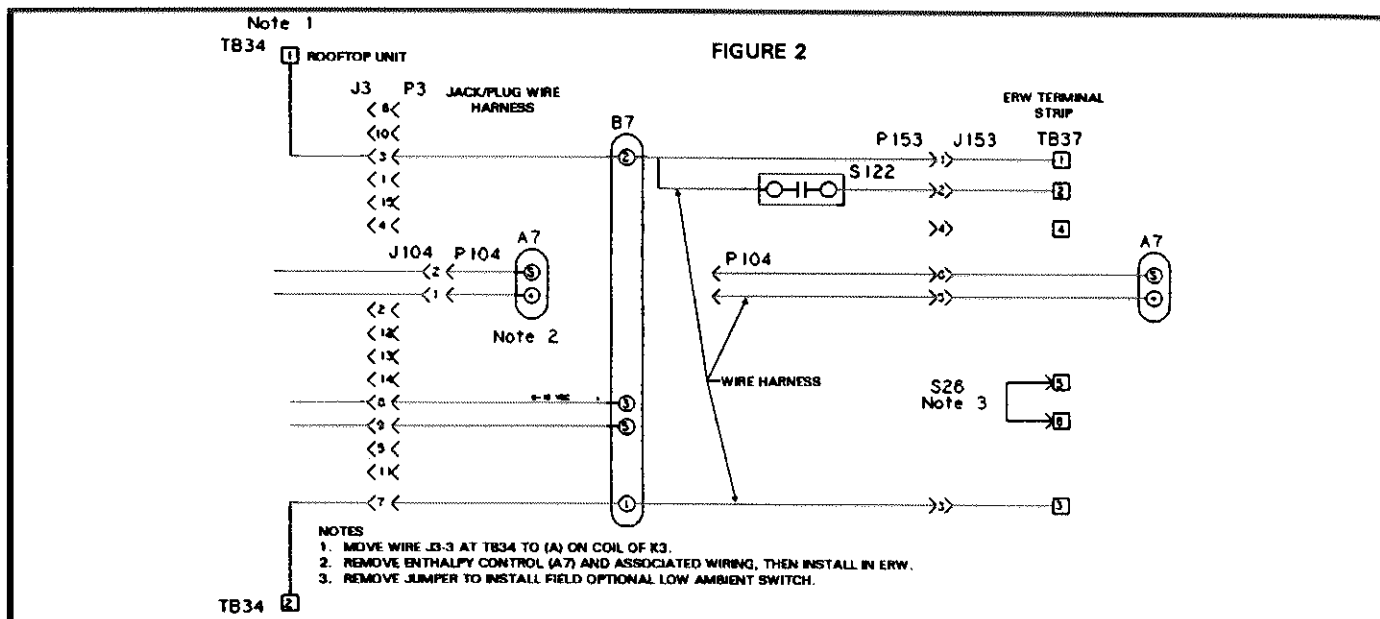
- 12- Attach provided gasketing material (1/4") to face of ERW unit to prevent air leakage.

- 13- Using lifting lugs, raise ERW unit approximately three (3) feet. Remove nut and bolt assembly to slide telescoping part of leg out of guide from the top and reinsert into bottom of guide having attached flat foot under unit. Do not fasten tightly, adjustment will need to be made when unit is put into position. See Figure (4).

- 14- Lift and move ERW unit into position in front of horizontal exhaust air opening.

**NOTE:** A treated 2"x 6"x 60" piece of wood or equivalent should be used under feet of standoff legs to prevent roof penetration. See Figure (5).





15-Lower ERW into bottom support plate catching the front edge of the ERW bottom into the 1-1/2" flange. Tuck the front top flange of ERW under the rooftop unit top panel and secure. Use existing screws to securely fasten ERW to rooftop unit. With the ERW in place, adjust the standoff legs to level and support ERW against rooftop unit. Tighten securely. Rotate lifting lug to original position and tighten machine bolts.

16- Seal, if required, along face (top and sides) of ERW unit where it meets rooftop unit to insure no air leakage.

17-Remove ERW access panels [Figure (6)] to connect field wiring. Connect wire harness plug (P153) and jack (J153) of ERW control wiring together in exhaust air section. Mount [formally removed] enthalpy control (Honeywell C7400) in fresh air hood using existing screws to securely fasten. Insert female terminals of purple wire to (+) terminal and blue wire to (S) terminal of enthalpy control.

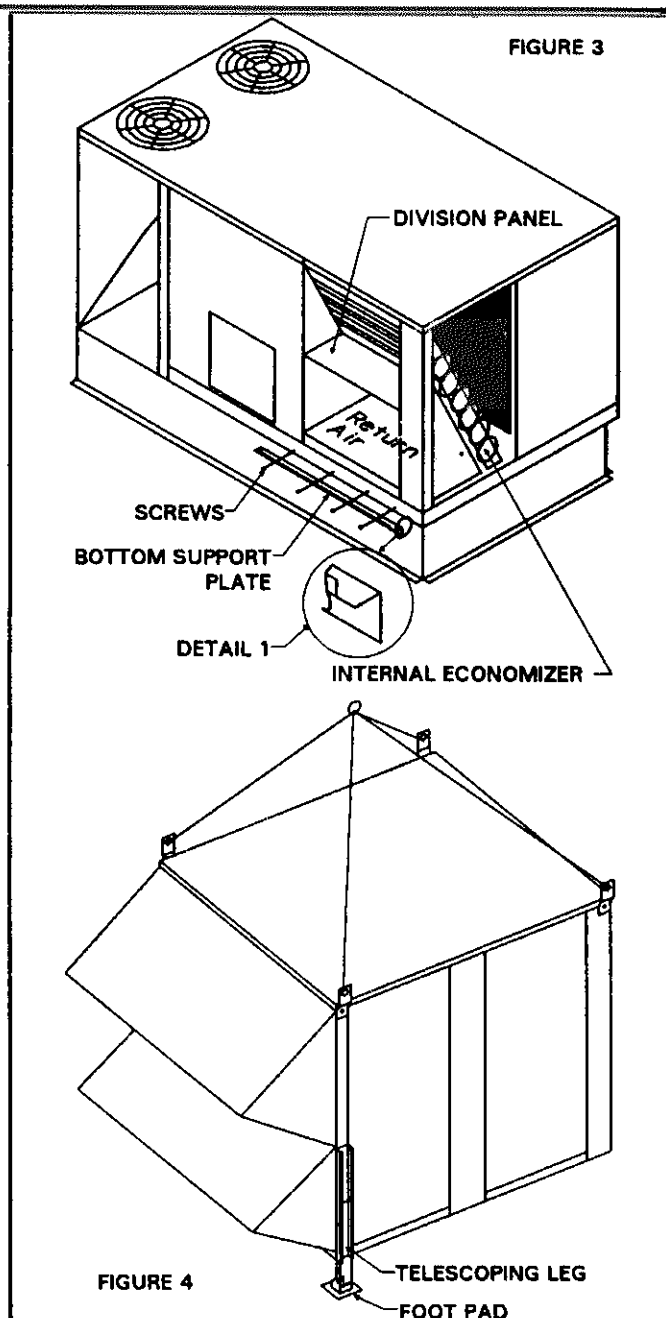
18-Remove ERW support block to allow wheel rotation when unit is placed into operation. Refer to Figure (7).

19-All electrical connections must conform to any local codes and the current National Electric Codes (NEC) and Canadian Electric Code (CEC). Refer closely to unit wiring diagram in unit and/or in these instructions for proper wiring connections. Refer to the unit nameplate for minimum circuit ampacity and maximum overcurrent protection size. Electrical data is listed on unit rating plate and motor nameplates.

20-Connect line voltage power supply to ERW unit from rooftop unit disconnect switch.

21-Ground unit with a suitable ground connection either through unit supply wiring or an earth ground.

**NOTE-** Unit voltage entries must be sealed weather tight after wiring is complete.



22-Replace access panels onto the ERW unit and secure.

23-Important: At control panel of rooftop unit, remove red wire (J3-3) from terminal strip (TB34) and install on (A) terminal of (K3) blower contactor.

24-Close access panel on the rooftop unit and secure.

25-Restore power to unit.

26-Clean-up once ERW is operating properly. Caulk any open joints, holes or seams to make the units completely air and water tight.

27-Leave this instruction manual with owner or in an envelope to be kept near the unit.

## VIII-OPERATION

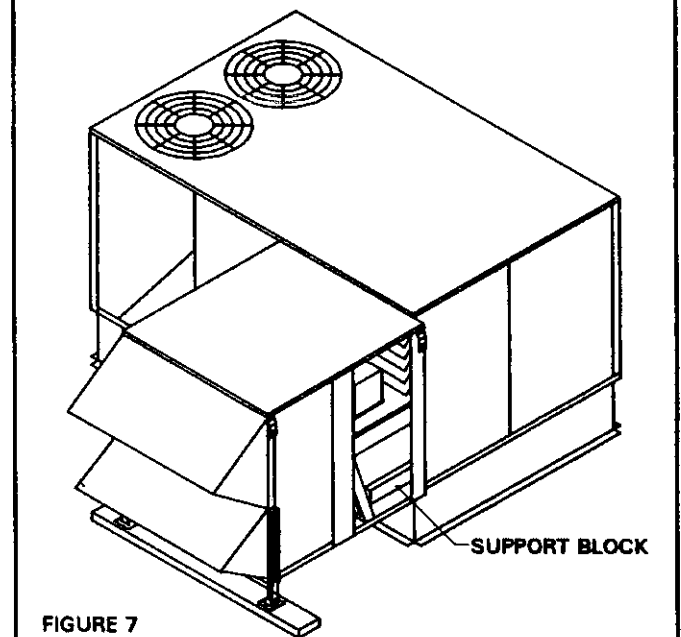
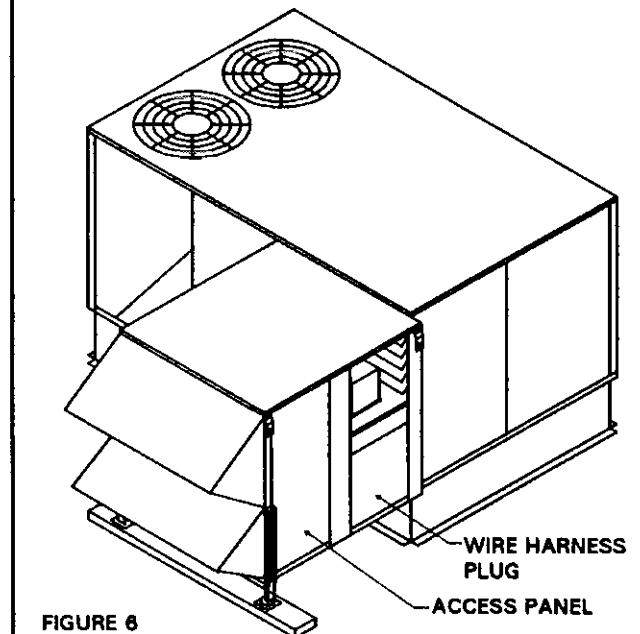
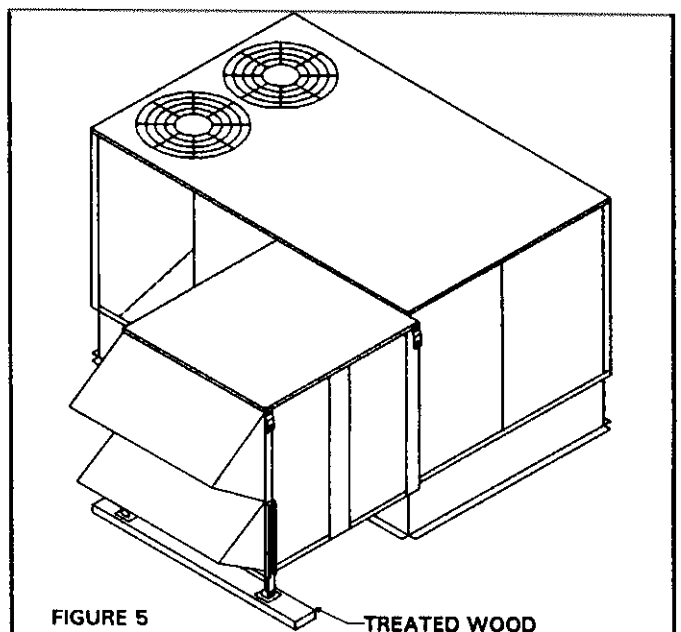
### HOW IT WORKS

The patent pending unit contains an Energy Recovery Wheel that is a new concept in rotary air-to-air heat exchangers. Designed as a packaged unit for ease of installation and maintenance, only matching up to rooftop unit with an internal economizer and connection of electrical power is required to make the system operational. The concept consists of a unique rotary energy recovery wheel that pivots in and out of fresh air streams within a heavy duty, permanently installed blower cabinet that provides ready access to all internal components. The Energy Recovery Wheel is 36" in diameter containing eight energy transfer segments, wheel drive motor with belts and air seals. Each energy transfer segment weighs three pounds and has 125 square feet of transfer surface area. The segments snap in place between the stainless steel spring retainers and are permanently bonded with a dry desiccant coating for total enthalpy recovery.

When slowly rotating through counterflowing exhaust and fresh air streams the ERW absorbs sensible heat and latent heat from the warmer air stream and transfer this total energy to the cooler air stream during the second half of its rotating cycle. Rotating at 30 revolutions per minute, the wheel provides constant flow of energy from warmer to cooler air stream. The large energy transfer surface and laminar flow through the wheel causes this constant flow of recovered energy to represent up to 85% of the difference in total energy contained within the two air streams.

Sensible and latent heat are the two components of total heat. Sensible heat is energy contained in dry air and latent heat is the energy contained within the moisture of the air. The latent heat load from the outdoor fresh air on an air conditioning system can often be two to three times that of the sensible heat load and in the winter it is a significant part of a humidification heat load.

During both the summer and winter, the ERW transfers moisture entirely in the vapor phase. This eliminates wet surfaces that retain dust and promote fungal growth as well as the need for a condensate pan and drain to carry water.



Because it is constantly rotating when in the air stream, the ERW is always being cleared by air, first in one direction then the other. Because it is always dry, dust or other particles impinging on the surface during one half cycle, are readily removed during the next half cycle.

During the heating season, when outdoor air temperatures are below 5 degrees Fahrenheit, it is recommended to use the (optional) low ambient kit (field installed).

### Recovery Wheel Mode

On a thermostat call for blower operation in heating, cooling or continuous blower, the ERW media will rotate between fresh air and exhaust air streams. Both the fresh air blower and (1) one exhaust air blower will also be operating to overcome the air resistance of the ERW media. The ERW unit will operate in this mode until economizer mode is activated. See Figure (8).

### Economizer/Power Exhaust Mode

On the activation of the economizer mode [closure of damper switch], the ERW unit will shutdown for approximately 120 seconds to allow the ERW media to pivot out of the air stream. After the 120 second timer has been satisfied, the exhaust air blower will operate. The ERW unit will act as a 100 % power exhaust unit. See Figure (9).

This mode will continue until economizer has been deactivated. The exhaust air blower will shut down and the 120 second timer will be activated. During this time period the ERW media will pivot back into the air stream. When timing is complete the unit will operate in the Recovery Wheel Mode. See Figure (8).

### IX-System Check

- 1-Disconnect ERW main power.
- 2-Remove ERW control access panel and install jumper at low voltage terminal strip between "TB37-1 and TB37-2". Wheel should pivot out of air stream.

*Note: If Low ambient kit is used the jumper between TB37-5 & TB37-6 should be removed. Also if system check out is being conducted at low ambient temperatures, technician should be aware that this kit can cause system not to operate.*

- 3-Turn thermostat to "Cont" for blower operation.
- 4-Restore power to unit. Observe ERW drive motors (damper motor) for wheel and dampers, it should pivot wheel out of air stream, opening fresh air dampers and 120 seconds later the exhaust blower will operate .
- 5-Remove jumper(s) from low voltage terminal block (TB37). View pivoting of media back into air stream and closing of fresh air dampers. After 120 second timer has cycled then both fresh air blower and one exhaust air blower will operate.

- 6-Verify that the ERW (3) three phase blower motors are phased sequentially ensuring correct rotation and operation.

- a.) Disconnect power.
- b.) Reverse any two field power leads to the ERW.
- c.) Reapply power.

### A-Economizer Settings

Refer to economizer instructions for minimum air flow requirement. The damper end switch setting on the internal economizer damper assembly is field adjustable to any position above minimum air flow for fresh air requirements at the customers specified conditions.

RECOVERY WHEEL MODE

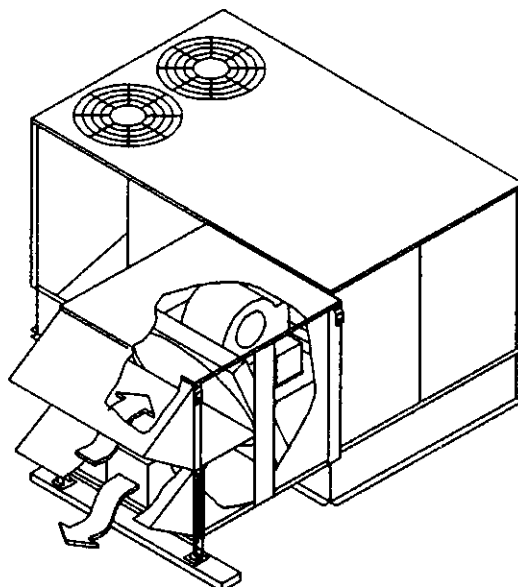


FIGURE 8

ECONOMIZER/POWER EXHAUST MODE

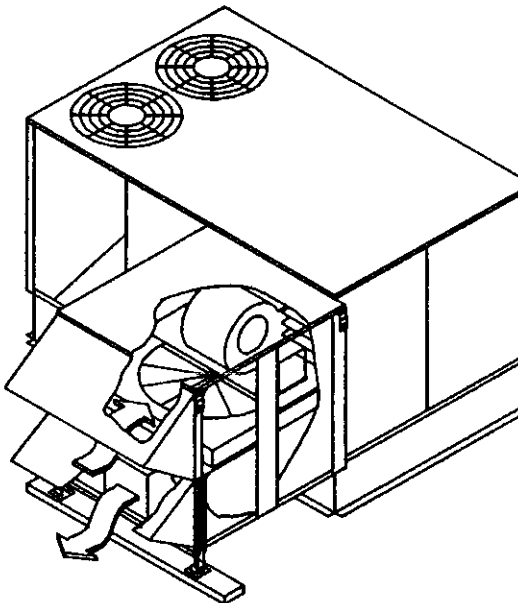


FIGURE 9

## B- Blower Speed Adjustment

Blower speed selection is accomplished by changing the sheave setting on both fresh air and exhaust air blowers. All blowers are factory set at "closed" for maximum airflow. To determine air flow setting, external static pressure readings will need to be read across the ERW. See Figure (10) for location to take pressure readings. Refer to blower performance Table #1 showing specific air volumes at various speeds. The table is for balanced air flows (fresh air and exhaust air are equal), unbalanced airflow will effect ERW performance. Table #2 shows the correction factors applied for unbalanced flows and its effect on wheel and system performance. Table #3 shows the exhaust air blower performance of the ERW when in the power exhaust mode using the reading from Table #1 (turns) and knowing the pressure drop of the exhaust air duct work.

9-Disconnect main power to unit before making adjustment to economizer and/or ERW unit.

10-Replace ERW control access cover.

11-Set thermostat to normal operating position.

12-Restore power to unit.

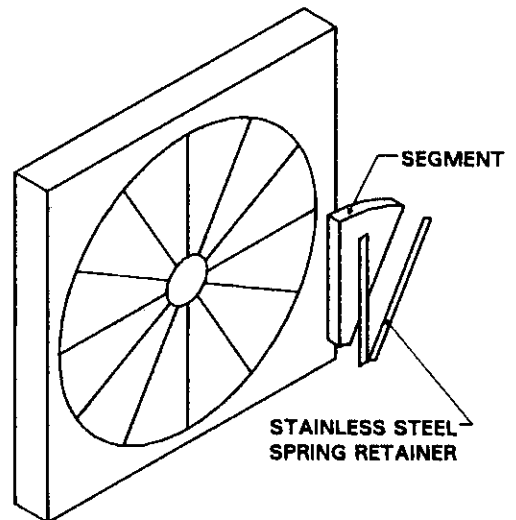
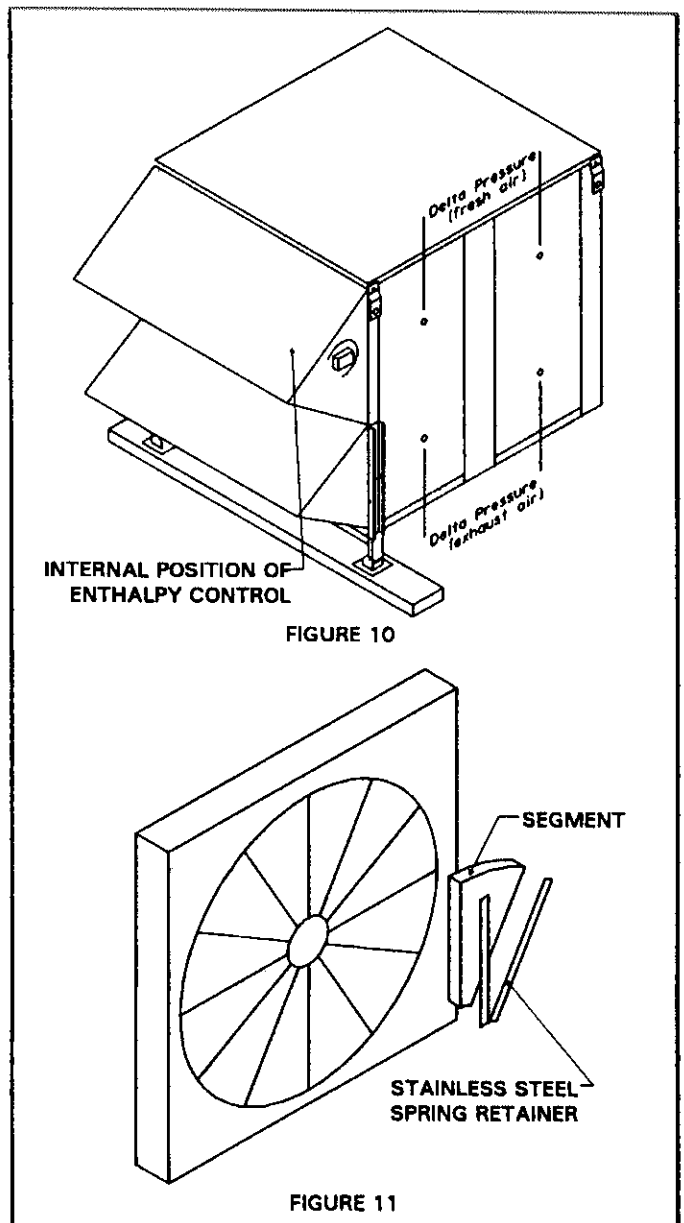
## X-MAINTENANCE

1-All motors use prelubricated sealed bearings; no further lubrication is necessary.

2- All blower assemblies use sealed ball bearing; no further lubrication is necessary.

3-Make visual inspection of dampers, linkage assemblies and ERW rotating bearings during routine maintenance. Filters should be checked periodically and cleaned when necessary. Filters are located in fresh air and exhaust hoods. **DO NOT** replace permanent filters with throw-away type filters.

4-Eight pie-shaped ERW segments, are seated on stops between the stainless steel spring retainers, secured to the hub and rim of wheel. Annual inspection of the self cleaning wheel is recommended. With power disconnected, remove ERW access panels (rear) and unplug [J150 & P150] (Refer to wiring diagram in this instruction manual). Each segment is secured in place by a stainless steel spring retainer located on wheel rim. Remove one end of the stainless steel spring retainer from the slot in the wheel rim and remove. Do the same on the next retainer. Remove segment and wash with water and/or mild detergent. Replace segment by reversing the above procedure. See Figure (11).



## ERW Blower Performance (Balanced Air Flow) (Best performance is observed with fresh and exhaust air flow equal )

**Example:** Measure static pressure across Energy Recovery Wheel, Table indicates unit CFM, Blower RPM and Blower Energy.

Then select number of turns open, position of motor sheave setting (factory set at 0 turns) to find

blower(s) RPM and blower energy consumption for the indicated CFM.

**Sample:** Static across ERW is 0.85" of W.C. with motor sheaves closed(0 turns open), locate this value under wheel static, proceed across horizontally to find unit air flow is 1275 CFM.

Then continue across horizontally until you are under the "0" turn(s) column to find that the internal economizer

ERW blowers are running at 961 RPM and energy consumption of each blower is 445 Watts.

If you want to reduce energy consumption, continue across until you are under the "2" turns column to find new values.

Recommend opening motor sheaves to both blowers 2 turns. Repeat test to determine accurate results.

Air Flow CFM	Wheel Static (in W.C.)	Sheave Rotation											
		Closed			1 Turn			2 Turns			3 Turns		
		Speed (RPM)	Power (KW)	Speed (RPM)	Power (KW)	Speed (RPM)	Power (KW)	Static (RPM)	Power (KW)	Speed (RPM)	Power (KW)	Speed (RPM)	Power (KW)
600	0.40	966	0.296	923	0.288	880	0.279	837	0.271	799	0.262	761	0.252
675	0.45	966	0.309	923	0.300	880	0.292	837	0.283	799	0.271	761	0.260
750	0.50	965	0.323	922	0.314	879	0.305	837	0.296	798	0.282	760	0.268
825	0.55	964	0.337	922	0.328	879	0.319	836	0.309	798	0.294	760	0.279
900	0.60	964	0.353	921	0.343	879	0.333	836	0.323	798	0.306	760	0.290
975	0.65	963	0.370	921	0.359	878	0.348	836	0.337	798	0.302	x	x
1050	0.70	963	0.388	920	0.376	878	0.364	836	0.352	798	0.334	x	x
1125	0.75	962	0.406	920	0.393	878	0.380	835	0.367	x	x	x	x
1200	0.80	961	0.425	919	0.411	877	0.396	x	x	x	x	x	x
1275	0.85	961	0.445	919	0.429	877	0.414	x	x	x	x	x	x
1350	0.90	960	0.466	918	0.448	x	x	x	x	x	x	x	x
1425	0.95	960	0.487	918	0.468	x	x	x	x	x	x	x	x
1500	1.00	960	0.509	917	0.488	x	x	x	x	x	x	x	x

\* Note: Indicates total power requirements (fresh air blower, exhaust air blower, and 112 Watts for Energy Recovery Wheel rotation).

**Table #1**

## Unbalanced Air Flow Calculations

**Example :** Measure Static pressure across top half of Wheel, find CFM from table, Repeat process on bottom half of Wheel.  
Ratio CFM values (Flow Ratio [R]) with larger on bottom. Then match R value and minimum CFM to select Wheel Effectiveness.

**Sample :** Fresh air static of .67=1000CFM, Exhaust air static of 1.00=1500CFM., Flow Ratio[R]= 1000/1500=.667

@ 1000 CFM move over to R between .70 and .65. Then interpolate Wheel Effectiveness of .89 or 89%.  
With the System Table using same CFM and R values interpolate System Effectiveness of .59 or 59%.

Static Pressure (in. w.g.)	Minimum Air Flow* CFM	Wheel Effectiveness (Based on Minimum Air Flow Vs Flow Ratio)									
		1.00	0.95	0.90	0.85	0.80	0.75	0.70	0.65	0.60	0.55
1.00	1500	0.76	0.77	0.78	0.79	0.81	0.82	0.83	0.85	0.86	0.87
0.90	1350	0.77	0.78	0.80	0.81	0.82	0.84	0.85	0.86	0.88	0.89
0.77	1150	0.79	0.80	0.81	0.83	0.84	0.85	0.86	0.87	0.89	0.90
0.67	1000	0.80	0.81	0.83	0.84	0.85	0.86	0.88	0.89	0.90	0.91
0.57	850	0.82	0.83	0.84	0.86	0.87	0.88	0.89	0.90	0.92	0.93
0.47	700	0.84	0.85	0.86	0.87	0.89	0.90	0.91	0.92	0.93	0.94
0.33	500	0.86	0.87	0.88	0.89	0.90	0.91	0.92	0.94	0.95	0.96
											0.97

\*Note: Minimum air flow equals the lesser of supply or exhaust flows

Static Pressure (in. w.g.)	Minimum Air Flow* CFM	System Effectiveness (Based on Minimum Air Flow Vs Flow Ratio)									
		1.00	0.95	0.90	0.85	0.80	0.75	0.70	0.65	0.60	0.55
1.00	1500	0.76	0.73	0.70	0.67	0.65	0.61	0.58	0.55	0.51	0.48
0.90	1350	0.77	0.75	0.72	0.69	0.66	0.63	0.59	0.56	0.53	0.49
0.77	1150	0.79	0.76	0.73	0.70	0.67	0.64	0.60	0.57	0.53	0.49
0.67	1000	0.80	0.77	0.74	0.71	0.68	0.65	0.61	0.58	0.54	0.50
0.57	850	0.82	0.79	0.76	0.73	0.69	0.66	0.62	0.59	0.55	0.51
0.47	700	0.84	0.81	0.78	0.74	0.71	0.67	0.64	0.60	0.56	0.52
0.33	500	0.86	0.83	0.79	0.76	0.72	0.68	0.65	0.61	0.57	0.53
											0.48

\*Note: Values in this table are less than Wheel Effectiveness due to infiltration(higher exhaust air) or Leakage(higher fresh air.)

**Table #2**

# ERW Power Exhaust Performance

7.5 to 12.5 Tons (ERW Out Of Air Stream, Supply Air Blower Off)

Return Air System		Sheave Rotation											
Static Pressure		Closed			1 Turn			2 Turns			3 Turns		
Inch wg	Pa	CFM	Wg	Pa	CFM	Wg	Pa	CFM	Wg	Pa	CFM	Wg	Pa
0.0	0	3600	1700	3420	1613	3240	1538	3060	1443	2732	1288	2403	1134
0.1	25	3528	1684	3352	1581	3175	1498	2998	1415	2677	1263	2355	1111
0.2	50	3456	1630	3283	1549	3110	1467	2938	1386	2622	1237	2307	1088
0.3	75	3345	1578	3178	1499	3011	1420	2843	1341	2538	1197	2233	1053
0.4	100	3195	1507	3035	1432	2876	1356	2716	1281	2424	1144	2133	1006
0.5	125	3045	1436	2893	1365	2741	1293	2598	1221	2310	1090	2033	959

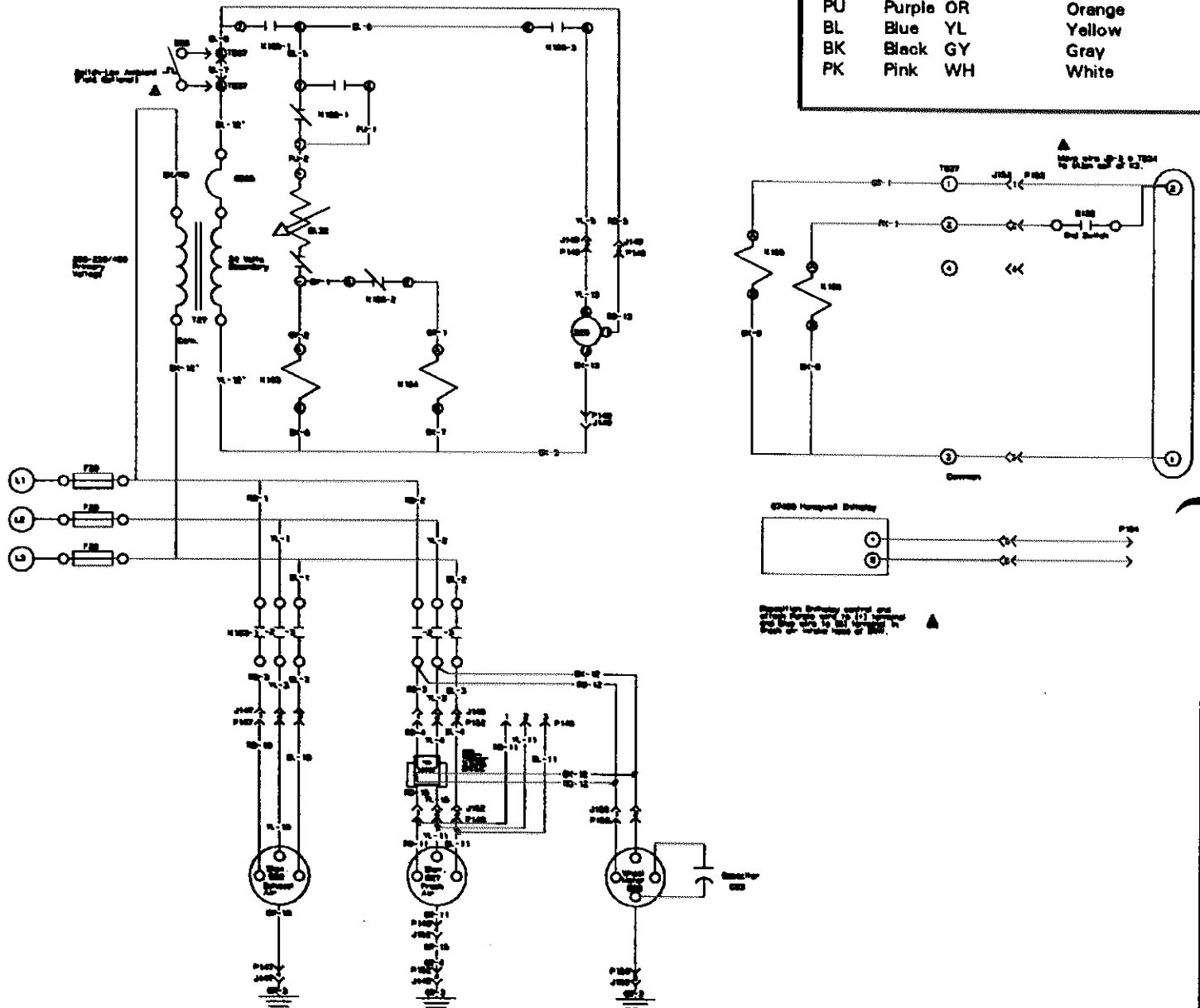
Table #3

# COMPONENT CODE

B26	Motor, Exhaust Air	J147	Jack, Exhaust Air Blower	P147	Plug Exhaust Air Blower
B27	Motor, Fresh Air	J148	Jack, Fresh Air Blower	P148	Plug, Fresh Air Blower
B28	Motor, Desiccant Wheel	J149	Jack, Wheel & Damper Motor	P149	Plug, Wheel & Damper Motor
B29	Motor, Wheel & Damper	J150	Jack, Wheel Motor	P150	Plug, Wheel Motor
C23	Capacitor, Wheel Motor	K163	Contact, Exhaust Air	T27	Transformer, Desiccant Wheel
CB20	Circuit Breaker, Desiccant Wheel	K164	Contact, Fresh Air Blow.&Wheel Motor	T28	Transformer, Step-down
DL32	Delay, Desiccant Wheel	K165	Relay, Desiccant Mode	TB37	Terminal Strip, Desiccant Wheel
F29	Fuse, Desiccant Wheel	K166	Relay, Economizer Mode		

## WIRE COLOR CODE

RD	Red	GR	Green
PU	Purple	OR	Orange
BL	Blue	YL	Yellow
BK	Black	GY	Gray
PK	Pink	WH	White



- Notes: 1. Remove jumper to install field optional low ambient switch.  
 2. Wire harness field connected.  
 3. Reinstall enthalpy control.

# HARNESS D'

J 147 & P 147  
J 148 & P 148  
J 149 & P 149  
J 150 & P 150  
J 152 & P 152  
J 153 & P 153

B26 Motor, Exhaust Air  
B27 Motor, Fresh Air  
B28 Motor, Desiccant Wheel  
B29 Motor, Wheel & Damper  
C23 Capacitor, Wheel Motor  
CB20 Circuit Breaker, Desiccant Wheel  
DL32 Delay, Desiccant Wheel  
F28 Fuse, Desiccant Wheel  
J147 Jack, Exhaust Air Blower  
J148 Jack, Fresh Air Blower

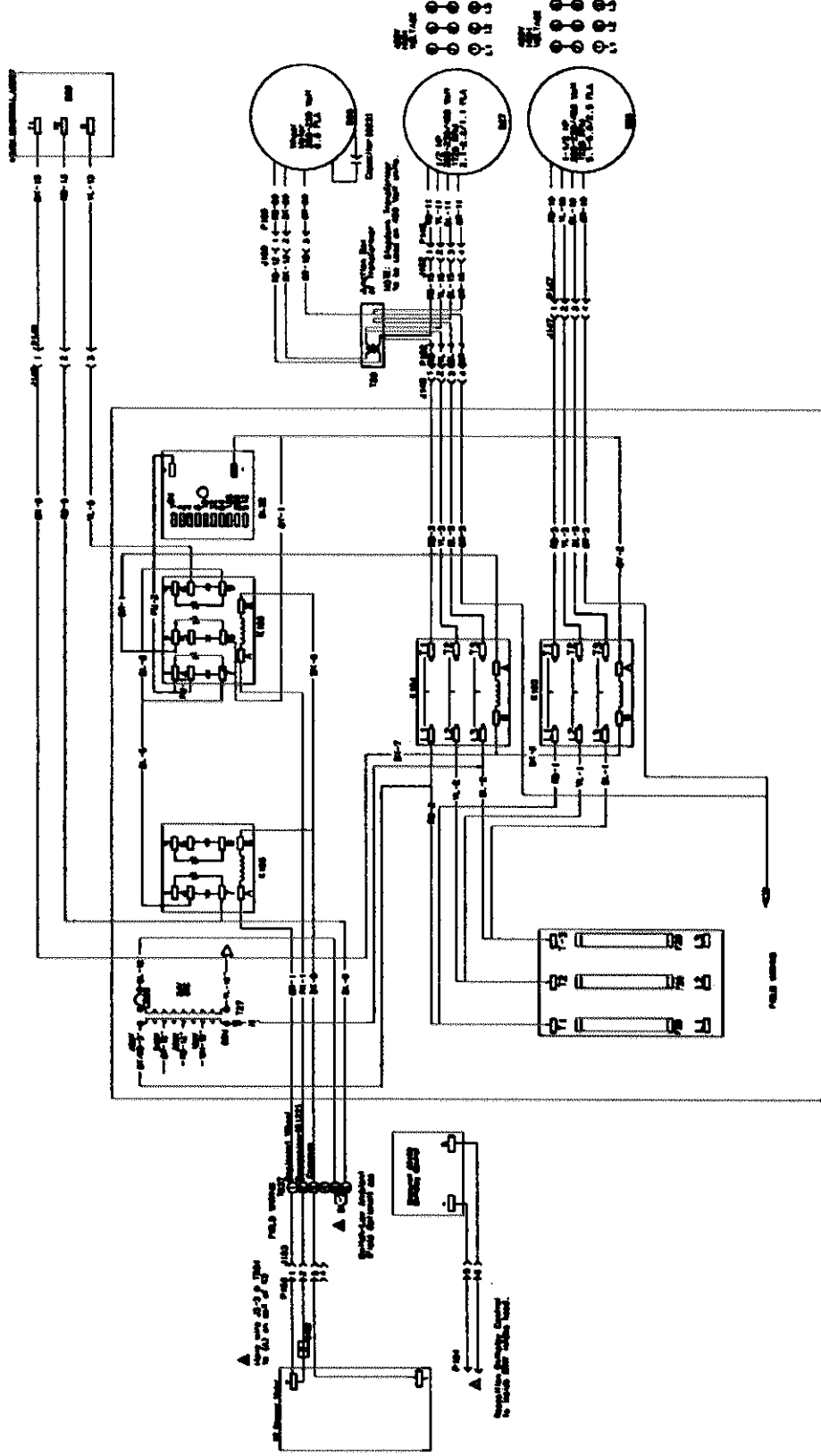
## COMPONENT C'

J149 Jack, Wheel & Damper M.  
J150 Jack, Wheel Motor  
J152 Jack, Transformer Stepdown  
J153 Jack, Field Connection  
K163 Contactor, Exhaust Air  
K184 Contactor, Fresh Air Blower & Wheel Motor  
K185 Relay, Desiccant Mode  
K166 Relay, Economizer Mode  
P147 Plug, Exhaust Air Blower  
P148 Plug, Fresh Air Blower

P149 Plug, Wheel & Damper Motor  
P150 Plug, Wheel Motor  
P152 Plug, Transformer Stepdown  
P153 Plug, Field Connection  
S26 Switch - Low Ambient  
T22 Switch End  
T27 Transformer, Desiccant Wheel  
T28 Transformer, Step-down  
TB37 Terminal Strip, Desiccant Wheel

## WIRE COLOR

RD	Red	GR	Green
PU	Purple	OR	Orange
BL	Blue	YL	Yellow
BK	Black	GY	Gray
PK	Pink	WH	White



## Notes:

1. Remove jumper to install field optional low ambient switch.
2. Reposition enthalpy control and wire nut existing wires to wire harness.

Lennox "715"  
Desiccant Wheel - 460V (3 PH)

Rooftop Systems, Inc.  
2405 McIver Lane  
Carrollton, Texas 75006  
Phone: (214) 247-7447  
Fax: (214) 243-0940

Date: August 6, 1996  
Drawn by: MGL  
Unit#: 60-715-31-33  
Diagram#: 71531-3W

Energy Recovery Wheel  
Dimensional Drawing

