



Evolution RC

Preliminary Service Manual

Proprietary Information For Kendro Use Only

This manual contains hyper-links throughout its contents. On all Table of Contents pages the links will bring you to the appropriate page. Each manual section has its page marked in blue on the upper right corner of the page. These page numbers also have hyper-links to return you to the previous menu.

Steve Culmo



Evolution RC

Table of Contents

- 1.0 Operation**
- 2.0 Installation**
- 3.0 Preventative Maintenance**
- 4.0 Theory of Operation**
- 5.0 Troubleshooting**
- 6.0 Repair & Replacement**
- 7.0 Calibration & Software**
- 8.0 Schematic Diagrams**
- 9.0 Illustrated Parts List**

Evolution RC

Table of Contents

1.0 Operation

1.1 Introduction

1.2 Installation

1.3 Centrifuge Controls

1.4 Centrifuge Operation

1.5 Maintenance

1.6 Messages & Diagnostics

1.7 Advanced Functions Module

1.8 Rotor Information

SORVALL®

SORVALL®
Evolution® RC



**OPERATING
INSTRUCTIONS**

 **Kendro®**

OPERATING INSTRUCTIONS

SORVALL[®] Evolution[®] RC ***Superspeed Centrifuge***

**Kendro Laboratory Products
Newtown, Connecticut
U.S.A.**

SORVALL[®]  **Kendro[®]**

This manual is a guide for use of the

SORVALL® Evolution® RC Superspeed Centrifuge

Data herein has been verified and is believed adequate for the intended use of the system. Always follow the recommendations set forth herein; failure to do so could result in personal injury or property damage. Kendro does not guarantee results and assumes no obligation for the performance of products that are not used in accordance with the instructions provided. This publication is not a license to operate under, nor a recommendation to infringe upon, any process patents.


Publications prior to the Issue Date of this manual may contain data in apparent conflict with that provided herein. Please consider all data in this manual to be the most current.

Warnings, cautions, and notes within the text of these instructions are used to emphasize important and critical instructions.

WARNING: Informs the operator of a hazard or an unsafe practice that could result in personal injury, affect the operator's health, or contaminate the environment.

CAUTION: Informs the operator of an unsafe practice that could result in damage of equipment.

NOTE: Highlights essential information.

Warnings and cautions appear in the left sidebar near the information to which they correspond and are accompanied by the hazard symbol .

Important Safety Information

Certain potentially dangerous conditions are inherent in the use of all centrifugation systems. To ensure safe operation of this system, anyone using it should be aware of all safe practices and take all precautions described below and throughout these operating instructions.



WARNING

Use specified Sorvall® rotors only. Use of another manufacturer's rotor can cause rotor failure which could result in personal injury and/or centrifuge damage.

When using radioactive, toxic, or pathogenic materials, be aware of all characteristics of the materials and the hazards associated with them in the event leakage or rotor failure occurs during centrifugation, in which case neither the centrifuge nor the rotor can protect you from particles dispersed in the air. To protect yourself, we recommend additional precautions be taken to prevent exposure to these materials, e.g., use of controlled ventilation or isolation areas.

Always be aware of the possibility of contamination when using radioactive, toxic, or pathogenic materials. Take all necessary precautions and use appropriate decontamination procedures if exposure occurs.

The use of sealed rotors, buckets and/or sample containers will provide increased protection from contamination during routine operation. However, these items will not guarantee contamination protection from accidents resulting in damage to the rotor or buckets. Do not run hazardous materials in the centrifuge unless placed in a biohazard enclosure and operated using all appropriate safety precautions.

Never use any material capable of producing flammable or explosive vapors or creating extreme exothermic reactions.

Never exceed the maximum rated speed of the installed rotor. To do so can cause rotor failure which could result in personal injury and/or centrifuge damage.

Always reduce (derate) rotor speed whenever:

- the rotor speed/temperature combination exceeds the solubility of the gradient material and would cause it to precipitate;
- rotor compartment load exceeds the maximum allowable compartment load specified (check this whenever average fluid density is greater than 1.2 g/ml). See Chapter 4, Operation.

Failure to reduce rotor speed under these conditions can cause rotor failure.

Centrifuges routinely deal with high energy levels and could move suddenly in the unlikely event of a rotor failure. During centrifuge operation, never lean on or move the centrifuge, keep the work surfaces and surrounding area clear of objects (including all hazardous materials), and do not work on top of or next to the centrifuge. See Chapter 2, Installation.

(continued)

Important Safety Information (cont.)



CAUTION

Do not run or precool a rotor at the critical speed as this will have a detrimental effect on centrifuge component life. See Rotor Information on page A-2.

Do not operate the centrifuge without a rotor properly installed and locked to the centrifuge drive. See the rotor instruction manual.

The centrifuge must be on a level surface and the front stabilizers lowered in order to minimize centrifuge movement in the event of a rotor failure. See Chapter 2, Installation.

The centrifuge can be damaged if connected to a voltage outside the range specified for this centrifuge. Check the voltage before plugging the centrifuge into a power source. See Chapter 2, Installation.

Always maintain the centrifuge in the recommended manner. See Chapter 5, Maintenance.

Table of Contents

Important Safety Information	iii
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Chapter 1: Introduction and Description

General Description	1-1
Centrifuge Features	1-1
Centrifuge Specifications	1-4

Chapter 2: Installation

Inspection	2-1
Location	2-1
Environmental Conditions	2-2
Electrical	2-2
Levelling	2-3

Chapter 3: Controls

Control Panel	3-1
Rotor Display and Controls	3-3
Time Display and Controls	3-4
Speed Display and Controls	3-5
Temperature Display and Controls	3-6
Start and Stop	3-7

Chapter 4: Operation

Startup Procedure	
• Step 1–Power on the Centrifuge	4-1
• Step 2–Identify and Load the Rotor	4-1
• Step 3–Set the Time Parameters	4-3
• Step 4–Set the Speed Parameters (rpm/RCF)	4-3
• Step 5–Set the Temperature (°C)	4-4
• Step 6–Start the Run	4-4
Rotor Precool/Preheat (Optional)	4-4
Once the Run is in Progress	
• Slow-Start/Slow-Stop	4-4
• Changing the Run Parameters	4-5
• Safe Speed System	4-5
• Stopping the Run	4-5
If a Power Outage Occurs	4-6
Reducing Speed for Rotor Compartment Loads	
in Excess of Design Mass	4-6
• Energy Management System	4-6
Continuous Flow Operation	4-7

Chapter 5: Maintenance

Cleaning	5-2
Lubrication	5-2
Emergency Sample Recovery	5-3
Parts Ordering Information	5-3
Service Decontamination Policy	5-4

Chapter 6: Messages and Diagnostics

Run Status Indicators	6-1
Informational and Error Messages	6-1

Chapter 7: Advanced Functions Module

Description	7-1
Touch Button Action	7-3
Function Description	7-4

Appendix

Rotor Information	A-2
Warranty	A-3

List of Illustrations

1-1. Evolution® RC Parts Location and Identification	1-3
2-1. Centrifuge Dimensions	2-1
2-2. Leveling Adjustment	2-3
2-3. Control Panel Adjustment	2-4
3-1. Control Panel	3-2
4-1. Rotor/Message Display at Startup	4-1
4-2. Evolution® RC Tubing Holder	4-7
5-1. Door Interlock Override	5-3
7-1. Control Panel with AFM™ Advanced Functions Module	7-1

List of Tables

5-1. Maintenance Schedule	5-1
6-1. Evolution® RC Error Messages	6-3
Rotor Information	A-2

Chapter 1: Introduction and Description

This guide provides you with the information you need to install, operate and maintain your SORVALL® Evolution® RC Superspeed Centrifuge. If you encounter any problems concerning either operation or maintenance that is not covered in the manual, please telephone Kendro for assistance. In the United States, call toll-free 800-522-7746. Outside the United States, the nearest Kendro office (see back cover) or your representative for SORVALL® products. As an additional source, please visit our internet web site at <http://www.kendro.com> or <http://www.kendro.de> for immediate access to information regarding this and other Kendro product offerings.

General Description

The SORVALL® Evolution® RC Superspeed Centrifuge sets a new standard in superspeed performance and usability. With its powerful drive system, ergonomic design and the functionality you need for a basic centrifuge, it is the next step in the evolution of superspeed centrifuges.

When used with a SORVALL® SE-12 rotor, the Evolution® RC can reach a top speed of 26 000 rpm with a maximum RCF (relative centrifugal force, or *g*-force) of 70 450. The Evolution® RC accepts all SORVALL® Superspeed and *Supraspeed*® rotors with the exception of the S-20 *Supraspeed*® swinging-bucket rotors or the SH-MT horizontal microtube rotor.

Centrifuge Features

High Capacity

With the Evolution® RC's high capacity rotor chamber, you can perform six-liter runs at up to 8500 rpm (15 810 *g*) in as little as nine minutes using the SLC-6000 Composite Rotor.

High Performance Drive

The Evolution® RC's brushless DC direct drive system is designed for speed, accuracy, long life, and low maintenance — and no vacuum system is required to achieve high performance. Virtually pulse-free, it is inherently non-cogging, which ensures the smoothest acceleration and deceleration possible. (Cogging is typical of induction and brush type motors and can cause sample disturbance during acceleration and deceleration.) Features include:

- Three acceleration options and four braking options, with settings for full torque acceleration and braking performance that can deliver among the shortest run times in the industry.
- Rotor-specific imbalance thresholds which allow “eyeball balance” convenience.

Ergonomic Design

The Evolution® RC is ergonomically designed for operator convenience. Features include:

- Low rotor-liftover height and short reach to controls
- Large display for across-the-room viewing with dual display of set and actual parameters
- An adjustable, low-glare control panel that may be purchased with either rotary knobs or scroll keys for setting run parameters
- An easy-glide chamber door that retracts and disappears behind the top deck, making the chamber easy to access
- Rubberized pads on either side of the door provide a slip-free surface for placing rotors and related equipment prior to loading.
- Convenient rotor lid holder at the top of the control console.

Precise Temperature Control

The Evolution® RC's DuoTherm™ refrigeration system combines heating and cooling with accurate temperature control from +2°C to +40°C in run mode and from +2°C to +30°C in standby mode. The DuoTherm™ system offers quick temperature change response and precise temperature control. Rotors may be precooled or preheated.

Installation

With a narrow 28-inch (710 mm) width, the Evolution® RC is smaller than most superspeed and ultraspeed centrifuges and therefore requires less floor space. Its high-strength frame is designed to limit centrifuge movement in the event of possible rotor failure. As a result, the Evolution® RC does not need to be bolted to the floor, unlike other superspeed centrifuges.

Easy Rotor Identification

There is no need to memorize rotor codes with the Evolution® RC. Rotors are listed on the display panel by name and type — you simply select from the list. RunBrowser™ lets you quickly recall the parameters for the last five runs, a timesaver if you regularly use the same settings.

Run Options

The Evolution® RC provides the basic functionality you need for most centrifuge operations — speed, time and temperature — so that run parameters can be set quickly and easily. Run options include the following:

- RCF Run — RCF can be chosen in place of rpm to control run speed. This allows RCF to be reproduced from run to run and rotor to rotor.
- Accel/Brake — Multiple settings for automatic control of slow-start acceleration rate and slow-stop braking rate, for minimizing gradient or pellet disturbance.

- Continuous Flow Runs — With the SORVALL® TZ-28/GK or SS-34/KSB-R rotors.

Expanded Voltage Range

Configured and installed and by a Kendro service representative according to local supply voltage, the Evolution® RC is designed to accommodate a broad range of electrical configurations — from 187–253 volts — and can handle extreme variations in supply voltage without operation or performance capabilities being affected.

Diagnostics

In the event of a warning condition or system malfunction, the centrifuge displays a message identifying the source of the problem. Fault conditions are verified before they are reported on the display, eliminating “nuisance” faults that could be generated by normal system operation. In addition, Kendro service representatives can access more detailed information to expedite diagnosis and troubleshooting of fault conditions.

A toll free number is available in the United States for technical assistance, 800-522-7746. Elsewhere, contact the nearest Kendro office (see back cover) or your local SORVALL® products representative.

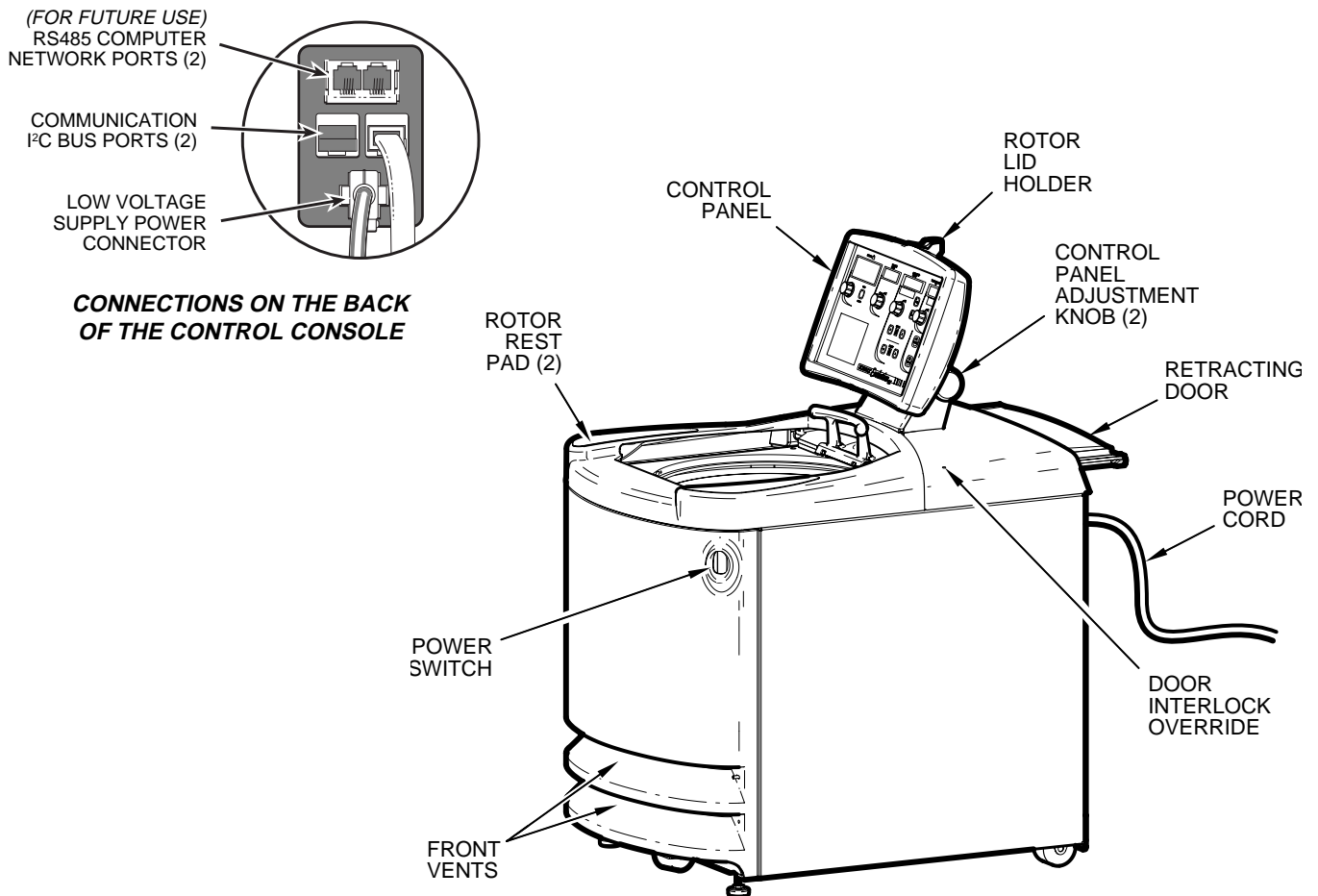


Figure 1-1. Evolution® RC Parts Location and Identification

Centrifuge Specifications

Rotor Speed

Set Speed Range	100 (rpm or RCF) to rotor maximum; in increments of 10 below 1000, and in increments of 100 above 1000 (calculates to single digits in rpm/RCF mode change)
Speed Control	±0.2% or 20 rpm, whichever is greater
Maximum Speed	26 000 rpm (with SE-12 rotor)
Maximum RCF	70 450 g (with SE-12 rotor)

Temperature

Set Range	-20°C to +40°C in 1°C increments
Temperature Control	±2°C ¹
Control Range	+2°C to +40°C
Temperature Displayed	Estimated sample temperature in 1°C increments

Time

Set Time Range	One minute to 99 hours, 59 minutes; or select HOLD for continuous operation
Time Displayed	Indicates time remaining (timed run) or time elapsed (continuous/hold run) up to 99 hours, 59 minutes

Environment Conditions

Ambient Temperature	10°C to 38°C (50°F to 100°F) ¹
Relative Humidity	Up to 90%, non-condensing
Noise Level	63 dbA ²

Dimensions

Width	710 mm (28.0 inches)
Height	1295 mm (51.0 inches) to top of control console; 850 mm (33.5 inches) to top deck lift-over
Depth	1055 mm (41.5 inches) with door closed; 1125 mm (44.2 inches) with door open

Net Mass (weight) 390 kg (860 lb)

Electrical Requirements

Available Configurations ³	200-230Vac, 60 Hz, single phase, 30 A 200-230Vac, 50 Hz, single phase, 32 A (CE certified) 220-240Vac, 50 Hz, polyphase, 32 A/P (CE certified)
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Approved configurations and power cord for the above:

- 60 Hz single phase: NEMA receptacle 6-30R for NEMA plug 6-30P
- 50 Hz single phase: IEC 60309 receptacle for 3-pin plug
- 50 Hz polyphase: IEC 60309 receptacle for 5-pin plug

¹ The centrifuge will operate in ambient temperatures ranging from +10°C to +38°C (50°F to 100°F); temperature control specifications may not be maintained for high-speed low-temperature runs if inlet air temperature is above 25°C (77°F).

² With an SS-34 rotor at 20 500 rpm and 4°C, measured 3 feet from the front panel at an approximated operator height.

³ Factory voltage specifications listed. At installation, the centrifuge is to be configured for the operation location's specific supply voltage, which must be a dedicated supply circuit delivering not less than 187Vac, nor more than 253Vac.

Chapter 2: Installation

This chapter contains instructions on preparing your SORVALL® Evolution® RC centrifuge for operation. Initial installation is to be performed by your local Kendro Service representative.

Inspection

When you receive your centrifuge, carefully inspect it for any signs of shipping damage. If you find damage, please report it immediately to the transportation company and file a damage claim, then notify Kendro. Also check the parts received with the centrifuge against the shipping list; if any parts are missing, contact Kendro (see back cover).

Location

Locate the Evolution® RC on a level floor and allow space for the size of the centrifuge (figure 2-1), plus clearance for door travel, free air circulation, and safe operation.



WARNING

The Evolution® RC weighs 390 kg (860 lbs). Be careful when moving and installing the centrifuge. Failure to use proper techniques can result in personal injury and/or damage to the centrifuge.



CAUTION

Do not move the centrifuge using the chamber door handle or the control console, or damage to these parts could result.

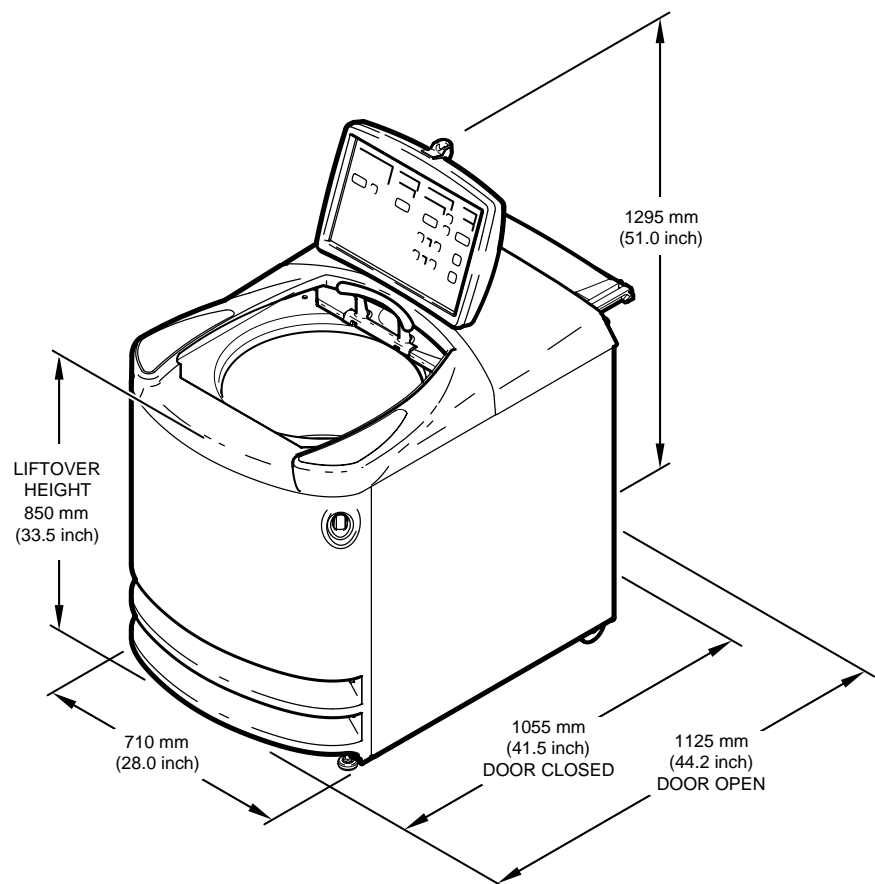


Figure 2-1. Centrifuge Dimensions

For free air circulation, required to achieve specified temperature control and allow for proper component cooling, the centrifuge requires a minimum of 140 mm (5-1/2 inches) clearance behind the rear panel.

For safety, personnel should know that centrifuges routinely deal with high energy levels and could move suddenly in the unlikely event of a rotor failure. Laboratory management procedures should require that no person or any hazardous materials are within a “clearance envelope” boundary of 300 mm (12 inches) from the centrifuge while it is operating. During centrifuge operation, personnel should be instructed not to lean on or move the centrifuge, not to stay within the clearance envelope longer than necessary for operational reasons, and not to deposit potentially hazardous materials within the clearance envelope.

Environmental Conditions

An ambient temperature range of 10°C to 38°C (50°F to 100°F) must be maintained for centrifuge operation. The relative humidity can be up to 90%, non-condensing. For optimal temperature control at low set temperatures, ambient temperature should not exceed 25°C (77°F). If the ambient temperature exceeds 25°C, the centrifuge may not maintain low temperatures at high speeds for some rotors.

The centrifuge is intended for use in 1) a Pollution Degree 2 Environment, 2) an installation category II supply circuit, and 3) at a maximum altitude of 2000 meters.

Electrical

The Evolution® RC will operate safely and meet the performance specifications detailed in Chapter 1 at the following voltages:

Phase	Hz	Amps	ac Voltage*
Single	60	30	200, 208, 220, 230
Single	50	32	200, 208, 220, 230
Poly	50	32 each	220, 230, 240

* Factory specification listed; centrifuge may be configured for any one of the specific supply voltages listed.

The Evolution® RC has been designed to ensure full performance under the broadest possible range of voltage conditions. During initial installation by your local Kendro Service representative, the centrifuge input wiring may require reconfiguring, based on the nominal local supply voltage as well as on the loaded line voltage measured at the installation site.

60 Hz single-phase centrifuges are supplied with a 3-wire power cord with 3-prong plug, including ground connection, to fit a NEMA

6-30R receptacle. 50 Hz single-phase centrifuges are CE-rated and are supplied with a 3-wire power cord for an IEC 60309-type 3-pin receptacle (32A, 2-pole and earth). 50/60 Hz polyphase centrifuges are also CE-rated, and are supplied with a power cord for a IEC 60309-type 5-pin receptacle (32 A, 3-pole, neutral and earth).

A dedicated circuit is required. The ON/OFF main power switch is a 30-Amp circuit breaker; however, for emergency disconnect purposes, we recommend a separate means of power interruption in a remote location.

Levelling



CAUTION

The centrifuge can be seriously damaged if it is operated when it has not been properly levelled.



WARNING

The front stabilizers must be used as explained in this section to lift the caster off the floor. This will help minimize centrifuge movement in the event of a rotor failure.

1. Position the centrifuge in its operating location.
2. Using the 3/4-inch (19 mm) wrench supplied, lower the two front locking stabilizers until they lightly contact the floor.
3. Rotate each stabilizer an additional four revolutions until the front caster in the center is about 5 mm (3/16 inch) off the floor and spins freely.
4. Check that the centrifuge does not rock on its four support points, the two front stabilizers and the two rear casters (see figure 2-2).

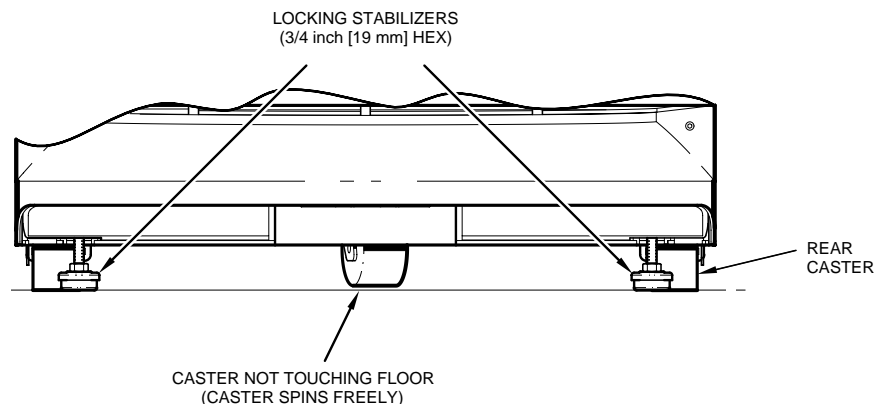


Figure 2-2. Leveling Adjustment

Setting Up the Control Panel

To adjust the angle of the control panel:

1. Loosen the two knobs located just behind the control panel on either side of the base (see figure 2-3 on the next page).

NOTE Both knobs are loosened by turning them counterclockwise. However, because the two knobs face in opposite directions, when loosened and tightened from in front of the centrifuge, they will turn in opposite directions.

2. Tilt the control panel to the desired angle.
3. Tighten the knobs into place.

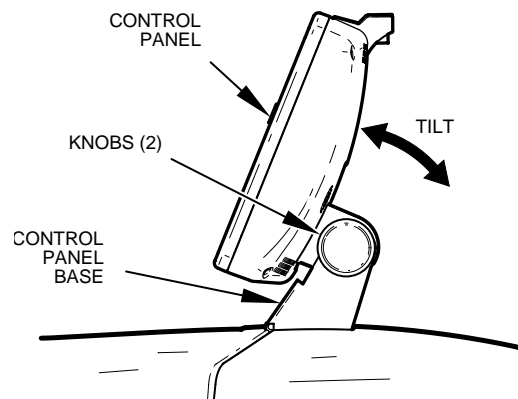


Figure 2-3. Control Panel Adjustment

Chapter 3: Controls

This chapter provides a detailed description of the Evolution® RC controls. For step-by-step operating instructions, see Chapter 4, Operation.

Control Panel

NOTE: To adjust the angle of the control panel:

1. Loosen the two knobs on either side of the base of the control panel (see figure 2-3). The knobs turn in opposite directions.
2. Tilt the control panel to the desired angle.
3. Tighten the knobs firmly into place.

The control panel for the Evolution® RC may be purchased with either knobs or up and down arrow keys — referred to as “scroll keys” — for setting run parameters. Figure 3-1 on the next page shows the two control panel models available. Although the mechanical means for setting the run parameters differ, the displays and functions are identical for both panels.

Functional Areas

The control panel consists of five major functional areas:

1. Rotor/Message
2. Time
3. Speed
4. Temperature
5. Start/Stop Controls.

The top line of the Rotor/Message area identifies the rotor; the bottom line either identifies the rotor type or displays informational/error messages. The Time, Speed and Temperature areas have two separate displays: the bottom display shows the set parameters; the top display shows the actual run conditions.

Setting Run Parameters

The means for setting the run parameters depends upon the centrifuge control panel.

Control Panel with Knobs

Turn the knob beneath the appropriate display to the right or left until the desired setting is shown. The display values increase or decrease at different increments according to the speed with which you turn the knob: the faster you turn the knob, the larger the increment.

Control Panel with Scroll Keys

Press the up or down scroll key until the desired setting is shown. The display values increase or decrease at different increments according to the length of time you hold down the scroll key. A single press of the key advances the smallest increment; the longer you hold the key down, the larger the increment.

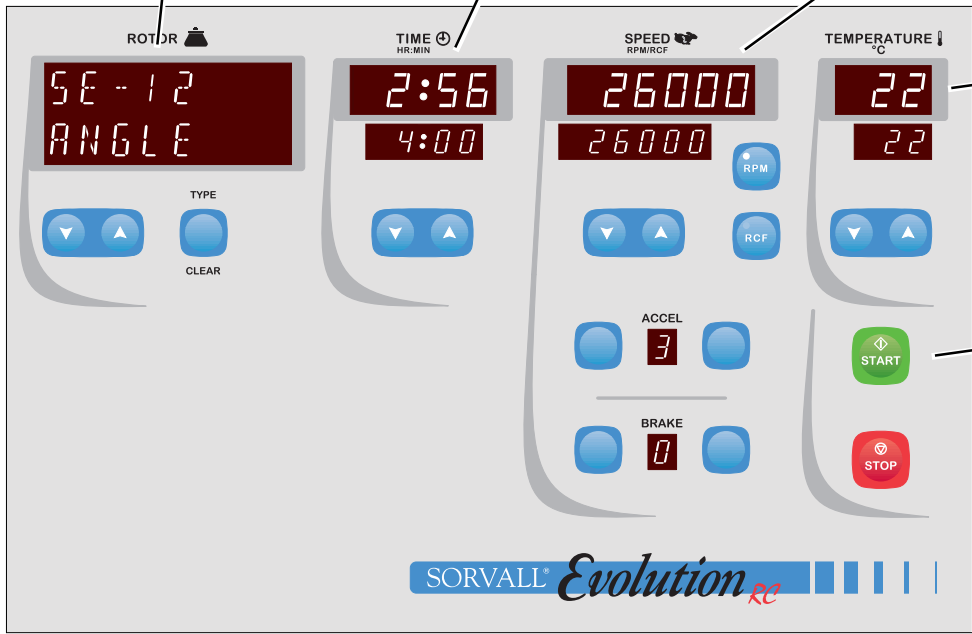
ROTOR/MESSAGE DISPLAY
Identifies the rotor type (lower line) and rotor name (upper line). Also displays error and informational messages.
Dial or Scroll Keys
Select the rotor name.
Type/Clear
Press to select the rotor type or to clear an error or informational message in the LED display.

TIME DISPLAY*
For a TIMED run, displays the set time and remaining run time; for a HOLD time, displays HOLD and the accumulated run time.
Dial or Scroll Keys
Select the run time from 1 minute (00:01) to 99 hours/59 minutes (99:59). To select a HOLD run, set just above 99:59 or below 00:00 to HOLD.

SPEED DISPLAY*
Displays the set and actual RPM or RCF.
RPM/RCF Buttons
Select the display mode: speed (RPM) or *g*-force (RCF).
Dial or Scroll Keys
Set or change the RPM/RCF.

TEMPERATURE DISPLAY*
Displays the current and set temperature for the RUN.
Dial or Scroll Keys
Select the temperature from -20°C to +40°C.

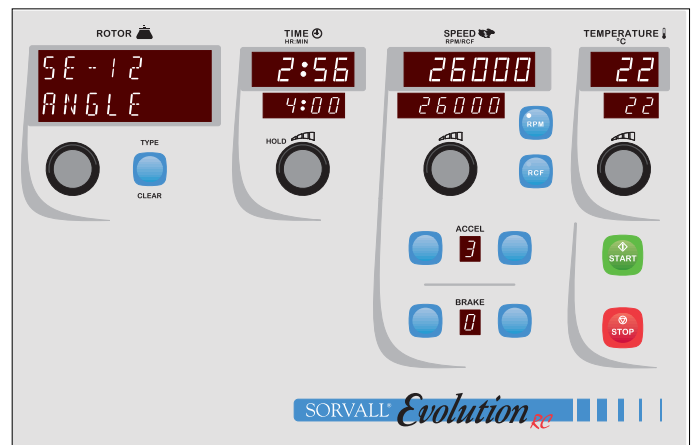
START and STOP Keys
Start and stop the centrifuge run.



The image shows a control panel for a Sorvall Evolution RC centrifuge. It features four main display sections: Rotor/Message, Time, Speed, and Temperature. Each section has a two-line LED display and associated control buttons. The Rotor/Message display shows 'SE-12' and 'ANGLE'. The Time display shows '2:56' and '4:00'. The Speed display shows '26000' and '26000'. The Temperature display shows '22' and '22'. Below the displays are buttons for 'TYPE', 'CLEAR', 'ACCEL', 'BRAKE', 'RPM', 'RCF', 'START', and 'STOP'. The panel is labeled 'SORVALL Evolution RC' at the bottom.

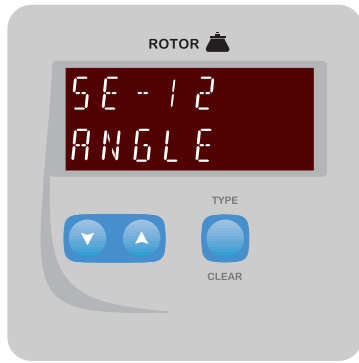
Control Panel with Scroll Keys

* Upper display = Actual run condition
Lower display = Set parameter



Control Panel with Knobs

Figure 3-1. Control Panel



Rotor Display and Controls

This portion of the control panel serves two functions:

1. Identifies the name and type of the rotor selected for a run.
2. Shows error and informational messages on the bottom line of the display.

Rotor LED Display

The rotor name is identified on the top line of the LED display and the rotor type is identified on the bottom line.

When a fault occurs or when information needs to be relayed to the user due to certain run conditions, the rotor type is replaced with a descriptive message. The message scrolls continuously across the display until it is cleared (see TYPE/CLEAR Key below). Messages and their corresponding corrective actions are itemized in *Chapter 6, Error and Informational Messages*.

TYPE/CLEAR Key

This key serves two functions: 1) to select the rotor type, and 2) to clear error and informational messages that appear in the LED display. Either TYPE or CLEAR is illuminated at any given time to indicate which function is currently active.

TYPE Function

When TYPE is illuminated, the rotor type is shown on the bottom line of the Rotor LED display. The TYPE key is used to scroll through the rotor types. Selections include the following:

Type	Description
RECENT	The five most recent sets of unique run parameters in last-in, first-out order (the most recent run is shown first). A run is considered unique if one or more run parameters are different. For instance, two sets of run parameters that are identical with the exception of the rate of acceleration are considered unique.
ANGLE	Fixed angle rotors
SWINGING	Swinging bucket rotors
OTHER	All other rotors (vertical, continuous flow, etc.)

NOTE: You can optionally use the Rotor Dial/Scroll Keys to scroll continuously through all rotors and rotor types.

To scroll through the rotor types, you may press the TYPE key repeatedly or hold the key down until the desired type is shown.

CLEAR Function

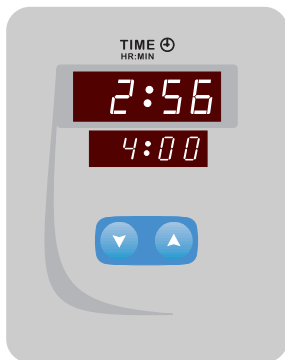
CLEAR is illuminated when an error or informational message appears on the lower line of the LED Display. The CLEAR key is used to clear the message and redisplay the rotor type. For detailed information on error handling, refer to *Chapter 6, Error and Informational Messages*.

Rotor Knob/Scroll Keys

The rotor knob /scroll keys are used to select a specific rotor within a rotor type. Turn the rotor knob to the right or left or press the up /down scroll keys until the desired rotor is shown. Here are guidelines for making a selection:

- Rotors are displayed on the upper line of the LED display, rotor types are identified on the bottom line. Rotors are displayed in the same order that they appear in the Rotor Information table in the Appendix (page A-2).
- As you move through the rotor list, the display advances from one rotor type to the next — from RECENT to ANGLE, SWINGING, OTHER and vice versa.
- When you reach the end of the rotor list, the display wraps around to the beginning of the list (in either direction).
- The TYPE key is optional when selecting a rotor. You can use it at any time to quickly advance to a specific rotor type.

NOTE: The rotor name cannot be changed while a run is in progress.



Time Display and Controls

Time LED Display

The Time LED display shows the following:

- Upper display — Actual run time once a run is in progress
- Lower display — Time setting selected.

You may select a timed run or a continuous “hold” run.

Time Knob/Scroll Keys

The time knob / scroll keys are used to set the centrifugation run time. The SET display values increase or decrease incrementally according to the speed with which you turn the knob or the length of time you hold down the scroll key.

Timed Run

Timed runs may range from one minute (00:01) to 99 hours and 59 minutes (99:59). The HR:MIN value you select appears in the SET display. When you press START, the timer begins and the RUN display counts down from the set value to zero (00:00), then shows END.

You can change the time or switch to a HOLD run while the run is in progress.

HOLD Run

To select a HOLD run, turn the time knob / scroll keys one setting lower than 00:01 or above 99:59. HOLD appears in the SET display. The RUN display counts up from 00:00, showing the accumulating run time until you press the STOP key. After 99:59, HOLD appears in the RUN display until you stop the run.

You can switch to a timed run at any time.



Speed Display and Controls

RPM/RCF Keys

Press the appropriate key to select RPM or RCF (*g*-force). The indicator on the key illuminates, verifying the mode selected. You may press the RPM or RCF key at any time during a run to switch the display between RPM and *g*-force.

Speed LED Display

The Speed LED display shows the following:

- Upper display — Run speed / *g*-force once a run is in progress.
- Lower display — Set speed / *g*-force.

You cannot set the speed higher than the maximum allowed for the rotor indicated in the Rotor / Message Display.

NOTE: If you specify a speed and then select a rotor, the speed will default to the maximum allowed for the rotor. Always select a rotor before specifying a speed.

Speed Knob/Scroll Keys

The speed knob / scroll keys are used to select the centrifugation RPM or RCF. The SET display values increase or decrease incrementally according on the speed with which you turn the knob or the length of time you hold down the scroll key.

The maximum RPM / RCF allowed depends on the rotor specified on the Rotor / Message Display.

ACCEL

ACCEL is used to specify the acceleration time. Two slow-start options are designed to provide optimal reorientation conditions and prevent disturbance of gradient or pellet. A full-torque acceleration option is also available. Options include:

Option	Acceleration Time
1 (Slow)	2 minutes (approximate) to 500 rpm
2 (Medium)	1 minute (approximate) to 500 rpm
3 (Fast)	Full torque acceleration

When a slow-start option is selected, the rotor accelerates from 0–500 rpm over a predefined time period, then accelerates at full torque to set speed. When you press START, the ACCEL selection blinks during the slow-start period. You cannot change the ACCEL selection once a run has started.

BRAKE

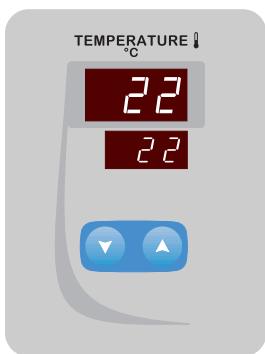
BRAKE is used to specify the deceleration time. The following options are available:

Options	Deceleration Time
0 (Slow)	Coast (brake off)
1 (Medium slow)	2 minutes (approximate) from 500–0 rpm
2 (Medium fast)	1 minute (approximate) from 500–0 rpm
3 (Fast)	Full torque deceleration

Options 0–2 are slow-stop options, and are designed to provide optimal reorientation conditions and prevent disturbance of gradient or pellet:

- For option 0, the rotor decelerates from set speed to a complete stop without any braking action. The BRAKE selection blinks from 500–0 rpm.
- For options 1 and 2, the rotor decelerates from 500–0 rpm over the period of time indicated. When the slow-stop time threshold is reached, the BRAKE selection blinks until 0 speed is reached.

You may select a BRAKE option at any time during a run except when deceleration below 500 rpm is in progress.



Temperature Display and Controls

Temperature LED Display

The Temperature LED display shows the following:

- Upper display — Calculated sample temperature
- Lower display — Set sample temperature

Temperature Knob/Scroll Keys

The temperature knob/scroll keys are used to select the centrifugation temperature. Temperature can range from -20°C to $+40^{\circ}\text{C}$. The temperature field defaults to the setting for the previous run. You may change the temperature setting at any time during a run.

The SET display values increase or decrease incrementally depending on the speed with which you turn the knob or the length of time you hold down the scroll key.



Start and Stop

The START and STOP keys are used to start and stop a run, respectively.

Start Key

Once all run parameters have been entered, the START key is pressed to begin a run. The rotor will accelerate at the rate specified in the ACCEL field.

NOTE: In order for the run to start, a rotor, run time and run speed must be specified and serious error conditions must be corrected and the corresponding message(s) cleared from the Rotor/Message Display.

Stop Key

The STOP key may be pressed at any time to end a run. The run will decelerate at the rate specified in the BRAKE field. When the Rotor/Message Display reads End and a beep sounds, you can safely open the rotor chamber door.

Chapter 4: Operation

This chapter provides step-by-step instructions for operating the Evolution® RC Centrifuge.

Startup Procedure

Step 1 – Power On the Centrifuge

Turn the centrifuge power ON using the power ON/OFF switch on the upper right corner of the front cabinet panel. The microprocessor automatically runs a system test every time the centrifuge is turned on. During the system test routine, “PLEASE WAIT” will appear in the Rotor/Message Display; do not attempt to open the chamber door or to use any controls until after the test routine is completed.

- If an error is found in the system test, you are notified with a message in the Rotor/Message Display.
- After the system test, the Rotor field defaults to “-----,” indicating that a rotor needs to be identified. All settings in the remaining displays (time, speed and temperature) are those for the most recent run.

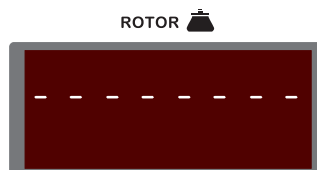


Figure 4-1. Rotor Message Display at Startup

To ensure that the rotor and chamber temperatures are at equilibrium at the start of the run, you may optionally follow the precool/preheat procedure on page 4-4.

Step 2 – Load and Identify the Rotor

For best run conditions and prolonged centrifuge life, the rotor chamber should be dry at the start of a run. Before installing the rotor, wipe the chamber dry with a clean cloth or paper towel.

Tips for Preparing Rotors and Tubes

When preparing and loading rotors and tubes, you can use the following features of the Evolution® RC:

1. Rest the rotor cover (if any) on top of the control panel: Slide the rotor locking screw into the rotor lid holder located at the center top of the control panel.
2. Rest the rotor/tubes on the rubberized panels on either side of the door.



WARNING

Be sure the rotor and/or tubes are properly supported when resting them on the rubberized side panels. Improperly supported parts can tip and cause equipment damage and personal injury.

**WARNING**

When loading the rotor, be sure not to exceed the maximum compartment mass of the rotor (see the Rotor Information Table in the Appendix). If the maximum compartment mass is exceeded, the maximum operating speed must be reduced (see Reducing Speed for Rotor Compartment Loads in Excess of Design Mass in this chapter). Failure to do so can cause rotor failure which could result in personal injury and/or centrifuge damage.

Do not operate the centrifuge without the rotor properly installed. The rotor cover must be secured to the rotor and the rotor must be properly seated and locked to the centrifuge drive spindle. See the rotor manual.

**WARNING**

Before performing a run, be sure that the rotor displayed on the control panel is the installed rotor. Use only approved SORVALL® rotors (refer to Rotor Information in the Appendix). Installing an unapproved rotor or misidentifying a rotor, depending on the rotor/speed combination set, may allow operation at speeds above the maximum rated speed of the installed rotor, possibly resulting in rotor failure.

Loading and Identifying the Rotor

1. Prepare the rotor:
 - Load and balance the samples. The Evolution® RC has a greater imbalance tolerance than other centrifuges, because the imbalance margin is defined uniquely for each rotor.
 - Place the cover (if any) on the rotor.
 - For fixed-angle rotors, turn the large cover locking knob counterclockwise to secure the cover to the rotor.

For further details, refer to the rotor manual.

2. Open the chamber door. When you press against the handle, it slides open.

Tip: The door handle is designed for easy opening while you are holding a rotor. Press the rotor body against the handle to slide the door open.

3. Install a rotor approved for use in the Evolution® RC, making sure the rotor is fully seated and does not rock on the tapered spindle, then lock the rotor to the drive spindle by turning the small rotor locking knob counterclockwise.
4. Note name of the installed rotor, then close the chamber door.
5. Select the rotor type and rotor –it is important to correctly specify the installed rotor; *read the WARNING:*

- To recall the most recently used rotor, either press the TYPE key once or, depending on the control panel installed, press a rotor scroll key once or turn the rotor knob a single notch.
- To select any other rotor, use the rotor knob / scroll keys. Rotors are listed in the order indicated on the rotor table on page A-2. You can press the TYPE key at any time to move directly to a specific rotor type.

Rotor types include:

Type	Rotor Description
Recent 1–5	The last five different rotors used in last-in, first-out order (the most recently used rotor = RECENT 1). When you select a rotor from this category, the set parameters (time, speed, temperature, etc.) default to the most recent parameters used with the rotor.
Angle	Fixed angle
Swinging	Swinging bucket
Other	All other rotors (vertical, continuous flow, etc.)

NOTE: Unless RECENT is chosen to recall parameters, when a rotor is selected, the SPEED setting will default to that rotor's maximum.

6. To use the default run parameters shown on the control panel, simply press the START key to begin centrifugation. To change any of the parameters, refer to the steps that follow.

Step 3 – Set the Time Parameters

You can select a timed run or a continuous (hold) run. The timed run counts down (in hours and minutes) from the time you set to 00:00, then comes to a stop automatically. The continuous (hold) run counts up from zero (00:00) and continues until you press the STOP key.

- **For a Timed Run**

Specify the desired time in the SET display. Time may range from 1 minute (00:01) to 99 hours and 59 minutes (99:59).

- **For a Continuous (Hold) Run**

Advance the TIME controls (knob or scroll keys) above 99:59 or below 00:01 until HOLD appears in the SET display.

Step 4 – Set the Speed Parameters (RPM/RCF)

Speed may be set in either RPM or RCF (*g*-force). Use the RCF option when you know the *g*-force to be applied during centrifugation. The corresponding RPM is automatically calculated.

NOTE: Specify the installed rotor before setting desired run speed. Otherwise, when the rotor is selected, the set speed will automatically change –either to a value from a recent run, or to the displayed rotor's maximum.

1. Press the RPM or RCF button to indicate the mode for setting the run speed. The light on the corresponding button illuminates.
2. Set the desired run speed (in terms of the selected mode, either RPM or RCF) using the knob or scroll keys.
3. Set the acceleration time to one of the following:

Entry	Acceleration Time (approximate)
1 (Slow)	2 minutes from 0 to 500 rpm
2 (Medium)	1 minute from 0 to 500 rpm
3 (Fast)	Full torque acceleration

Options 1 and 2 are slow-start options. When selected, the rotor accelerates from 0 to 500 rpm over the time period indicated above, then accelerates normally to set speed.

4. Set the braking time to one of the following:

Entry	Deceleration Time (approximate)
0 (Slow)	Coast (brake off)
1 (Medium slow)	2 minutes from 500 to 0 rpm
2 (Medium fast)	1 minute from 500 to 0 rpm
3 (Fast)	Full torque deceleration

Options 0, 1 and 2 are slow-stop options. When selected, the rotor decelerates from 500 to 0 rpm over the time period indicated above.

Step 5 – Set the Temperature (°C)

Temperature settings can be from -20°C to $+40^{\circ}\text{C}$; the control range for estimated sample temperature is from $+2^{\circ}\text{C}$ to $+40^{\circ}\text{C}$. To change the temperature setting, use the temperature knob or scroll keys.

NOTE: To achieve a large change in rotor and chamber temperature in a short length of time, we recommend pre-equilibrating rotor and chamber temperature (see Rotor Precool/Preheat below) to avoid the possibility of a ROTOR OVER TEMP or ROTOR UNDER TEMP fault.

If performing maximum speed runs in ambient temperature conditions above 25°C (77°F), the system may be unable to maintain extremely low sample temperature with some rotors.

Step 6 – Start the Run

Press the START key to start the run (*read the WARNING*).

In order for the run to start, a rotor, run time and run speed must be specified; the rotor chamber door must be closed; and any serious error conditions must be corrected and the corresponding message(s) cleared from the Rotor/Message Display. If these conditions are not met, correct the condition(s) in error and press START again.



WARNING

Do not leave rotors or other objects on centrifuge surfaces during operation.

Also during centrifuge operation, do not stay within a “clearance envelope” boundary of 300 mm (12 inches) from the centrifuge longer than necessary for operational reasons, do not lean on or move the centrifuge, and not to deposit potentially hazardous materials within the clearance envelope.

Rotor Precool/Preheat (Optional)

You may precool or preheat the rotor and rotor chamber, if necessary, to ensure that the rotor and chamber temperatures are at equilibrium at the start of a run. To do so:

1. Open the chamber door and install the rotor.
2. Close the chamber door, then specify the installed rotor.
3. Set the TIME display to HOLD.
4. If precooling, set speed to 2500 rpm; if preheating, set speed to approximately 90% of the rotor maximum.
5. Set the desired temperature, then press START.
6. Allow the centrifuge to run until the value in the upper temperature display is within two degrees of the value in the lower temperature display, then press STOP.

In many cases, the temperature will come into range within five minutes; the actual time required to pre-equilibrate temperatures will vary by rotor and other factors.

NOTE: Composite rotors require significantly more time to change temperature than metallic rotors. Therefore, rather than attempting to equilibrate a composite rotor in the centrifuge, we recommend storing composite rotors in a temperature-controlled environment to ensure desired sample temperature.

Once a Run is in Progress

Slow-Start/Slow-Stop

If you selected a slow-start option, the entry in the ACCEL field blinks until full torque acceleration begins. If you selected a slow-stop option, the BRAKE selection blinks during deceleration until 0 speed is reached.

Changing the Run Parameters

While a run is in progress, you can change all run parameters at any time with the following exceptions:

- The acceleration selection cannot be changed during acceleration.
- The brake selection cannot be changed while the rotor is decelerating below 500 rpm.
- Rotor and rotor type cannot be changed until the rotor has come to a stop and End is shown in the SPEED Display.

You can switch the display between RCF and RPM at any time by pressing the RPM/RCF key. You can also switch between a timed run and a continuous (hold) run.

Switching to a Timed Run

To switch to a timed run while a hold run is in progress, enter the remaining run time desired in the SET Display. The RUN display counts down from the time you specify.

Switching to a Hold Run

If you switch to a hold run while a timed run is in progress, the RUN display begins counting up from the run time which has already elapsed.

For example, suppose you are 15 minutes into a one hour timed run. When you switch to HOLD, the RUN display begins counting up from 00:15 and continues until you press STOP.

Stopping the Run

Timed runs come to a stop once the set time has counted down to 00:00. You can press the STOP key at any time to stop a timed run before the set time has elapsed. The run stops according to the brake option selected on the control panel. The remaining run time is displayed in the Time RUN Display.

To stop a continuous (hold) run, you must press the STOP key. The accumulated run time is displayed in the Time RUN Display.

When the run has come to a stop, End appears on the Speed Display and a long beep sounds. The rotor chamber door unlocks and is safe to open.

If a Power Outage Occurs

If a power outage occurs, the Evolution® RC automatically restarts once the power returns. If a run was in progress at the time of the outage, the interrupted run will resume, providing the run speed remains above 1000 rpm and no faults have occurred. The message Power Resumed appears in the Rotor/Message Display.

If the run speed is less than 1000 rpm when the power returns, the rotor coasts or brakes to a stop and the centrifuge goes into standby mode. The message POWER FAILURE appears in the Rotor/Message Display, notifying you that the power was interrupted.

Reducing Speed for Rotor Compartment Loads in Excess of Design Mass



WARNING

Failure to properly reduce set speed when rotor compartment loads exceed the rotor's maximum allowable compartment mass can result in rotor failure.

There is a maximum allowable compartment mass established for each centrifuge rotor (see Rotor Information in the Appendix). To prevent rotor failure, the total contents of any compartment, including specimen, tubes, cover, and adapters (if used) must not exceed the mass specified unless rotor speed is reduced proportionally.

Strict adherence to the maximum allowable compartment mass or reduced speed is required to prevent rotor failure. Read the WARNING on the Safety Information Page in front of this manual.

The rotor speed is reduced in proportion to the square root of the ratio for the maximum allowable compartment mass to the actual compartment mass (including specimen, tubes, covers, and adapters). If the compartment mass is more than that specified for the rotor, the reduced speed can be determined by using the formula given below.

$$\text{Reduced Speed} = \text{Maximum Rotor Speed} \times \sqrt{\frac{\text{Maximum Compartment Mass}}{\text{Actual Compartment Mass}}}$$

Energy Management System

The Evolution® RC's Energy Management System is designed to ensure that the energy produced by the rotor/load/speed combination will not exceed the maximum allowable for the centrifuge to safely contain a rotor failure.

During acceleration, the Energy Management System evaluates the performance of the installed rotor to establish how much energy would be produced if the run was to continue to SET speed. If it is determined that the energy produced could exceed the maximum allowable, the run will be terminated and an ENERGY EXCEEDED message will be displayed in the ROTOR field.

Do not expect the Energy Management System to reduce set speed, or to determine if a rotor has been misidentified or overloaded in such a way that the set speed is too high. To prevent rotor failure, be sure to correctly specify the installed rotor, and if compartment loads exceed design mass, always reduce maximum speed according to the square root formula on the previous page.

NOTE If, for some reason, the Energy Management System is unable to determine how much energy would be produced, motor torque will be reduced and SPEED LIMITED RUN will be displayed in the ROTOR field. When motor torque is reduced, it takes longer to accelerate to set speed and, in a few cases, the maximum attainable speed could be reduced slightly (limited by windage).

Continuous Flow Operation

If you are using the TZ-28/GK or SS-34/KSB rotor for continuous flow operations, you may need to purchase the kits described below.

NOTE: You can use the TZ-28 rotor in the Evolution® RC for sealed or continuous flow runs only. Dynamic loading is not available.

TZ-28/GK Rotor

The following kits are used for TZ-28/GK continuous flow operation in the Evolution® RC:

Catalog #	Description
49633	Continuous Flow Distributor Adapter for Inlet-Outlet Assembly
49089	Inlet-Outlet Assembly for Distributor Adapter

If you have previously purchased the kits required, you can use them in the Evolution® RC. If necessary, to obtain a tubing holder for an Evolution® RC (see figure 4-2), contact Kendro.

SS-34/KSB

The KSB-R Continuous Flow System Kit (Catalog No. 14005) is required to operate an SS-34/KSB System in the Evolution® RC. If you have previously purchased this kit, you can use it in the Evolution® RC. If necessary, to obtain a tubing holder for an Evolution® RC (see figure 4-2), contact Kendro.

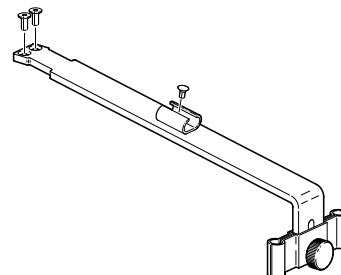


Figure 4-2. Evolution® RC Tubing Holder

Chapter 5: Maintenance

This chapter describes routine maintenance procedures that are to be performed by the user. Any further maintenance should be performed by a Kendro Service Representative or other qualified service personnel.



WARNING

There are no user-serviceable items inside the centrifuge. High voltage electrical circuits in this centrifuge can cause severe electrical shock. Due to the hazards involved, repair should only be attempted by a qualified technician who is familiar with electronics and trained in the servicing of this centrifuge; untrained personnel must not attempt procedures that are not included in this manual. Failure to comply can result in personal injury.

If hazardous materials have been processed in the centrifuge, take all necessary precautions when cleaning or servicing the centrifuge to avoid personal exposure to contaminants.



CAUTION

Use only cleaning and decontamination methods mentioned in this guide or in the SORVALL® Product Guide. Cleansers other than those specified may be harmful to the centrifuge.

To gain the most in safety, performance, and useful life from your centrifuge, it is necessary to maintain it as described in this chapter. Proper maintenance is a simple and inexpensive way to help prevent major failures. In addition to the maintenance described in this chapter, a Kendro service contract, which includes a yearly Preventive Maintenance visit, is recommended to keep your centrifuge in good condition.

Table 5-1 is a suggested maintenance schedule.

Table 5-1. Maintenance Schedule

Clean...	Frequency
Rotor chamber	Daily or immediately after a spill
Tapered spindle	Wipe before installing a rotor, clean once a week
Cabinet panels	Once a month
Control panel	Once a month
Door seal	Once a month
Front vents	Check monthly; clean as required

**WARNING**

Because of the characteristics of the samples likely to be processed in this centrifuge, biological or radioactive contamination may occur. Always be aware of this possibility, and take normal precautions. Use appropriate decontamination procedures should exposure occur.

**CAUTION**

Chlorides are extremely harmful to aluminum alloy rotors and can cause stress corrosion cracking. Therefore, do not use chlorides to disinfect the chamber.

Cleaning

Rotor Chamber

The rotor chamber should be kept clean and wiped dry routinely to maintain efficient cooling. Wash the chamber with a mild, *nonalkaline* detergent (such as dishwashing liquid) and warm water, then rinse and dry with a soft absorbent cloth.

Use 70% ethanol to disinfect the rotor chamber or a 2% glutaraldehyde solution to sterilize it. For general radioactive decontamination, use a solution of equal parts of ethanol, 10% SDS, and water. Follow this with ethanol rinses then deionized water rinses. Dry with a soft absorbent cloth. Dispose of all wash solutions in proper radioactive waste containers.

Drive Spindle

Wipe the drive spindle with a soft cloth each time a rotor is to be installed to reduce the chance of the rotor sticking. Once a week, wipe the drive spindle with a cloth dampened with warm water.

Cabinet

Use a mild *nonalkaline* detergent (such as dishwashing liquid) and warm water to clean the top deck and the chamber door.

Control Panel

To clean the control panel, spray a small amount of a mild cleaning liquid (such as window cleaner) on a clean cloth and wipe the panel clean. DO NOT spray cleaners directly on the control panel.

Door Seal

Open the chamber door all the way and wipe down the door seal and door runners using a mild *nonalkaline* detergent (such as dishwashing liquid) and warm water. Keep the door runners dry and clean.

Front Vents

To maintain the efficiency of the refrigeration system, keep the front vents free of dust and dirt and anything that might block the air intake. At one to three month intervals, clean the vents with a brush, cloth or vacuum cleaner.

Lubrication

All components are prelubricated and require no further lubrication. The refrigeration unit is hermetically sealed and the ball bearings in the centrifuge motor and drive are permanently lubricated.

**WARNING**

When the main power shuts off, the brake will not operate. Wait until the rotor stops before using the mechanical override. Reaching into the rotor chamber while the rotor is spinning can cause personal injury. Anything that falls into the chamber may be ejected at high speed.

Emergency Sample Recovery

If a power failure or system malfunction causes the centrifuge to shut off while the rotor is spinning, the rotor chamber door will not unlatch. A mechanical override is provided to allow sample recovery in the case of an emergency. This procedure is intended for emergency recovery purposes only; do not use routinely.

The door latch override is a small recess located on the rear deck of the centrifuge (see illustration). To open the chamber door:

1. Be sure the rotor has coasted to a complete stop.
2. Insert a straightened paperclip straight down into the door interlock override hole and push down.
3. Open the chamber door.

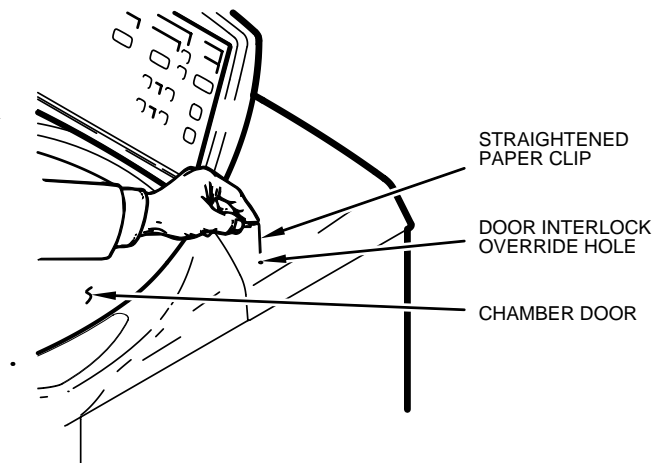


Figure 5-1. Door Interlock Override

Parts Ordering Information

To order replacement parts: in the United States, telephone toll-free 800-522-7746. Outside the United States, contact local distributor or agent. Be sure to provide a description of the part, centrifuge model, and centrifuge serial number.

**WARNING**

Because of the characteristics of the samples likely to be processed in this centrifuge, biological or radioactive contamination may occur. Always be aware of this possibility, and take normal precautions. Use appropriate decontamination procedures should exposure occur.

Service Decontamination Policy

If a centrifuge or rotor that has been used with radioactive or pathogenic material requires servicing by Kendro personnel, either at the customer's laboratory or at a Kendro facility, comply with the following procedure to ensure the safety of all personnel:

1. Clean the equipment to be serviced of all encrusted material and decontaminate it (see Care and Maintenance section of centrifuge or rotor instruction manual) prior to servicing by the Kendro representative or returning it to the Kendro facility. There must be no radioactivity detectable by survey equipment.

The SORVALL® Product Guide contains descriptions of commonly used decontamination methods and a chart showing method compatibility with various materials. The Care and Maintenance Section of the centrifuge or rotor instruction manual contains specific guidance about cleaning and decontamination methods appropriate for the product it describes.

Clean and decontaminate your centrifuge or rotor as follows:

For lowspeed, superspeed, and SUPRAspeed® floor model centrifuges:

- a. Remove rotor from the rotor chamber.
- b. Remove, wash, and decontaminate motor sealing gasket and pad.
- c. Drain line plugs and clean drain line (if any).
- d. Decontaminate lid, rotor chamber, and drive using an appropriate method.
- e. Remove all encrusted material from around the motor and drive assemblies.

For rotors:

Remove tubes, bottles, and adapters from the rotor and decontaminate rotor using an appropriate method. If tubes or rotor caps are stuck in the rotor, or the rotor lid is stuck, notify Kendro representative; be prepared with the name and nature of the sample so the Kendro Chemical Hazards Officer can decide whether to authorize the rotor's return to a Kendro facility.

Do not leave a loaded rotor locked inside a centrifuge that requires servicing. If, with a loaded rotor installed in the chamber, a centrifuge malfunction makes it so that the chamber door will not open by normal means, follow the Emergency Sample Recovery procedure found in your centrifuge operating instructions manual to gain access to the rotor.

2. Complete and attach Decontamination Information Certificate (in the back of your rotor or instrument manual) to the centrifuge or rotor before servicing.

Decontamination Information Certificates are included with this book. Additional certificates are available from the local Kendro Representative or Field Service Engineer. In the event these certificates are not available, a signed, written statement certifying that the unit has been properly decontaminated, identifying what the contaminants were and outlining the decontamination procedures used will be acceptable.

NOTE: The Field Service Engineer will note on the Customer Service Repair Report if decontamination was required and, if so, what the contaminant was and what procedure was used. If no decontamination was required, it will be so stated.

If a centrifuge or rotor to be serviced does not have a Decontamination Information Certificate attached and, in Kendro's opinion presents a potential radioactive or biological hazard, the Kendro representative will not service the equipment until proper decontamination and certification is complete.

If the centrifuge or rotor must be returned to a Kendro facility:

1. Contact your Kendro representative to obtain an Equipment Return Decontamination Form; be prepared with the name and serial number of the centrifuge or rotor and the repairs required.
2. Complete the Equipment Return Decontamination Form and returned it to Kendro. Upon receipt of a completed form, a Returned Material Authorization Number (RMA Number) will be issued to you.
3. With the RMA Number clearly marked on the outside of packaging, send the items to the address obtained from your Kendro representative.

NOTE: United States federal regulations require that parts and instruments *must* be decontaminated before being transported. Outside the United States, check local regulations.

If equipment is received at Kendro facilities without a valid RMA Number on the outside of the shipping container and a completed Equipment Return Decontamination Form on file, the equipment will be treated as a potential contamination hazard, and will not be serviced until decontamination certification has been completed. The sender will be contacted for instructions regarding disposition of the equipment in question; all disposition costs will be borne by the sender. If contaminated equipment is received at Kendro facilities, both the carrier and appropriate authorities shall be notified.

Chapter 6: Messages and Diagnostics

This chapter itemizes the information that may be conveyed to you in the course of a run, including messages, faults and warning messages.

Run Status Indicators

The following information appears on the control panel at different times to inform you of run conditions and requirements:

Message	Field	Explanation/Action
End	Run Speed	Run has ended and it is safe to open the chamber door.
Error	Run Speed	Run has ended abnormally due to an error condition. A descriptive message also appears in the Rotor/Message Display.
-----	Set Rotor	Indicates that a rotor needs to be identified. Displays when: <ul style="list-style-type: none"> • The centrifuge is first powered on; • A run ends and the chamber door has been opened.

Another indicator is the long beep which sounds at the end of each run. This indicates that the chamber door is unlocked and it is safe to open the door.

Informational and Error Messages

A number of different messages may appear on the Rotor/Message Display. Some messages inform you of a specific run condition, such as when a rotor imbalance is detected. Other messages warn of internal problems with the centrifuge that warrant a service call.

Messages scroll across the lower line of the Rotor/Message Display, replacing the rotor type, and are accompanied by three audible beeps. Make a note of the message, then press the CLEAR key to clear the display and redisplay the rotor type.

- NOTE:**
1. Some messages clear on their own if the system is able to self-correct the condition.
 2. If more than one condition is being reported, a secondary message displays when you clear the display. Continue pressing CLEAR (recording each message) until the rotor type redisplay, the CLEAR light goes out and the TYPE light is lit.

Table 6-1 below and on the next four pages alphabetically itemizes the messages which may appear on the Rotor/Message Display and provides a description of each with the action required .

Reporting Error Conditions

If a service call is necessary, make a note of the error message(s) before clearing the display. Your service representative needs to know each error listed in order to identify and troubleshoot the error condition.

Table 6-1. Evolution® RC Error Messages

<p>ACCELEROMETER FAULT Imbalance detector communication failed. (Error 003) <i>Major fault: run will terminate and rotor will brake to stop; fault can be cleared after stop.</i> Contact Kendro Service.</p>	<p>CHAMBER TOO COLD Chamber temperature was below –19°C. (Error 046) <i>Major fault: run will terminate and rotor will brake to stop; fault can be cleared after stop.</i> Contact Kendro Service.</p>
<p>AUXTACH I/O ERROR Secondary tachometer communication failed. (Error 034) <i>Minor fault/advisory: operation will continue; message can be cleared at any time.</i> Contact Kendro Service.</p>	<p>CHAMBER TOO HOT Chamber temperature was above 49°C. (Error 045) <i>Major fault: run will terminate and rotor will brake to stop; fault can be cleared after stop.</i> Contact Kendro Service.</p>
<p>AUXTACH SHUTdOWN Auxiliary tachometer indicated speed of 800 rpm or more over the selected rotor's top speed. (Error 033) <i>Serious malfunction: run will terminate and rotor will coast to stop; in most cases, power will be removed from all circuits and display will go blank. Cannot be cleared.</i> Cycle power OFF/ON. If centrifuge does not complete start-up or if fault recurs, contact Kendro Service.</p>	<p>CLOSE dOOR An open chamber door disabled the run. (Error 004) <i>Major fault: run will terminate and rotor will brake to stop; fault can be cleared after stop.</i> If “START” was pressed without the chamber door fully closed, close the door and select the appropriate rotor. Otherwise, contact Kendro Service.</p>
<p>bAd ROTOR FILE Software rotor file is corrupted. (Error 037) <i>Serious malfunction: the system will not run. Cannot be cleared.</i> Cycle power OFF/ON. If fault recurs, contact Kendro Service.</p>	<p>dOOR NOT LOCKEd After a lock command was issued, the door latch remained unlocked (as if mechanical override used). (Error 005) <i>Major fault: run will terminate and rotor will brake to stop; fault can be cleared after stop.</i> If not the result of using the mechanical override, contact Kendro Service.</p>
<p>bAd RUNFILE Software run file is corrupted. (Error 039) <i>Minor fault/advisory: operation will continue; message can be cleared at any time.</i> Contact Kendro Service.</p>	

(continued)

Table 6-1. Evolution® RC Error Messages (continued)***DOOR NOT UNLOCKEd***

After an unlock command was issued, the door latch remained locked. (Error 006)

Minor fault/advisory: operation will continue; message can be cleared at any time.

May indicate that the door latch arm is obstructed and is unable to move. Make sure that the door is not pressing against the door latch arm – close the door fully, clear the fault, and open the door. Otherwise, contact Kendro Service.

DRVbOX FAULT

Drivebox internal problem. (Error 032)

Major fault: run will terminate and rotor will brake to stop; fault can be cleared after stop.

Contact Kendro Service.

ENERGY EXCEEDEd

During acceleration, the Energy Management System determined that, at SET speed, the energy of the installed rotor would exceed the centrifuge maximum. (Error 018)

Major fault: run will terminate and rotor will brake to stop; fault can be cleared after stop.

May indicate that the SET rotor is not the rotor installed. Make sure the rotor specified on the control panel matches the installed rotor, and that the installed rotor loads are according to the instructions in the rotor manual. May also indicate that the motor has overheated; check other faults (see MOTOR TOO HOT on next page). Otherwise, contact Kendro Service.

FAILED TO MAKE SPEED

Centrifuge was unable to reach SET speed. (Error 015)

Minor fault/advisory: operation will continue; message can be cleared at any time.

May indicate that the installed rotor does not match SET rotor; SET speed was calculated to be lower than the centrifuge energy limit, but higher than rotor windage will allow. Make sure the rotor specified on the control panel matches the installed rotor. Otherwise, contact Kendro Service.

IIC bUS LOCKEd

The major communication (I²C) bus is locked-up. (Error 036)

Serious malfunction: run will terminate and rotor will coast to stop; cannot be cleared.

Cycle power OFF/ON. If fault recurs, contact Kendro Service.

IMBALANCE FAULT

The imbalance signal from the accelerometer exceeded the maximum for the rotor. (Error 002)

Major fault: run will terminate and rotor will brake to stop; fault can be cleared after stop.

Typically indicates an unbalanced load in the rotor. Make sure opposing compartment loads are balanced according to instructions in the Rotor Manual, that tubes/bottles are orientated correctly and properly loaded according to instructions in the manual. Also, make sure that the rotor cover (if any) is properly installed on the rotor, that the rotor is properly seated on the tapered drive spindle, and that the rotor locking knob(s) are tightened securely. If the rotor is properly balanced, this fault may indicate an accelerometer failure or that the tapered drive spindle or gyro is damaged. Contact Kendro Service.

KE CAL ERROR

Programmed-in motor torque constant (K_e) calibration value is out of range. (Error 038)

Minor fault/advisory: operation will continue; message can be cleared at any time.

Contact Kendro Service.

KE GAIN ERROR

Programmed-in motor torque constant (K_e) gain value is out of range. (Error 040)

Minor fault/advisory: operation will continue; message can be cleared at any time.

Contact Kendro Service.

KE I/O ERROR

K_e P.C. board communication failed. (Error 011)

Major fault: run will terminate and rotor will brake to stop; fault can be cleared after stop.

Contact Kendro Service.

(continued)

Table 6-1. Evolution® RC Error Messages (continued)**MOTOR TOO HOT**

Motor temperature was above 150°C.(Error 016)

Major fault: run will terminate and rotor will brake to stop; fault can be cleared after stop.

If multiple runs have been performed while using a large rotor with short rest periods, allow the motor to cool, then restart the run. Allowing more time between runs can prevent recurrence. Otherwise, contact Kendro Service.

NO AIR SENSOR

Chamber air temperature sensor communication failed. (Error 012)

Major fault: run will terminate and rotor will brake to stop; fault can be cleared after stop.

Contact Kendro Service.

NO TACH SIGNAL

Main tachometer communication failed. (Error 019)

Serious malfunction: run will terminate and rotor will coast to stop; cannot be cleared.

Cycle power OFF/ON. If fault recurs, contact Kendro Service.

OVER ROTOR SPEED

Speed was more than 500 rpm over rotor maximum. (Error 024)

Major fault: run will terminate and rotor will coast to stop; fault can be cleared after stop.

Contact Kendro Service.

OVER SPEED

Speed was more than 500 rpm over SET. (Error 021)

Major fault: run will terminate and rotor will coast to stop; fault can be cleared after stop.

Contact Kendro Service.

PFC I2C FLT

Power factor correction (PFC) module I²C communication failed. (Error 031)

Minor fault/advisory: operation will continue; message can be cleared at any time.

Contact Kendro Service.

PFC 18 V FLT

Power factor correction (PFC) module internal 18V supply was out of range. (Error 028)

Minor fault/advisory: operation will continue; message can be cleared at any time.

Contact Kendro Service.

PFC 400 V FLT

Power factor correction (PFC) module voltage was below 385V; indicates an overcurrent condition. (Error 026)

Minor fault/advisory: operation will continue; message can be cleared at any time.

Contact Kendro Service.

PFC b V FLT

Loaded supply line voltage was less than 175V. (Error 027)

Minor fault/advisory: operation will continue; message can be cleared at any time.

Indicates that incoming line voltage is too low. Incoming loaded line voltage must be within centrifuge requirements (187–253 Vac).

PFC OVERLOAD

Power factor correction (PFC) module input line current was too high. (Error 029)

Minor fault/advisory: operation will continue; message can be cleared at any time.

Contact Kendro Service.

PFC OVERTEMP

Power factor correction (PFC) module temperature was too high. (Error 030)

Minor fault/advisory: operation will continue; message can be cleared at any time.

Contact Kendro Service.

PFC SCI FLT

Power factor correction (PFC) module internal communication failed. Error 025)

Minor fault/advisory: operation will continue; message can be cleared at any time.

Contact Kendro Service.

(continued)

Table 6-1. Evolution® RC Error Messages (continued)**POWER FAILURE**

Power outage occurred, speed was below 1000 rpm when power was restored; run terminated. (Error 013)

Minor fault/advisory: operation will continue; message can be cleared at any time.

Clear the fault and the run can be restarted.

POWER RESUMEd

Power outage occurred, speed was above 1000 rpm when power was restored; run resumed. (Error 014)

Minor fault/advisory: operation will continue; message can be cleared at any time.

Clear the fault.

ROTOR OVER TEMP

Estimated sample temperature was more than 10°C over SET for 10 minutes. (Error 008)

Major fault: run will terminate and rotor will brake to stop; fault can be cleared after stop.

Contact Kendro Service.

ROTOR UNDER TEMP

Estimated sample temperature was more than 10°C under SET for 10 minutes. (Error 010)

Major fault: run will terminate and rotor will brake to stop; fault can be cleared after stop.

Contact Kendro Service.

SENSOR GAIN ERROR

Programmed-in temperature sensor gain value is out of range. (Error 041)

Minor fault/advisory: operation will continue, although continued operation could subject sample to extreme temperatures; message can be cleared at any time.

Contact Kendro Service.

SENSOR OFFSET ERROR

Programmed-in temperature sensor offset value is out of range. (Error 042)

Minor fault/advisory: operation will continue, although continued operation could subject sample to extreme temperatures; message can be cleared at any time.

Contact Kendro Service.

SPEED CEILING EXCEEDed

Rotor speed was more than 26 500 rpm. (Error 022)

Major fault: run will terminate and rotor will coast to stop; fault can be cleared after stop.

Contact Kendro Service.

SPEED CHANGE TOO LARGE

Improbable speed change occurred, may be caused if no rotor is installed. (Error 020)

Serious malfunction: run will terminate and rotor will coast to stop; cannot be cleared –cycle power OFF/ON, if fault recurs, contact Kendro Service.

Make sure that the specified rotor is properly installed on the tapered drive spindle. Otherwise, contact Kendro Service.

SPEED CLIMb IN dECEL

Speed increased when it should have been decreasing. (Error 023)

Major fault: run will terminate and rotor will coast to stop; fault can be cleared after stop.

Contact Kendro Service.

SPEED dRIFTING

Centrifuge was not able to properly control rotor speed. (Error 047)

Minor fault/advisory: operation will continue; message can be cleared at any time.

Contact Kendro Service.

SPEED LIMITED RUN

During acceleration, the Energy Management System was unable to determine the energy of the installed rotor, so motor torque was reduced. Acceleration will be affected, so it will take longer to reach SET speed; in some cases, large rotors may not be able to achieve their top speed. Situation poses no hazard to the user. (Error 017)

Minor fault/advisory: operation will continue; message can be cleared at any time.

May indicate that observed performance of the installed rotor is out of range for the rotor that is programmed. Make sure the rotor specified on the control panel matches the installed rotor, and that the installed rotor loads are according to the instructions in the rotor manual. Otherwise, contact Kendro Service.

(continued)

Table 6-1. Evolution® RC Error Messages (continued)**SYSTEM FILE ERROR**

No hard disk read/write, can't open file; memory may be full or the run/fault log may be corrupted. (Error 001)

Minor fault/advisory: operation will continue; message can be cleared at any time.

Contact Kendro Service.

TACH MISMATCH

The main and secondary tachometers do not agree. (Error 035)

Serious malfunction: run will terminate and rotor will coast to stop; cannot be cleared.

Cycle power OFF/ON. If fault recurs, contact Kendro Service.

TEMP GAIN ERROR

Programmed-in temperature gain value is out of range. (Error 043)

Minor fault/advisory: operation will continue, although continued operation could subject sample to extreme temperatures; message can be cleared at any time.

Contact Kendro Service.

TEMP OFFSET ERROR

Programmed-in temperature offset value is out of range. (Error 044)

Minor fault/advisory: operation will continue, although continued operation could subject sample to extreme temperatures; message can be cleared at any time.

Contact Kendro Service.

Chapter 7: Advanced Functions Module

This chapter provides information regarding the Evolution® RC AFM™ Advanced Functions Module, and this information applies only to centrifuges that are so equipped. Centrifuges equipped with the AFM™ Advanced Functions Module are easily identifiable, because they have an LCD screen in the lower-left quadrant of the control panel (see illustration). For information regarding standard centrifuge controls or operating instructions, refer to Chapter 3, Controls, or Chapter 4, Operation.

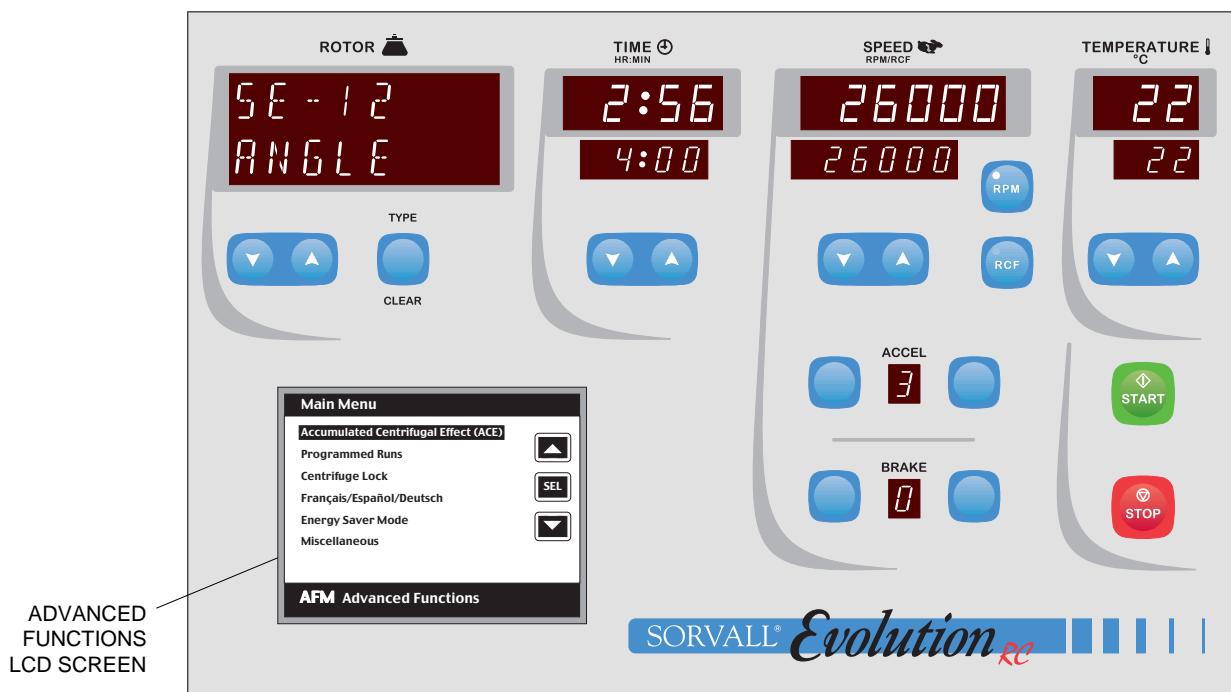


Figure 7-1. Control Panel with AFM™ Advanced Functions Module

Description

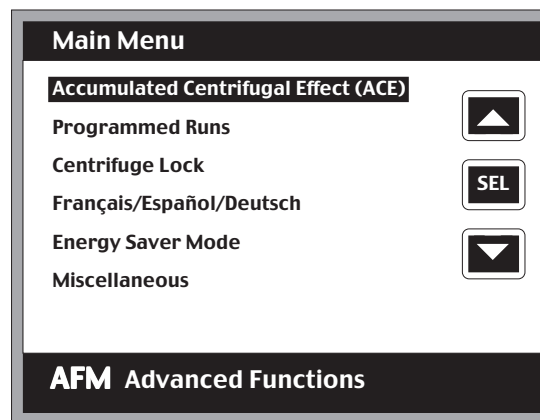
The AFM™ Advanced Functions Module adds an interactive touch panel to the standard controls of the Evolution® RC centrifuge. The functions add convenience, increased control capabilities, and administrative safeguards to the normal centrifuge operation. The touch panel is an illuminated, pressure-sensitive, high-resolution monochrome LCD display screen mounted behind a transparent section of the seamless control panel surface, allowing for easy cleaning while ensuring protection of high-reliability components.

Functions added include:

- An Accumulated Centrifugal Effect™ (ACE) integrator function that allows run duration to be controlled in terms of $\int \omega^2 dt$;

- A programmability function that allows up to 35 different sets of run parameters to be stored in centrifuge memory for easy review and recall in the future;
- A centrifuge lock function providing a password-protected control panel lock that may be set either so that the set run parameters cannot be changed (to allow only exact repeat runs), or so that only a single run can be performed and subsequent runs or changes to run parameters are disallowed;
- A multilingual display function that allows Advanced Functions screens and control panel error messages to appear in English, French, German, or Spanish;
- An Energy Saver Mode function that allows the centrifuge to power-down in a sleep mode instantaneously, or to start and later return from a sleep mode at a specified time of day.

The AFM™ Advanced Functions Module touch panel is active whenever the centrifuge is on. When the centrifuge is first turned on, after the startup routine has been completed, the touch panel will illuminate and the Main Menu screen (below), showing selectable Advanced Functions, will be displayed.



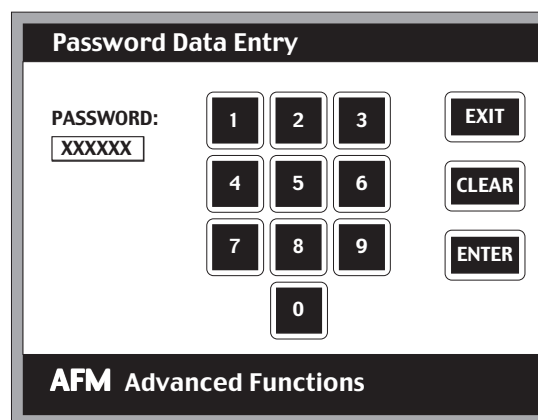
Specific Advanced Functions selection screens may be accessed by lightly touching the up/down arrows at the right side of the Main Menu screen to move the highlight bar to the menu item of interest (*scrolling* through menu items). Once the menu item is highlighted, touching the SEL (select) button positioned between the up/down arrows will access that particular function's selection screen.

NOTE Touch panels register contact over their entire surface, even if contact is made where buttons are not located. If the Advanced Functions screen is contacted in more than one place at the same time, erroneous input or erratic operation can occur. Be careful to touch only one spot on the screen at a time; do not rest your hand on the screen when making selections or inputting values.

Touch Button Action

Interactive touch buttons are used on the Advanced Functions selection screens; each button has a specific action:

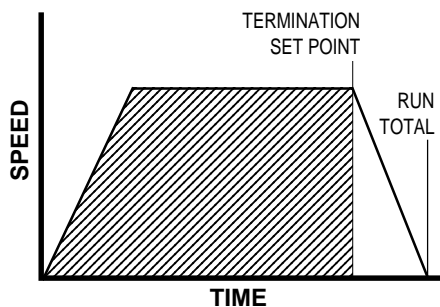
- **SEL** (Select) chooses the highlighted item. From the Main Menu, this will bring up a selection screen for the function highlighted, or from a selection screen, this may turn a feature on or bring up a subsequent input screen for inputting values.
- **Up/Down Arrows** move the highlight bar up or down so that a selection can be made, or in the Programmed Runs screen, scroll up or down (by Program No.) to view programs in memory.
- **EXIT** leaves the current screen and returns to the previous screen. On data entry screens, or on selection screens if a selection was not made, touching EXIT returns to the previous screen without any input/selection action. On a selection screen, if a selection was made, touching EXIT activates the selection.
- **CLEAR** deletes a keyed-in value on a data entry screen. On the Programmed Run screen, CLEAR deletes the displayed program.
- **ENTER**, used on data entry screens, inputs the keyed-in value and returns to the previous screen.
- **RECALL** and **STORE** are used on the Programmed Run screen. STORE saves set run parameters from the control panel to the Program No. on the LCD screen; RECALL uses parameters from the LCD screen and sets all run parameters on the control panel.
- A **numeric keypad**, used on data entry screens, is provided for keying-in values for entry.



NOTE To provide users with visual input feedback, the image on each touch-panel button will reverse (change from white to blue) when a button-push registers.

Function Description

Accumulated Centrifugal Effect™ (ACE)



Accumulated Centrifugal Effect™
calculating the area under the curve

The Accumulated Centrifugal Effect™ (ACE) function allows for an alternative method to control run duration. When ACE control is selected, the centrifuge calculates the effect of speed in relation to time throughout the run (the shaded area in the illustration at left), adjusting run duration to account for acceleration differences (rotor loading or ACCEL setting differences) and set speed differences to deliver repeatable centrifugation results.

When START is pressed, the realized ACE value begins to accumulate in the Actual Value display. The run will terminate and deceleration will begin when the Set Value (expressed as $\int \omega^2 dt^*$ value up to 9.99×10^{35} [displayed as 9.99E+35]) is reached. After termination, the Actual Value display will continue to accumulate until the rotor stops – this run total is for reference; care should be taken not to confuse the Actual Value display's final accumulation with the controlling input/timeout value, which is indicated in the SET Value display. Compared to control by time, ACE selection provides a more advanced and relevant form of run duration control, thereby improving separation consistency, run reproducibility, and dependability of results.

Accumulated Centrifugal Effect (ACE)

Disable ACE

Enable ACE

Actual Value

Set Value

▲

SEL

▼

EXIT

AFM Advanced Functions

Once Enable ACE has been selected, the ACE Data Entry screen will appear to prompt the user to either accept the existing Set Value (EXIT), or to key-in and input a new value (ENTER). The control panel Set TIME display will indicate ACE, and the set and actual ACE values will be displayed on the Advanced Functions screen.

* The integral value can be calculated deriving the following formula:

$$\int \omega^2 dt = \omega^2 \Delta t = \omega^2 \Delta t$$

Where: Δt = Change in time (seconds)

and ω^2 = Angular speed
 $= 2\pi [n/60]$
 n = Speed (rpm)

Programmed Runs

The Programmed Runs function allows the pre-programming of up to 35 different sets of run parameters for future simple recall and error-free run reproducibility. After using the centrifuge control panel to set all run parameters, those parameter settings may be stored to program memory by selecting Programmed Runs from the Main Menu, then pressing STORE. To eliminate inadvertent loss of existing programs, the store run sequence alerts users before overwriting. The up/down arrow keys allow convenient browsing through existing programs (by Program No.) for reference or for selection by pressing RECALL to reestablish the stored run parameters on the control panel for use.

Programmed Run

Program No.: 01

Rotor: SA-300

Time: 01:20 Hr:Min

Speed: 26000 RPM

Temperature: 20 °C

Accel: 3 Brake: 3

▲

RECALL

▼

CLEAR STORE EXIT

To save, set parameters using control panel, press STORE

Centrifuge Lock

The Centrifuge Lock function allows control panel functionality to be locked to prevent unauthorized changes to run parameters. Locking and unlocking is password-protected, and allows for two password types. A standard password can only unlock the centrifuge when it was used to lock it; a supervisory password can unlock the centrifuge regardless of what password was used to lock it.

The centrifuge lock function allows for the centrifuge to be locked at one of two levels, Repeat Runs or Single Run Only.

Centrifuge Lock Options

Repeat Runs

Single Run Only

▲

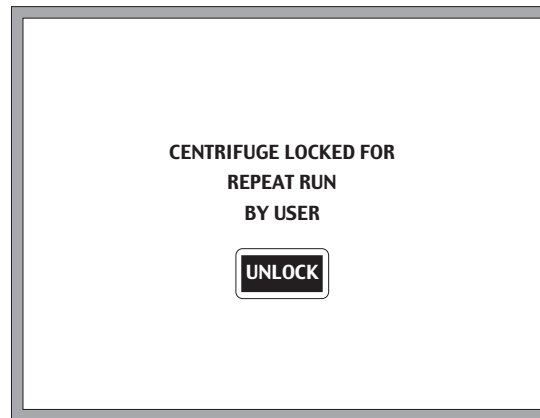
SEL

▼

EXIT

AFM Advanced Functions

Repeat Runs deactivates all controls on the control panel so that the set run parameters cannot be changed (START and STOP are the only active keys). This selection allows only a single set of run parameters to be performed over and over, until it is unlocked.

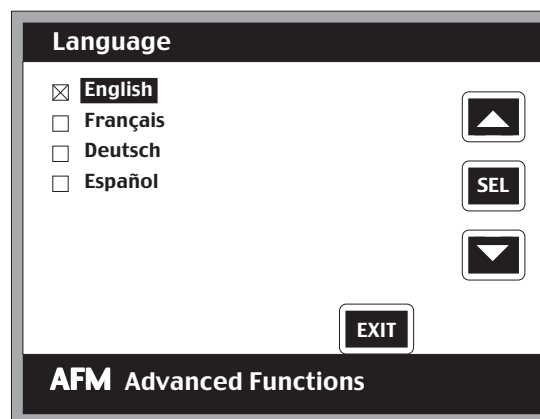


Single Run Only similarly deactivates controls so that set parameters cannot be changed, but it also limits the functionality of START and STOP keys so that they will work only once. This selection disallows all subsequent use of the centrifuge until it is unlocked.

Use of the Centrifuge Lock may offer considerable advantages by restricting centrifuge use, preventing unauthorized run parameter or program memory changes, or improving process control by reducing the possibility for operator error.

Language Selector (English/Français/Español/Deutsch)

The Language Selector function allows the Advanced Functions Module display screens and centrifuge control panel error messages to be viewed in any of four major languages: English, French (Français), German (Deutsch), or Spanish (Español).

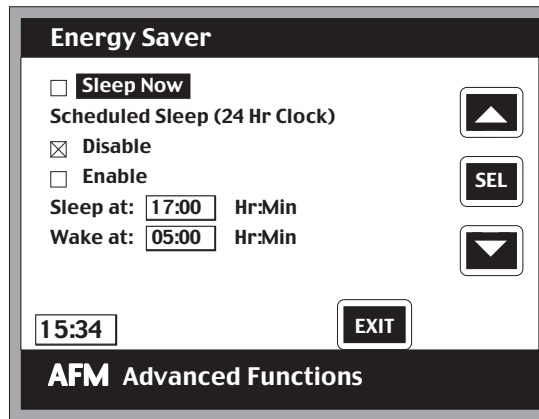


When the displays are operating in any one language, the other three alternatives will be indicated on the Main Menu for simple selection and use.

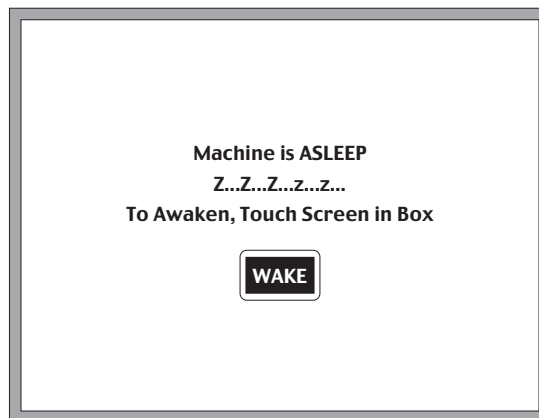
Energy Saver Mode

The Energy Saver Mode function allows the centrifuge to be placed into a dormant “sleep” state, and operates in one of three ways:

- a. If Sleep Now is selected with Scheduled Sleep Disabled, the centrifuge will immediately go to sleep and will remain sleeping until it is manually awakened.
- b. If Sleep Now is selected with Scheduled Sleep Enabled, the centrifuge will immediately go to sleep and will remain sleeping either until it automatically awakens at a specified time, or until it is manually awakened before the wake time is reached.
- c. If Scheduled Sleep is Enabled and Sleep Now has not been selected, the centrifuge will automatically go to sleep at a specified time and will remain sleeping either until it automatically awakens at a different specified time, or until it is manually awakened before the wake time is reached.

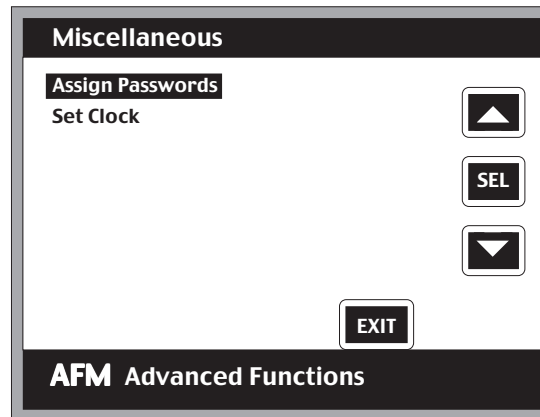


During sleep, all major centrifuge systems are powered-down (the Advanced Functions Module touch panel will remain lit and the cooling fans for the drive module and motor will continue to run). Once in the Energy Saver Mode, the sleeping centrifuge may be awakened at any time by touching the WAKE button on the Advanced Functions Module touch panel.



Miscellaneous

Miscellaneous is the last item that is selectable from the Main Menu. Once Miscellaneous is selected, two setup choices appear.



Assign Passwords allows 6-digit numeric passwords to be entered to allow use of the Centrifuge Lock feature (to lock or unlock). Two password types are available. A standard password can only unlock the centrifuge if it was the password that was used to lock the centrifuge; the Supervisory Password can unlock the centrifuge regardless of what password was used when the centrifuge was locked. Up to 34 standard passwords and one Supervisory Password may be assigned.

To access the Assign Passwords function, the Supervisory Password is required. When assigning passwords, positions 2-35 are for standard passwords; position 1 contains the Supervisory Password. The Supervisory Password is factory-set to "111111" but can be changed by inputting a new password in position 1.

NOTE If you change the Supervisory Password from the factory setting, be sure to record the new password and keep it in a safe place for future reference. If a unique Supervisory Password is forgotten or otherwise lost, a Kendro Service representative will be required to access the Assign Passwords function.

Set Clock allows the centrifuge clock (24-hour type) to be set so that the Energy Saver function's Scheduled Sleep/Wake can be used.

Appendix

Rotor Information

Rotor Type / Name	Maximum Speed (rpm)	Maximum RCF (g-force)	K Factor ¹	Critical Speed (rpm)	Rotor Capacity (places x ml)	Maximum Compartment Mass (grams)	r _{max} (cm)	r _{min} (cm)
FIXED ANGLE								
SS-34	20 500	50 228	714	1400	8 x 50	115	10.70	3.27
SLA-3000	12 000	24 336	2364	900	6 x 500	780	15.13	3.94
SLA-1500	15 000	34 155	1475	1200	6 x 250	420	13.59	3.66
SLA-1000	16 500	35 793	1725	1200	4 x 250	400	11.77	1.84
SLA-600TC	13 000	27 750	913	1200	12 x 50	74	14.70	7.99
SLC-6000	8500	15 810	3549	1000	6 x 1000	1500	19.59	5.42
SLC-4000	9000	15 182	4631	750	4 x 1000	1500	16.78	2.53
SLC-3000	10 000	17 604	3394	975	6 x 500	780	15.76	4.12
SLC-1500	14 000	29 994	1676	1000	6 x 250	420	13.70	3.74
SA-800	20 500	49 054	560	1550	8 x 100	162	10.45	4.12
SA-600	17 000	41 837	747	1250	12 x 50	115	12.96	5.52
SA-512	19 500	48 930 ²	394 ²	1450	(16+16) x 16	30	11.52 ²	6.37 ²
SA-300	25 000	67 509	573	1600	6 x 50	115	9.67	2.35
SM-24	20 500	51 965 ²	434 ²	1450	(16+8) x 16	27	11.07 ²	5.38 ²
SE-12	26 000	70 450	335	1950	12 x 14	30	9.33	3.81
F-20/MICRO	20 000	51 427	187	1450	32 x 1.5	3	11.51	8.57
GS-3	9 000	13 689	4203	850	6 x 500	780	15.13	3.94
GSA	13 000	27 485	2023	1000	6 x 250	580	14.56	3.77
F-16/250	14 500	31 939	1576	1150	6 x 250	420	13.60	3.67
F-28/50	20 000	51 248	660	1350	10 x 50	115	11.47	4.04
F-28/36	18 000	41 366	480	1350	12 x 36	66	11.43	6.18
F-28/13	19 500	48 548	295	1500	16 x 13.5	23	11.43	7.34
SWINGING BUCKET								
SH-3000	4 700	4 575	8138	1450	4 x 750	1805 ³	18.54	9.11
SH-3000 M (microplates)	4 700 ⁴	3 706 ⁴	–	1550	4 x 3 standard 96-well plates	987 ³	15.02	–
HB-6	13 000	27 617	1765	1350	6 x 50	164	14.63	4.50
HS-4 1PL	7 500	10 826	3912	1150	4 x 250	1035 ³	17.23	7.22
HS-4 3PL	7 500	10 725	3870	1150	12 x 50	1035 ³	17.07	7.22
HS-4 4PL	7 500	11 071	3866	1150	16 x 50	1035 ³	17.62	7.46
HS-4 24PL	7 500	9 249	2643	1150	96 x 5	1035 ³	14.72	8.18
SH-80	20 000	45 395	400	1500	8 x 10	78	10.16	5.40
HB-4	13 000	27 712	1667	1400	4 x 50	250 ³	14.68	4.82
OTHER								
SS-34/KSB-R	20 000	47 808	750	1300	8 x 50	1.2 g/ml	10.70	3.27
SV-288	20 000	40 301	210	1400	8 x 36	50	9.02	6.47
SV-80	19 000	40 969	98	1300	16 x 5	6.4	10.16	8.84
TZ-28	20 000	42 580	612	1200	1 x 1350	1620	9.53	3.62
TZ-28/GK	19 000	38 428	678	1100	1 x 1350	1.2 g/ml	9.53	3.62

¹ With maximum allowable volume at maximum speed.

² Outer row.

³ Includes the weight of the bucket or carrier.

⁴ Maximum for rotor; actual top speed will typically be less, limited by the microplates used.

Warranty

Kendro Laboratory Products makes no warranty of any kind, expressed or implied, except as stated in this warranty policy.

The SORVALL® Evolution® RC Superspeed Centrifuge is warranted to be free from defects in material and workmanship for a period of one year from the date of delivery. The compressor, condenser, evaporator and all interconnecting tubing are warranted to be free of defects in material and workmanship for a period of five years from the date of delivery. The drive motor is warranted to be free of defects in material and workmanship for a period of three years from date of delivery. Kendro will repair or replace and return free of charge any part which is returned to its factory within said period, transportation prepaid by user, and which is found upon inspection to have been defective in materials or workmanship.

This warranty does not apply to any damage to any instrument resulting from: normal wear and tear; misuse; abuse; use of electrical currents or circuits other than those specified on the plate affixed to the instrument; accident; negligence; failure to follow operating instructions; or use of any rotor other than a SORVALL® rotor intended for use in this instrument.

Kendro reserves the right to change, alter, modify or improve any of its instruments without any obligation whatsoever to make corresponding changes to any instrument previously sold or shipped.

The foregoing obligations are in lieu of all other obligations and liabilities including negligence and all warranties, of merchantability or otherwise, expressed or implied in fact or by law, and state our entire and exclusive liability and buyer's exclusive remedy for any claim or damages in connection with the sale of furnishing of goods or parts, their design, suitability for use, installation or operation. Kendro will in no event be liable for any special or consequential damages whatsoever, and our liability under no circumstances will exceed the contract price for the goods for which liability is claimed.

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Evolution RC

Table of Contents

2.0 Installation

2.1 Pre-Installation Checklist

2.2 Installation Instructions

2.3 Installation Checklist



Customer Pre-Installation Checklist Evolution RC Centrifuge

Prior to delivery of your new SORVALL[®] centrifuge, the following power and physical requirements should be in place:

- POWER RECEPTACLE:** Installations requiring voltages between 187 Vac – 253 Vac need NEMA 6-30R or Hubbell 9330 receptacle. For serviceability and quick disconnect, the receptacle should be located where it is always visible and easily accessible.

- POWER SOURCE:** Power line must consist of a dedicated 30 amp line with a voltage (loaded) that is within 187 Vac – 253 Vac. The Evolution will perform properly at any voltage (loaded) between 187 Vac – 253 Vac.

- AMBIENT TEMPERATURE:** Ambient inlet temperature must be within 15°-38°C (68°-86°F) with less than 90% humidity. To maintain proper temperature control and optimal instrument performance, ambient inlet temperature should not exceed 25°C.

- FLOOR:** Floor must be level with a fall of no greater than 8 mm (3/8 inches) from the back of the instrument to the front of the instrument. No fall is permitted from front to back. Floor must also be solid and able to withstand approximately 395 kg (870 lbs).

- CLEARANCE:** Physical dimensions of this instrument are 71 cm (28 inches) wide, 112 cm (44 inches) deep, 84 cm (33 inches) inches high to the top of the deck, and 127 cm (50 inches) high to the top of the control console

All floor model centrifuges that are manufactured worldwide that carry either the UL label or CE mark must adhere to the following requirements.

**UL 3101-2-20
IEC 1010-2-20**

These requirements require that there be at least 300 mm (12 inches) clearance on all sides of the centrifuge. The Evolution RC™ will perform properly with 2 inches clearance on the left, right sides and 6 inches clearance to the rear of the centrifuge.

- ❑ **VENTILATION:** Ventilation and free air circulation must be adequate to handle approximately 14,000 Btu/hour heat output and maintain an air inlet temperature of 20°-30°C (<25° for optimal performance). Air inlet to instrument must not be in close proximity of another heat source.

Revised 5/18/01

Evolution RC Installation Instructions

Installation

Inspect, unpack, and install the instrument following the instructions that are outlined in Chapter 2 pages 2-1 through 2-4 in the Evolution RC Instruction Manual.

Ground Continuity

Using a digital multi meter set to the lowest resistance setting measure the instrument's ground continuity by placing one meter lead on the ground lug of the power plug and the other on the instrument's frame. The meter should indicate a resistance of less than 0.1Ω . Check the ground continuity to all major assemblies insuring that the ground continuity is no higher than 0.1Ω anywhere in the instrument. Record the measured ground continuity on the Evolution RC Installation Checklist.

Remove Panels

Using a 6mm Allen wrench remove the (2) socket head screws located at the top of the rear panel. Using the 6mm Allen Wrench loosen the socket head screw located at the base of the control console bracket and remove the rear deck assembly and set aside. Using a 3mm Allen wrench remove the (6) socket head screws located at either side of the rear panel. Remove the rear panel and set aside. Using a 4mm Allen Wrench, remove the (2) socket head screws located on lower corners of the front panel. Remove the panel and set aside.

Line Voltage

Plug the instrument power cord into the mains supply after insuring that the instrument's main circuit breaker is in the off position. Using the digital meter measure the mains supply at the instrument's line filter. Insure that the mains supply is between 187 volts and 253 volts. Record the measured mains voltage on the Installation Checklist. Unplug the instrument from the supply. On the autotransformer move wire #70 to the transformer tap that most closely matches the measured line voltage. Insure that the compressor supply wire (#69) is configured correctly for the instrument that is being installed (230 volt transformer tap for 60Hz instruments 200 volt transformer tap for 50Hz instruments).

After the centrifuge installation is complete monitor the Line Voltage while running the heaviest available rotor to maximum speed with the temperature set so that the compressor is on. If the line voltage that is recorded is different than that measured with the centrifuge in a static condition re-adjust wire #70 to the autotransformer tap that most closely matches the loaded line voltage.

Cable Inspection

Inspect all cables, harnesses, and PC boards for loose connections or shipping damage. Repair any problems that may be found prior to turning the main power on.

Low Voltage Power Supply

Plug the I2C bus test adapter (P/N 73373) into the spare I2C connector on the rear of the control console. Using a digital meter measure the +5 volt power supply voltage at TP-7 or 8 (+5 volts) and TP-5 or 6 (ground). Adjust the supply located at the rear of the instrument chamber for +5.25 volts DC \pm 0.05 volts DC and record the voltage on the Installation Checklist. Removing the rear deck assembly and the drip tray at the rear of the door will access the power supply.

Reinstall all panel assemblies onto the instrument.

Level the Centrifuge

After moving the centrifuge into position use a 3/4" wrench to lower the feet until both feet just contact the floor. Turn the leveling feet in equal amounts until the

front feet lift the instrument so that the front wheel of the instrument is not contacting the floor and the wheel can be spun freely by hand.

Inspect Existing Rotors

Inspect any rotors that will be used in the centrifuge looking for signs of corrosion or damage. Make any necessary repairs or make recommendations on rotor retirements.

Run Rotor to Maximum Speed.

Using the rotor with the highest rated speed that is available install the rotor into the instrument and set the following parameters.

Speed:	Rotor maximum speed
Time:	10 minutes
Temperature:	4°C

Start the centrifuge and allow it to accelerate to top speed. Insure that the instrument displayed speed equals the set speed shown in the Set display. Allow the instrument to run until the timer reaches 00:00 and brake to a stop. Midway through the run, measure and record the supply line voltage.

Customer Training / Demo

- ❖ Review the Evolution RC Operator's Manual with the users of the instrument.
- ❖ Demonstrate all modes of operation for the instrument.
- ❖ Demonstrate the proper handling of all rotors and show the user how to correctly install the rotors into the centrifuge as to not cause damage to the rotor or the instrument.
- ❖ Allow the user to operate all functions of the centrifuge (hands on training).
- ❖ Review the proper instrument and rotor maintenance procedures with the end user.
- ❖ Provide the customer with the telephone numbers and internet address for Applications, Customer Service, and Field Service.
- ❖ Provide the customer with Preventative Maintenance Service Contract information.

Installation Checklist Documentation

Account Information

Fill in the account information on the Installation Checklist as completely as possible including:

Institution
Address
Building / Room
City / State / Zip Code
Contact Telephone
User Name
Instrument Serial Number
Instrument Model Number
Installed By
Date Installed

Test Equipment Used

Record all of the test equipment that was used in the installation including serial numbers, calibration date, and calibration due dates.

Failure / Discrepancies

Describe in detail any problems or discrepancies that were encountered during the installation of the centrifuge.

Installation Rating

Fill out the instrument rating section of the Installation Checklist. Fold the checklist, secure, and mail to Kendro Laboratory Products.



Evolution RC™ Installation Checklist



Account Information:

Institution: _____
 Address: _____
 Bldg/Room: _____
 City/State/Zip: _____
 Telephone: _____
 User Name: _____
 Inst. Serial Number: _____
 Model Number: _____
 Installed by: _____
 Date Installed: _____

Test Equipment Used			
Type	S/N	Calib. Date	Calib. Due Date
Digital Multimeter			
Stopwatch			
Digital Thermometer			
Centrifuge Analyzer			

Preinstallation:

- Instrument and all accessories arrived.
- Sufficient space is available.
- Proper receptacle installed
- Correct Line voltage & main circuit breaker installed
- Customer training scheduled

On Site Inspection:

- Shipping damage
- All parts & accessories

Location:

- Proper clearance
- Sufficient air circulation
- Room ambient _____°C

Installation:

- Ground continuity _____ohm (>0.1 ohm)
- Line voltage unloaded _____ vac (187 – 253vac)
- Nameplate matches instrument
- Remove all panels & inspect
 - Plugs, cables, IC's
- Record LVPS voltage _____vdc (5.25 ± 0.05 vdc)
- Level instrument
- Inspect all existing rotors in the lab.

Test Run

- Run rotor to maximum speed
- Line voltage _____vac (187vac-253vac)

Customer Training/Demo

- Review operator manual with customer
- Demo all modes of operation
- Demo proper rotor installation
- Hands-on training with the customer
- Review instrument & rotor maintenance
- Provide telephone numbers for Applications, Customer Service, & Field Service
- Provide PM contract information

Detailed description of any failures or discrepancies noted during installation

Business Reply Mail

Stephen J. Culmo
 Service Technical Support
 Kendro Laboratory Products
 31 Pecks Lane
 Newtown, CT 06470-9857

Detailed description of any failures or discrepancies noted during installation

Installation Rating System				
5 Excellent	4 Acceptable	3 Fair	2 Poor	1 Unacceptable
No problem, instrument working to specifications	Minor shipping damage to instrument and/or calibration required	Instrument would not operate without some repair	More than one system/parts failure, parts had to be ordered	Unable to install or test instrument and/or major shipping damage

Delivery	Hardware / Software Failure	Adjustments beyond normal procedures	Installation time actual hours
Rating =	Rating =	Rating =	Rating =

Overall average of the above ratings =

Evolution RC

Table of Contents

3.0 Preventative Maintenance

3.1 Static Checks

3.2 Functional Checks

3.3 Preventative Maintenance Checklist

Evolution RC

Preventative Maintenance

General

The preventative maintenance checks of the centrifuge and rotors are performed on service visits as specified by the service contract or requested by the user. In cases where no service contract exists, qualified service personnel selected at the discretion of the user must perform the preventative maintenance procedures on an annual basis.

The inspection and cleaning procedures that should be completed routinely by the user are found in the Instruction Manual. Check that the routine maintenance procedures are being performed. Discuss any problems with the user.

If the preventive maintenance checks reveal existing and / or potential problems with the centrifuge, perform the appropriate corrective maintenance procedures.

Use the preventative maintenance checklist (include at the end of this procedure) to record the completion dates of procedures, pertinent data, and any comments relating to the maintenance and operation of the centrifuge and rotors.

Static Checks

Location / Ambient Temperature

Verify that clearance and ambient temperature requirements are met. The centrifuge requires adequate ventilation and proper environmental conditions in order to function properly.

All floor model centrifuges that are manufactured worldwide that carry either the UL label or CE mark must adhere to the following requirements.

UL 3101-2-20
IEC 1010-2-20

These requirements require that there be at least 300 mm (12 inches) clearance on all sides of the centrifuge. The Evolution RC™ will perform properly with 2 inches clearance on the left, right sides and 6 inches clearance to the rear of the centrifuge. Clearances of less than 6 inches at the rear of the centrifuge may result in degraded refrigeration performance.

Ambient temperature should range between 20°C and 30°C with the relative humidity up to 90%, non-condensing for optimal performance. With temperatures between 10°C to 19°C and 30°C to 38°C the centrifuge will run but at de-rated performance levels.

Centrifuge Level

Insure that the instrument is on a solid floor, sits stable on the two rear wheels and the two front leveling feet. The front feet should be down far enough so that the front wheel of the instrument is not contacting the floor and the wheel can be spun freely by hand.

Clean Door Seal

1. The door seal insures that the centrifuge runs at high speed while generating a minimum amount of turbulence. Failure to keep the door seal clean can cause air leaks into the chamber causing ice to build up in the centrifuge chamber and causing possible degradation in the centrifuge's refrigeration performance.
2. Open the centrifuge door and clean the chamber door seal using a mild non-alkaline laboratory detergent. Insure that the detergent is removed from the seal by wiping using a damp cloth or paper towel.
3. Inspect the door seal for cracks or other damage and replace the seal (72845) if necessary.

Clean Door Rails

1. The door on the Evolution RC centrifuge rides on four (4) wheels in 2 plastic tracks on either side of the centrifuge deck. Dirt and debris will sometimes build up in the track. When this dirt is caught under the wheels on the door it is ground to a fine black powder that tends to migrate around the deck

assembly. Clean the door rails using isopropyl alcohol and a clean cloth or paper towel.

2. Remove the rear deck assembly by loosening and removing the two (2) socket head screws located at the rear of the deck assembly with a 6mm Allen wrench.
3. Loosen and remove the single (1) socket head screw located at the rear base of the control console with a 5mm Allen wrench.
4. Slide the rear deck assembly towards the rear of the instrument, then lift the rear deck assembly from the rear and remove it from the instrument.
5. Clean the door rails using a clean cloth and isopropyl alcohol. The front of the rails can be reached by opening the centrifuge door.

Clean the Condenser Fins

1. The refrigeration condenser in the Evolution RC centrifuge is located in the lower rear portion of the instrument. The condenser is extremely important in the function of the centrifuge. If the proper airflow is not maintained through the condenser the performance of the centrifuge refrigeration system will be degraded. In extreme cases, when the condenser is excessively dirty for a long period of time the refrigeration system will overheat and damage the refrigeration compressor.
2. Remove the centrifuge front panel assembly by removing the four (2) socket head screws located at the lower front corners of the panel by using a 4mm Allen wrench. Remove the panel by then pulling the bottom of the panel towards the front and the lowering the panel to the floor.
3. Using a vacuum cleaner, vacuum any dust or debris from the condenser and any other components inside the centrifuge cabinet.

Drive Spindle and Bearings

1. Wipe the tapered Drive Spindle with a damp cloth and wipe dry.
2. Inspect the tapered spindle assembly. If the spindle is damaged in any way, replace the drive spindle (~~72929~~). [59194](#)
3. Check the drive bearings by rotating the drive shaft by hand. If any roughness or noise is detected in the bearings remove the drive motor, separate the gyro

assembly from the motor and check each component individually. If the drive motor bearings are defective replace the motor assembly (73448), if the gyro bearings are defective replace the gyro assembly (73446).

See Repair & Replacement procedures in the Evolution RC Service Manual for details.

Electrical Connections

Unplug the instrument, raise the leveling feet and move the instrument away from the wall. Using a 6mm Allen wrench remove the (2) socket head screws located at the top of the rear panel. Using a 3mm Allen wrench remove the (6) socket head screws located at either side of the rear panel. Remove the rear panel and set aside. Check all of the connections on the line filter (2 line filters on polyphase configurations) insuring that they are tight. Check all connections on TB-1 insuring that all wires are secure.

Ground Continuity

Using a digital multi meter set to the lowest resistance setting measure the instrument's ground continuity by placing one meter lead on the ground lug of the power plug and the other on the instrument's frame. The meter should indicate a resistance of less than 0.1Ω . Check the ground continuity to all major assemblies insuring that the ground continuity is no higher than 0.1Ω anywhere in the instrument.

Line Voltage

Plug the instrument power cord into the mains supply after insuring that the instrument's main circuit breaker is in the off position. Using the digital meter measure the mains supply at the instrument's line filter. Insure that the mains supply is between 187vac and 256vac. Insure that incoming line jumper (Large white wire between the main terminal block and the autotransformer tap closest to the front of the centrifuge) is connected to the autotransformer tap that is closest to the measured line voltage. Record the measured line voltage on the Preventative Maintenance checklist.

Functional Checks

Fans

With the instrument power on insure that all of the instrument fans are operational when required.

Drive / PFC assembly fans should be on whenever the instrument power is on.

Compressor fans will turn on whenever the instrument refrigeration is functioning.

Display Test

Insure that all LEDs and displays are functioning properly. Insure that all LEDs are functioning with the same intensity.

Low Voltage Power Supply

Plug the I2C bus test adapter (P/N 73373) into the spare I2C connector on the rear of the control console. Using a digital meter measure the +5 volt power supply voltage at TP-7 or 8 (+5 volts) and TP-5 or 6 (ground). Adjust the supply located at the rear of the instrument chamber for +5.25 volts DC \pm 0.05 volts. Removing the rear deck assembly and the drip tray at the rear of the door will access the power supply.

Chamber Door Function

Inspect the door handle door any physical damage or cracks. Replace any broken or warn parts. Insure that the chamber door functions properly by pushing the door handle towards the rear of the instrument. The door should retract on it's own with little effort on the part of the operator. There should be no binding or drag in the operation.

Runlog / Faultlog Checks

1. Use the following procedure to access the service diagnostics in order to check the runlog and the faultlog.
2. Using a 3mm Allen wrench remove the (4) screws at the rear of the control console and remove the trim ring from around the display panel.
3. Locate the interface ribbon cable hanging just above the control console. Connect a nulling serial cable between the interface cable and the serial port on the laptop computer.
4. If the computer that is being used for the download does not have icons on the desktop for “Evolution Diagnostics” or “Evolution Download”, open the Hyperterminal program (resident on all windows versions) and configure as follows:
 - In the *Bits per Second* field, select “9600”
 - In the *Data Bits* field, select “8”
 - In the *Parity* field, select “None”
 - In the *Stop bits* field, select “1”
 - In the *Flow control* field, select “Hardware”
5. Open the “Evolution Diagnostic” icon. This will open Hyperterminal set for a baud rate of 9600 to enable the computer to display the evolution software along with the service diagnostics.

Note:

On centrifuges that use software revision #31 follow steps 6 through 11. For centrifuges using software revisions #41 and higher skip to step 12.

6. turn the main instrument power “ON”. As the Evolution RC instrument boots interrupt the boot process by depressing “CONTROL C” on the computer just after the “EVOL” program starts to run. See Figure #1.


```
HOT cable detected, Serial Loader starting.  
Press ESC to abort Hard disk boot  
Booting Hard Drive  
Loading...  
  
DR DOS Release 5.0  
Copyright (c) 1976,1982,1988,1990 Digital Research Inc. All rights reserved.  
Ampro Computers, Inc.  
  
C>ECHO ON  
  
C>evol
```

Figure #1

7. When the message displays “Halt the Batch Process” answer by typing “Y”.
8. Rename the Autoexec.bat file so that the instrument cannot be booted. (Rename the file something that will not be forgotten).

C>rename autoexec.bat steve

9. In this case the Autoexec was renamed “steve”.
10. Re-boot the Evolution RC instrument by cycling the power “OFF” then “ON”.
11. The instrument will re-boot then ask for the date and the time. If no changes are to be made depress “ENTER” 2 times.

```
HOT cable detected, Serial Loader starting.  
Press ESC to abort Hard disk boot  
Booting Hard Drive  
Loading...  
  
DR DOS Release 5.0  
Copyright (c) 1976,1982,1988,1990 Digital Research Inc. All rights reserved.  
Ampro Computers, Inc.  
  
Date: Sat 3-17-2001  
Enter date (mm-dd-yy):  
  
Time: 4:00:54.87  
Enter time:  
  
C>
```

Figure #2

12. On centrifuges that use software revisions with serial numbers 41 or higher turn the centrifuge power “ON” and allow the centrifuge to boot normally.
13. After the centrifuge has booted, type the letter “t” on the connected computer to get the the c>: prompt.

Fault Log Check

At the C> type “**TYPE FAULTLOG**”. The computer will display a list of all of the faults that were recorded along with date and time stamps when the faults occurred.

Note:

The fault log can be copied and placed in any Microsoft application. The faultlog can be erased by typing “**ERASE FAULTLOG**”. This will clear the faultlog and when the next fault condition exists the file will be re-created.

It is not necessary to erase the faultlog it is purely up to the individual Service Engineer’s preference.

Fault Log Cleared

If so desired the faultlog can be erased by typing “**ERASE FAULTLOG**”.

Run Log Check

At the C> type “**TYPE RUNLOG**”. The computer will display a list of all of the runs that were preformed including the following information.

Rotor Type
Run Set Speed
Run Set Temperature
Actual Run Duration (minutes)
Date
Time

Note:

The run log can be copied and placed in any Microsoft application.

The run log can be erased by typing “**ERASE RUNLOG**”. This will clear the run log and when the next run is performed the file will be re-created.

It is not necessary to erase the run log it is purely up to the individual Service Engineer's preference.

Run Log Cleared

1. If so desired the run log can be erased by typing **"ERASE RUNLOG"**.
2. At the "C>" prompt rename the Autoexec.bat file back to "Autoexec.bat".
3. Cycle the Evolution RC power "OFF then back "ON". The instrument will now boot up normally and will display the new software revision momentarily in the Temperature display. No other calibrations are needed and the instrument should run normally.
4. Disconnect the computer and tuck the interface ribbon cable into the control console. Install the trim ring using the 3mm Allen Wrench.

Instrument Operation

Rotor Table

Insert rotor acceleration Table

Rotor	Maximum Speed	Maximum RCF	Acceleration Time	Deceleration Time
	RPM	xG	Min:Sec	Min:Sec
SS-34	20,500	50,230	1:15	1:00
SLA-3000	12,000	24,340	2:15	1:45
SLA-1500	15,000	34,160	2:00	1:30
SLA-1000	16,500	35,790	1:15	1:00
SLA600TC	13,000	27,750	2:00	1:30
SLC-6000	8,500	15,810	4:45	3:00
SLC-4000	9,000	15,180	2:00	2:00
SLC3000	10,000	17,600	2:15	1:45
SLC-1500	14,000	29,990	1:30	1:15
SA-800	21,500	53,960	1:30	1:00
SA-600	17,000	41,840	2:00	1:30
SA-512	20,500	54,080	1:30	1:00
SA-300	25,000	67,510	1:15	0:45
SM-24	20,500	51,970	1:30	1:00
SE-12	26,000	70,450	1:00	0:30
F-20 MICRO	20,000	51,430	1:00	0:45
F-16/250	14,500	31,940	2:30	1:45
F-28/50	20,000	51,250	1:45	1:15
F-28/36	18,000	41,370	1:30	1:15
F-28/13	19,500	48,550	1:15	1:00
SH-3000	4,700	4,580	1:15	1:00
HB-6	13,000	27,620	0:45	0:45
HS-4	7,500	11,070	1:45	1:30
SH-80	20,000	45,400	0:30	0:30
SV-288	20,000	40,300	1:30	1:00
SV-80	19,000	40,970	1:15	0:45

Acceleration Time

1. Set the following parameters on the instrument.

Speed: Top Speed for the rotor being used
Time: 10 minutes.
Temperature: 4° C

2. Depress “**START**” to start the run, at the same time using a stopwatch time the instrument acceleration until the rotor reaches top speed (allow the stopwatch to continue running). Compare the reading to that of the table shown in figure !. Record the acceleration time on the PM Checklist. If the instrument doesn’t achieve the required acceleration time make the appropriate repair and retest.

Speed Control Operation

After the rotor has reached top speed allow the instrument to run for 5 minutes to allow the speed control to settle. Record the displayed speed in the instrument speed. Verify the instrument speed by comparing the Aux Tach with the instrument displayed speed. The Aux tach can be measured using a digital meter with frequency capability between TP-13 and TP-15 on the Drive Interface board located on the Drive / PFC assembly located in the lower front corner of the instrument. Record the Aux Tach speed the measured speed should be ± 200 rpm of the displayed speed.

Timer Operation

When the instrument timer reaches 00:00 and the instrument starts to decelerate record the stopwatch reading allowing the stopwatch to run. The time should be 10 minutes ± 3 seconds.

Deceleration Time

Keep the stopwatch running while the instrument is decelerating and stop the watch at the time when the door is unlatched. Subtract the split time taken when the instrument timer read 00:00 from the reading on the stopwatch at the end of the run, which will be the deceleration time. Record the deceleration time and compare it to the time specified in the table shown in Figure #1

Slow Start Operation

There are three (3) “ACCEL” settings on the Evolution RC. Select each of the three settings and verify the correct operation. When settings #1 and #2 are selected the instrument speed display will blink while the instrument slowly accelerates to 500 rpm then when the instrument switches to “FULL ACCELERATION” the display will stop blinking and will accelerate normally.

“ACCEL” Setting	Acceleration Time
1 (Slow)	2 minutes (approximate) to 500 rpm
2 (Medium)	1 minute (approximately) to 500 rpm
3 (Fast)	Full torque acceleration

Figure #2

Slow Stop Operation

There are four (4) “BRAKE” settings on the Evolution RC. Select each of the settings (0 through 4) and verify the correct operation. When “BRAKE” options 0 through 3 are selected the brake light will blink when the instrument speed is between 500 and 0 rpm. When “BRAKE” option #3 is selected the brake light will remain on.

“BRAKE Setting	Deceleration Time
0 (Slow)	Coast (brake off)
1 (Medium slow)	2 minutes (approximate) from 500 – 0 rpm
2 (Medium fast)	1 minute (approximate) from 500 – 0 rpm
3 (Fast)	Full torque deceleration

Rotor Inspection

Corrosion and Wear

- ❖ Check all rotors used in the Evolution RC for corrosion. Corrosion will be usually found at the bottom of the tube / bottle cavities and will be seen as pitting and / or blemishes in the paint or anodized surface.
- ❖ In the SLC Composite rotors inspect the rotors for cracks or deformities in the surface of the rotor and inside the tube / bottle cavities.
- ❖ Inspect the rotor drive adapters for wear or damage in the area where the rotor connects to the instrument drive shaft.



Evolution RC



Preventative Maintenance Checklist

Account Name:		Instrument Model:	
Account Address:		Serial Number:	
Report Number:		Date:	

Static Checks

- Location / Ambient Temperature
- Centrifuge Level
- Check and clean Door Seal
- Clean Door Rails
- Clean Condenser Fins
- Drive Spindle and Bearings
- Electrical Connections
- Ground Continuity < 0.1 W
- Line Voltage _____ VAC
- Transformer Taps Match Line Voltage

Functional Checks

- Fans
- Display Test
- Low voltage Power Supply
+5.25 VDC \pm 0.05 _____ VDC

Run / Fault Log

- Run Log Checked
Run Log Cleared Yes No
- Fault Log Checked
Fault Log Cleared Yes No

Instrument Operation

- Rotor used _____ Rotor
- Acceleration time _____ Min/Sec
- Displayed speed _____ RPM
- Measured speed _____ RPM
- Timer Operation _____ Min/Sec
10 min \pm 3 seconds
- Deceleration Time _____ Min/Sec
- Slow Start / Stop Operation

Rotor Inspection

- Corrosion and Wear
- Buckets and trunnions lubricated
(if applicable)
- "O" rings inspected (replace if necessary)

Comments:

S.R. Signature _____

Date:

Evolution RC

Table of Contents

4.0 Theory of Operation

4.1 General Overview

4.2 Drive System Theory

4.3 Door Lock Theory

4.4 Refrigeration System Theory

4.5 Door Interface Theory

4.6 Ke Board Theory

4.7 Refrigeration Interface Theory

4.8 Temperature Sensor Theory

EVOLUTION™ RC SUPERSPEED CENTRIFUGE OPERATING PARAMETERS: 50/60 Hz

GENERAL THEORY OVERVIEW, Evolution™ RC

1. Mechanical

The Evolution™ RC uses a brushless DC motor. The refrigeration system has a liquid line and a hot gas bypass valve to allow heating as well as cooling of the chamber. The primary benefits of hot gas are reduction of temperature undershoot at low speeds, rapid temperature change in either direction and more precise temperature control over the entire operating range. The maximum speed is 26000 rpm.

2. Electrical

The Evolution™ RC has a multi-tap transformer for the compressor system. Compressor connection is to the 200V tap for 50Hz operation, and to the 230V tap for 60Hz operation, nominal. Transformer input can be set to multiple input line variations. The drive system uses a brushless dc motor with a current mode control drive and power factor correction. The door lock system uses two hall-effect switches to detect the door locked and latched positions. There are several solid-state relays that control power to the compressor, door lock solenoid, fans, etc. There are several sensors (temperature, door, imbalance, etc.) installed at the appropriate locations to monitor system conditions. The system has minimum calibration requirements, one each for imbalance, temperature sensor offset, Ke value, and power supply.

3. Operator Interface

There is a keypad for entering all of the run parameters and options, as well as for starting or stopping a run. There are three pairs of numeric LED displays, one each for Speed, Time, and Temperature, as well as one two-line alphanumeric display for rotor selection, and for displaying advisory or fault messages. There are several status and option LED indicators. There is a beeper to alert the user to a certain condition, fault or warning.

4. Electronics

The Evolution™ RC uses a PC104 computer and UART interface to the IIC buss . A computer controls the centrifuge serially by an IIC protocol. There are several addressable interface ports which receive status voltages and transmit control signals. There is also additional processors in the system. There are two on the drive interface; one which communicates drive information (PFC) to and from the drive system back to the main computer; an auxiliary tach processor which

monitors and compares speeds. There is a processor on the Ke board which monitors motor constant and controls torque delivery to the motor. Moreover, there is a processor on the display which acts as a smart UART which communicates directly with the PC104. Finally, there are 4 other processors which control display functions, one each for speed, time, temp and rotor fields. Each processor utilizes a watchdog timer.

5. Firmware Control

5.1 Speed

Speed is measured by two sets of Hall-effect sensors in the motor. Main tach is derived from the drive interface, alternate tach from the motor commutation. Speed is controlled through a closed-loop algorithm that continuously adapts the drive PWM to match the rotor speed to the target speed. Alternate tachometry is achieved by the commutation signals from the drive. If tachs do not agree with other then the instrument is shut down. The Slow Start option provides a linear acceleration from 0 to 500 rpm. The Slow Stop option provides an exponential decay from 500 rpm to stop. The actual speed is filtered before being displayed in the LEDs. Optionally, the effective *g*-force (RCF) is calculated from the speed (using the rotor specific effective radius) and can be displayed.

5.2 Time

Whenever the rotor is spinning, time is counting. The Elapsed Time (Hold) always counts up. During a TIMED run, the Time Left counts down from the Set Time. When the Time Left = 0, the run ends.

5.3 Temperature

The process of spinning the rotor at high speeds creates heat by friction. The air sensor in the floor of the chamber measures temperature. Generally, the temperature inside the rotor is noticeably higher than the air temperature of the chamber. The displayed Run Temperature is an estimated sample temperature (EST) that is calculated based on the rotor selected, run speed, set temperature, measured chamber temperature, and elapsed run time. The liquid line and hot gas valves are cycled to maintain the EST at the Set Temp. Before displaying, the EST is filtered with a long time constant to simulate the thermal mass of the sample. Since we cannot measure the actual sample temperature, this is an open-loop control method. The centrifuge adds a hot gas valve which reduces the amount of undershoot when the compressor cooling cycle is completed.

5.4 Rotor Parameters

The Evolution has several rotor designed, mainly the SLC series, although others may be designed in the future.

5.5 Saved Programs

It is possible to save (and later recall) all of the run parameters into a Run Program. All of the run parameters and options may be saved. Recent function saves the last five different sets of run parameters.

5.6 Diagnostics

Through a serial port and laptop (external) computer, it is possible to observe certain real-time information and is possible to review the run and fault history.

5.7 Faults

Because of the significant velocities and energies involved, there are several fault traps that detect faults in the motor/drive system (including the tach), the door latch and lock, temperature control system, inertia, etc..

6. Safety

The Evolution™ RC has been designed and tested to verify that no failures could result in a hazardous condition as defined by Underwriters Laboratory and CE test procedures.

Specification EN 61010-1 and 61010-2-20.

DRIVE SYSTEM THEORY, Evolution™ RC*

INTRODUCTION:

Evolution centrifuge rotor is driven by an adjustable speed brushless DC (BLDC) drive system. The drive system consists of a motor, a drive (drive electronics), power factor correction, and control system / PC-104 computer.

The motor is a high torque brushless DC motor, 3 phase, Y-connected, 4 pole ferrite magnet design. The motor has been sized to meet the torque requirement for fast acceleration and deceleration. The hall board inside the motor provides the commutation signals for the drive electronics. The hall board also provides additional (separate isolated) speed feedback signals for the controller for speed control.

The drive is 30 amp peak, current mode pulse width modulated (PWM) brushless DC. The drive provides variable voltage power supply to the motor for the variable speed operation as well as the switching logic for the brushless DC operation. Input power to the drive is delivered from the power factor correction supply (PFC) at 400v. This increases the margin to brownout conditions and sinusoidal current draw from the AC line, thus reducing harmonic distortion. Due to higher currents in the motor, there is variability in motor magnets with temperature, the Ke board measures motor constant, and compensates the torque delivery to the motor.

The controller performs the speed control function and provides control signals for the drive under various stages of operation.

BLDC motor/drive basics:

The evolution uses a six step square wave BLDC motor/drive system. The BLDC motor is an inverted DC brush type permanent magnet motor, where the mechanical commutator with the brush assembly is replaced by an electronic switching module in the drive. The motor stator has 3 phase windings, connected in Y, while the motor rotor has permanent magnets. In order for the motor shaft to rotate in a smooth and predictable manner, the drive must synthesize a rotating magnetic field within the stator of the motor and maintain a quadrature phase shift (90 degree electrical angle) between the stator field (mmf) and the rotor magnetic field for all positions of the motor shaft. This is accomplished by switching the current flow through the stator windings sequentially in response to the rotor shaft position. The power output stage in a three phase bridge configuration provide the switching function. The rotor shaft position signals S1, S2, S3, commonly known as hall signals, are obtained from 3 hall switches mounted inside the motor. The hall signals S1, S2, and S3 are

* Parts taken from Automotion, Inc.

separated from one another by 120 degree electrical and converge in a device called decoder in the drive. The pattern of the signals S1, S2, S3 causes the decoder to sequentially select pairs of output transistors in the 3 phase bridge. The motor current switches from one pair of windings to the next pair and follows six steps/sequences in one 360 degree electrical revolution. By doing this the drive “commutates” the motor. Commutation is the process by which the drive synthesizes a rotating magnetic field within the stator. The magnetic field is created by the amperage that is caused to flow sequentially through the motor stator windings. This then reacts with the rotor magnet field to produce torque, which causes the motor shaft to rotate. Within each commutation cycle, the selected transistors are turned on and off with a variable duty cycle set by the external PWM command signal from the controller. Each time interval the selected transistors are turned on and off is referred to as a modulation frame. For this product family the modulation frame is repeated 18,000 times per second (18 KHz).

Torque produced by the motor is directly related to the average amperage passing through it. The ability to control torque is related to the ability of the Kendro controller to continually adjust the weighting of the PWM signal. As the “on time” for each frame of the PWM command signal increases above 50%, the amperage flow into the motor increases disproportionately faster than the change in the duty cycle. This effect is normal. It is a consequence of the manner in which energy is modulated into the motor by a PWM amplifier. This is an important concept as it affects the ability of the Kendro controller to throttle both the motor torque and the velocity.

Modulation Techniques (Full chop/Half chop):

The centrifuge uses two modulation techniques during the acceleration phase and the constant velocity (steady state) phase of operation. These techniques are referred to as Full Chop and Half Chop modulation.

The fundamental principles of Full Chop modulation differ little from Half Chop modulation. The effect upon the motor performance, however, can be very dramatic. Simply stated, Full Chop means the modulation is applied to both the current source and current sink transistors of the output bridge during each commutation frame. Half Chop means that only one transistor (current source) of the pair in conduction is modulated during each commutation frame. The reason for selecting between these options is rooted in the effect this has on the motor performance.

Generally Full Chop produces better control over motor torque at creep velocities. It also is the only viable modulation technique during a 4 quadrant regenerative decel/braking of the motor. Its negative side is that it results in higher current ripple than its Half Chop alternative.

Half Chop produces much lower current ripple which translates into lower magnetic losses within the motor stator. This results in lower motor operating temperatures. This can extend the load range for a given motor. Lower current ripple can also add to the useful peak torque that a given motor can deliver.

For the Evolution™ RC, Full Chop is used during slow start and deceleration while Half Chop is used during full acceleration and steady state run.

Current Limiting:

The drive provides an active method to set an upper limit upon the current delivery into the motor. During normal operation of the drive the user throttles current into the motor by varying the duty cycle of the PWM command. In general the higher the duty cycle (i.e. ON time/time interval between pulses) the greater is the current into the motor.

However since the ability of the user to control current into the motor by observing the current feedback signal is bandwidth limited, some other means must be provided to limit peak current levels. This is accomplished through internal drive control circuits. These circuits monitor, on a pulse by pulse basis (or modulation frame by modulation frame), the actual current being sourced through the motor. Should actual real-time current levels ever reach the present design limit for the drive, this will result in an immediate interruption of bridge modulation. This interruption will cause the current to begin to quickly decay to a lower level below the current limit threshold. Usually the increasing current flow into the motor from the drive will resume during the next full modulation frame.

Should current levels through the drive get far above normal peak current limit threshold, then alternative current limit will take place. Reaching this alternative limit will cause the drive to shut down and fault off the line. The motor will then be placed into a coast state. Once this type of fault occurs the user will be encumbered with the responsibility to determine why the current went to such extremes. Once the cause of this fault has been cleared the drive will need to be reset before normal operation can be resumed.

Braking (Deceleration):

The drive uses regenerative braking during deceleration for the Evolution™ RC.

The ability to slow a motor that is in motion requires some method of applying a counter torque. The technique is also referred to as four quadrant deceleration.

In this method the motor is commanded to decelerate by reverse commutation. In effect it is told to simply reverse direction by reversing the Direction Command to the drive. Once this occurs the current flow pattern passing

through the motor windings is inverted. Within fractions of a second the reversal of current through the motor causes a reversal of the motor torque.

With the torque reversed the motor is forced to decelerate at a rate that is in proportion to the level of average current. In this mode the voltage applied to the motor from the drive aids (in the same direction) the back emf of the motor. The back emf is proportional to the motor speed, while the voltage applied to the motor is proportional to the duty cycle of the PWM command. This permits the user to more accurately throttle the rate of deceleration from initial velocity down to zero speed by properly managing the PWM command signal.

This method also involves the conversion of the kinetic energy stored in the rotor and the load back into electrical energy. This electrical energy is returned to the drive where it must soon be dissipated. This is accomplished by converting the electrical energy (off the capacitor bus) into heat. The heat is created by shunting the electrical energy off across an external resistor called shunt resistor with shunt control from the drive.

Wave Forms:

Each hall signal is on for 180 degree elec. and off for 180 degree elec. and apart from one another by 120 degree elec. Note that each motor phase carries current for 2/3 of the time (240 degree elec.), while for 1/3 of the time (120 degree elec.) there is no current. The Tach signal output from the drive synchronizes with the phase 1 motor amp signal and consists of 2 pulses per 360 degree elec. or 8 pulses per motor revolution, since the motor is of 4 pole construction

During regenerative braking the phase current reverses as the drive receives the reverse direction command, while the motor is spinning in the forward direction.

Power Factor Correction

The PFC is a DC power supply, which supplies a voltage to the drive box, with IIC communications to the display console, whereas drive faults can be explicitly determined and communicated to the user. Current draw from the power source is sinusoidal and prevents high amplitude bursts from occurring near the peak of the voltage waveform. It also protects the system from AC line voltage dips and sags, thus preventing nuisance faults during centrifugation.

Control Signal Interface:

The controller will initiate the drive control by interchanging the TTL level control signals (Input/Output) with the drive via the I²C buss cable and the J1 connector in the drive. The signals leveled as input are inputs to the drive and outputs from the controller.

Door Lock System Overview

1.1 Definitions:

Minimum Speed - Circumferential velocity < 2 meters/sec for largest rotor.

Door Lock - The door lock is the mechanical device that provides the primary means of keeping the door closed in the event of a burst. The door lock must be engaged any time the rotor is spinning above minimum speed.

Door Locked - That the lock is in the fully locked position.

Door Unlocked - That the lock is in the fully unlocked position.

2.0 Functional Specifications

2.4 Door Sealing and Insulation

A gasket between the door, top deck, and evaporator provides an air seal to prevent/minimize condensation in the evaporator chamber. Door insulation is of sufficient R- value to prevent condensation on the top (outside) surface of the door at 90°F and 90% R.H., while operating at a set temperature of 4°C.

2.5 Closing Force

A latch mechanism is provided to hold the door in the closed position. The pulling force required to initiate door closure is less than 10 lb.

No damage to the latch, lock or interlock will occur if binding occurs due to a mechanical obstruction.

2.6 Sensors

The locked and unlocked positions of the door locking mechanism are detected using a bipolar Hall-effect switch.

For safety, the system must be able to detect that:

- The door is closed and able to be locked (Hall sensors).
- The lock is in the fully locked position (Hall sensors).

Additionally, sensors detect when the lock is in the fully unlocked position (Hall sensors).

2.7 Door Closed Sensor

Hall switch is used for detecting the closed position of the door. Software checks that the switch has cycled at least once every run. Failure to cycle will generate a “door sensor failure” fault.

2.8 Door Locked Sensor

The door locked/unlocked “switch” is a solid state hall sensor. Two magnets are mounted on the door locking solenoid arm. When the lock is in the locked position, the magnet will be in a position opposite the hall sensor. A high on the South output of the hall device indicates that the lock is in the locked position.

Software checks that both hall switches have cycled at least once every run. Failure to cycle will generate a “door lock failure” fault.

2.11 Power Failure Considerations

In the event of a power failure, the door lock remains locked upon re-initialization of the computer when power is restored. If the instrument is still above minimum speed when power is restored, the lock remains locked.

2.12 Loss of Tach Considerations

Loss of or error in the primary tach signal will be detected in software via comparison with the tach signal (backup) supplied by the drive box. A “tach error” fault will be generated. In the event of a “tach error” fault, the door lock will remain locked until the fault is cleared. If power is removed from the instrument during a tach failure, the door lock will remain locked during the re-initialization of the computer, when power is restored. A tach fault will be generated if the alternate (backup) tach indicates that the rotor is spinning above 200 rpm when the primary tach is in a failed condition, and also is used as a redundant check to ensure that a rotor overspeed condition does not exist.

2.13 Inertial Considerations

Door locking and interlocking devices are designed to be inertially insensitive such that accelerating or decelerating forces from a rotor disturbance will not cause the lock or interlock to disengage from their locked or interlocked positions.

Refrigeration System Theory

1. Specifications, Tecumseh Reciprocating Compressor

Refrigerant	R404a (SUVA® HP-62)
Charge:	3 lbs. (1360 grams) initial charge, before optimization 3.25 lbs. (1475 grams) typical total charge approx.
Power Input (transformer tap)	230Vac for 60Hz; 200Vac for 50Hz
Current Draw (@ 25°C ambient)	60Hz: 10A 50Hz: 12A
Operating Superheat	19°F ± 2 (10.6°C ± 1)
Maximum Condenser T.D.	25°F (13.9°C), panels off

2. Mechanical Theory

The refrigeration system consists of an air-cooled condenser, a hermetically sealed reciprocating compressor, a balanced port expansion valve, an evaporator which serves as the rotor chamber, a liquid line solenoid valve, a hot gas control valve, a high pressure relief valve, a sight glass/moisture indicator, a filter dryer, and related interconnecting tubing.

The stainless steel platecoil type evaporator functions as the primary heat transfer device for the removal of heat energy from the rotor.

The system used is a gas compression refrigeration cycle. A hermetically sealed reciprocating piston compressor accepts a low pressure, low temperature, superheated gas and converts it into a high pressure, high temperature, superheated gas.

Following compression, the gas enters the fan-cooled condenser where heat is rejected from the system to atmosphere. The condenser operates at constant pressure and the refrigerant exits condenser as a high pressure, medium temperature, saturated liquid.

The high pressure liquid is then subjected to an expansion device (a thermostatic expansion valve). A balanced port, internally equalized expansion valve is used to ensure that the proper superheat to the compressor is maintained under all load conditions. The valve is rated for 1-1/4 - 2 ton capacity.

The cool liquid expands to a gas as it enters the evaporator and circulates through passages in the outer walls of the evaporator. The evaporator works at

constant pressure, and heat from the chamber is transferred through the chamber walls to the refrigerant.

The cycle has been completed after the gas exits the evaporator and returns to the compressor through the suction return line.

System loads are the result of friction heating from air at the rotor surface. The load for a particular rotor is a function of the rotor geometry and it increases in a nonlinear fashion as the speed increases. Maximum load on the refrigeration system is achieved with an SLC-6000 rotor running at its maximum speed of 8500 RPM.

Temperature Control

1. General

The compressor is always on, operating continuously as temperature control circuitry supplies control output signals that activate relays to open or close the two refrigeration system solenoid valves controlling the flow of liquid refrigerant or hot gas.

The state of the control signals is determined by the following:

- Temperature measurements made by the air sensor;
- Estimated sample temperature based on measured air temperature, rotor speed, and coefficients stored in the rotor tables;
- The temperature control mode of operation.

2. Solenoid Valve Operation

The two solenoid valves (a liquid line valve and a hot gas valve) that control the flow of refrigerant cycle simultaneously, opening and closing in response to preprogrammed temperature requirements. The liquid line valve is normally open; the hot gas (condenser bypass) valve is normally closed. The valves are in this position when the refrigeration cycle is in the cooling mode or when the centrifuge power is OFF.

Temperature control is accomplished by controlling the state of the liquid line and hot gas control solenoid valves. These valves respond to signals from the refrigeration interface p.c. board. When the chamber needs to be heated, the hot gas control valve is opened (solenoid energized) and the liquid line valve is closed (solenoid energized). This diverts hot gas around the condenser and directly into the evaporator. In the heating mode, the liquid line valve blocks the flow of refrigerant from the condenser, while the hot gas valve opens a direct

line from the compressor to the evaporator. This action increases evaporator temperatures.

When chamber cooling is required, both solenoids are de-energized so the flow through the hot gas line is blocked and is allowed through the condenser, filter/dryer, liquid line solenoid valve, sight glass, expansion valve, and into the evaporator.

Restrictions in hot gas heating mode:

- 2 minutes maximum in the heating mode when the compressor is running; hot gas valve is restricted if floor sensor temperature is **>50°**; if floor sensor fails, a time limit of 30 seconds is applied.

The compressor and system valves are cycled ON and OFF in the Hold mode to control temperature and minimize noise and room heat.

3. Compressor Operation

The compressor and system solenoid valves cycle ON and OFF as required to control evaporator temperature. The compressor is always OFF when the chamber door is open, provided the est value is within $\pm 3^{\circ}\text{C}$ of the set temperature. If not, the compressor will start and the system solenoid valves will cycle as necessary to control est. The compressor will be OFF during slow start or slow stop, when speed is below 150 rpm.

4. Temperature Sensors

An LM 76 digital temperature detector is used for sensing air temperature. The air sensor has a direct bearing on temperature control; output from this sensor is used by the microprocessor to calculate estimated sample temperature (EST).

Theory of Operation - Evolution™ Temperature Control

As the rotor spins inside the centrifuge rotor chamber, an amount of heat is created that increases exponentially with rotor speed. A refrigeration system is employed to remove this heat so that the sample in the rotor is maintained at the desired temperature. The desired temperature is “set” by the user via the control panel. The temperature of the air inside the rotor chamber is sensed by a digital sensor that is located inside the rotor chamber. For any given set of run conditions (speed and temperature), there is a predictable offset between chamber air temperature and the actual sample temperature.

Prior to the utilization of microprocessors in centrifuges, sample temperature was controlled indirectly by maintaining the air temperature of the rotor chamber at the set temperature value. If sample temperature control is critical,

the user could compensate for the offset between chamber air temperature and actual sample temperature by making a series of experimental runs and adjusting the setpoint (set temperature) until the desired sample temperature for a particular set of run conditions was achieved.

Software capability in newer centrifuges provides the ability to do this correlation automatically so that an estimated sample temperature can now be used as the control input (vs. chamber air temperature) to control the state of the refrigeration system; thus allowing sample temperature to be maintained at the set temperature. The actual control point is determined by the set temperature and offset. For example, if the desired run conditions are 4,000 rpm and 20°C, the user would set 4,000 rpm and 20°C via the control panel. If the offset for this speed is say +4°C, meaning that after reaching equilibrium the actual sample temperature will be +4°C higher than the chamber air temperature, the control point used by the software would be 16°C. In other words, the software will control the refrigeration system as required to maintain the chamber air temperature at 16°C, resulting in a sample temperature of 20°C. This would be the same as the user manually setting the temperature dial to 16°C to achieve a 20°C sample on an instrument without software control. This estimated sample temperature, that closely approximates the actual sample temperature, is filtered and displayed on the front panel.

Since the actual sample temperature is estimated from the chamber air temperature, rather than measured directly, it is difficult to predict the sample temperature when it is not at equilibrium with the chamber air temperature. If, for example, a sample at 35°C is placed in the instrument with a chamber air temperature of 20°C, the sample will equilibrate exponentially to the air temperature plus the offset value. This could take several hours, depending on how far away the sample is from the air temperature, the volume of the sample and the run speed. During a normal control cycle, the air temperature may fluctuate as much as 2-3°C above and below the control point. However, because of the thermal inertia of the rotor buckets and the sample, the actual sample temperature varies on slightly during the cycle. For this reason, the air temperature is filtered and summed with the offset to provide the estimated sample temperature and displayed temperature. This filtering is intended to approximate the change in temperature of an average sample volume.

Theory of Operation: Door Interface Board

Overview:

The door interface board function consists of an IIC interface, bus expander, door latch driver and AC line monitor. The function of this board is entirely controlled by the IIC bus. A local buffer is utilized for the serial communications, accomplished by a bi-directional buffer, U1. This is a current based, unity gain device that will reduce the system cable capacitance by a factor of 10, to allow lower cost cables of longer length, to be utilized. Outputs are active low, which corresponds the open collector/open drain characteristics of IIC communications. The buffer directly connects to the 8-bit I/O expander. This device allows up to eight bi-directional ports to be configured at output drivers or inputs. Software writes a three byte instruction which will either read or write to the device. The address of this device is a hex "74". Eight ports are available for either inputs or outputs, dependant on how software addresses the chip. Port 0 is a read input that communicates a low level input that indicates a AC power fail or a normal AC power off. Port 2 is an enable for the driver/inverter. This becomes disabled at zero speed. P3 is the door solenoid driver. Ports P4-P7 are used for the door position sensors, active low. U4 and U5 form a circuit that monitors the AC line voltage. The low voltage secondary of the transformer is coupled to precision comparator, CR7, which drives an optocoupler which is on as long as AC power remains higher than 180 volts. CR7 pin 1 is at 2 volts when on and 5 volts off. The outputs will remain a logic "low" as long as "good" AC power is applied. If the voltage dips low enough the opto-coupler, pulls the interrupt on the IIC bus, via U4, allowing software to stop polling and read each device in the instrument to see which one has pulled the interrupt line. P0 port on the buss expander low, so that when the software polls this input, it will see that AC power is not there, and save run information before the power supply voltage drops and the whole system shuts down. This detection process will take less than 5ms. The actual time (before VCC drops to zero) will vary, minimum of 200msec. The run information will be written to E² memory prior to the VCC falling to zero. Power fail is only activated in the run state, it is disabled in the hold state.

Q1 forms a switch which opens when *any* IIC device pulls the interrupt line. With this switch open, the door solenoid will not energize, and the door remains locked. The solenoid driver is a current mode controller with a variable input (dependant on line voltage) ac voltage. When P3 output goes "low" Q3 turns on and drives current through the U3 opto-coupler and thus turns the output "on". This switch provides voltage to the VCC pin on the current mode controller, U6. Pin 10 of this device turns on Q2 and current begins to flow to the solenoid. At this point current begins to steadily rise until the voltage across R23 gets high enough to start the current fold-back, only allowing a holding current in the solenoid, and reducing heating effects. The voltage operating range of this circuit is 183-265 volts AC, but is normalized at 220v (line) VAC.

Theory of Operation: Ke Board

Overview:

The Ke board is designed to measure the motor constant, K_e , which directly relates to magnet strength in the motor. Magnetic characteristics change as the heat in the motor elevates the temperature, and this board will keep software updated on the motor torque constant. Software would then adjust the torque delivery accordingly, increased as the motor gets hotter. There are limitations to this, of course, whereas the current will only increase to a maximum. At this limit, acceleration may be effected in extreme cases. This is part of the control system and has no serviceable parts. There are several test points however, for diagnosis.

The motor Back EMF is switched into a ladder network of about 200k ohms, through a high voltage relay. The worst case current is about 2mA. The voltage drop across the last resistor in the divider is applied to an op-amp, which is set up as a precision rectifier. This rectified voltage is then fed into a sample and hold amplifier, where the output is a dc voltage proportional to the motor voltage. This becomes the input to the A/D converter, whose 16-bit output to the local processor represents the motor K_e value, which directly communicates on the bus. The processor is opto-coupled (electrically isolated) from the bus.

The relay used has a rating of 1000V, at 1 amp. The maximum motor voltage will be 450 volts, in an abnormal condition. This voltage is somewhat AC sinusoid in nature, but not referenced to the AC power line. When the relay is in the open condition, there exists a 60pf capacitance across the open contacts, causing a small current to flow into the input amplifier, causing an error. To prevent this, the relay U3 will close, shunting any leakage current to ground, keeping the amplifier voltage.

Theory of Operation : Refrigeration Interface

Overview

The interface board is indirectly connected to the IIC bus. A local bus driver isolates the board function from the actual communications from the PC104 computer. This bus extender (buffer) allows longer cables, with reduced possibility of noise within the instrument. On the other side of the bus driver, exists a remote I/O bus expander, which allows up to 8 inputs or outputs to monitor instrument functions. The bus driver sends clock and data signals to the digital temp sensors, through opto-couplers to increase overall noise margin. The temp sensor, LM76, is a digital device that has a two wire interface to the IIC buss. When the temp sensor is selected, it is a read only device. The hex value of the sensor is transmitted on to the bus, where the computer translates the reading into temperature value and displays on front panel. The temp sensor board has an on board memory that has the calibration information stored, to bring in actual sensor accuracy to within 0.5°C.

These opto- couplers have their own local power supply. When the I/O bus expander is selected, it also looks for information in the second byte on which output to toggle. Both devices will send back an acknowledge to the PC104 computer when prompted. If a cable is disconnected, the computer will not receive this acknowledge signal and call a fault.

Data is bi-directional to the sensor hence, two opto-couplers one to transmit to the sensor, and the other to receive from the sensor. Both the bus expander and temperature sensor respond to an address, which is selected by the computer. If system shutdown is active the compressor relay is disabled to prevent overheating, in the case of communication failure.

On the board also there are 6 output ports which drive the compressor solid state relay (SSR), cool/heat solenoids, and fan. These outputs control the output loads by way of opto-coupled Mosfet drivers. AC voltage is applied to these Mosfet drivers, via the main harness from the autotransformer. The output voltage, is nominal at 220 volts. Each one of these drivers can switch AC power to its respectable loads.

Theory of Operation: Temp Sensor

Overview:

The temp sensor utilizes a LM 76 digital sensor, voltage regulator, and local memory all encapsulated in a waterproof coating. Connection is established by using a 2mm ribbon cable.

The sensor utilizes a band gap type sensor and a 9 bit Delta-Sigma A/D converter and transmits data via the IIC bus. The sensor is available at all times to the bus, or acts like a slave device. SCL is an input only and the SDA is a bi-directional signal. The device has a seven bit slave address, then four most significant bits being hard wired as “1001”, and the three least significant being user selectable, or for the air sensor “000”: hence the address of “90”. Addressing a “90” to the device, causes an acknowledge signal, and binary information which is transposed in to a temperature reading on the front panel.

Memory on the sensor board can store an offset information from the temp sensor to trim the actual value of the data to the front panel. Offset calibration is necessary or the display will read zero. The I²C protocol requires minimum operating voltage to function correctly. The voltage regulator on board assures a 5 volts thus maximizing noise margin.

Evolution RC

Table of Contents

5.0 Troubleshooting

5.1	Error Messages
5.2	#001 System File Error
5.3	#002 Imbalance Fault
5.4	#003 Accelerometer Fault
5.5	#004 Close Door
5.6	#005 Door Not Locked
5.7	#006 Door Not Unlocked
5.8	#008 Rotor Overtemperature
5.9	#010 Rotor Undertemperature
5.10	#011 Ke I/O Error
5.11	#012 No Air Sensor
5.12	#013 Power Failure
5.13	#014 Power Resumed
5.14	#015 Failed To Make Speed
5.15	#016 Motor Too Hot
5.16	#017 Speed Limited Run
5.17	#018 Energy Exceeded
5.18	#019 No Tach Signal
5.19	#020 Speed Change Too Large
5.20	#021 Overspeed
5.21	#022 Speed Ceiling Exceeded
5.22	#023 Speed Climb In Decel

Evolution RC

Table of Contents

5.23	#024	Over Rotor Speed
5.24	#025	PFC SCI Fault
5.25	#026	PFC 400v Fault
5.26	#027	PFC B V Fault
5.27	#028	PFC 18v Fault
5.28	#029	PFC Overload
5.29	#030	PFC Overtemperature
5.30	#031	PFC I2C Fault
5.31	#032	DRVBOX Fault
5.32	#033	Auxtach Shutdown
5.33	#034	Auxtach I/O Error
5.34	#035	Tach Mismatch Error
5.35	#036	I2C Buss Locked
5.36	#037	Bad Rotor File
5.37	#038	Ke Cal Error
5.38	#039	Bad Run File
5.39	#040	Ke Gain Error
5.40	#041	Sensor Gain Error
5.41	#042	Sensor Offset Error
5.42	#043	Temp Gain Error
5.43	#044	Temp Offset Error
5.44	#045	Chamber Too Hot
5.45	#046	Chamber Too Cold
5.46	#047	Speed Drifting

Evolution RC

Table of Contents

5.47	#048	Drive Fault
5.48	#049	No Rotor
5.49	#050	PFC I/O Error
5.50	#051	Bad Ke Memory
5.51	#052	Bad Ke Checksum
5.52	#053	Ke Memory Not Programmed
5.53	#054	Bad Motor Temp Sensor

Evolution™ RC Faults

Error 001 **SYSTEM FILE ERROR**

No Hard Disk read/write, can't open file; memory full or run/fault log corrupted.

Minor fault/advisory: operation will continue; message can be cleared at any time.

Possible Causes:

- ∅ Memory full or run/fault log corrupted.
 - Delete run/fault logs.
- ∅ Damaged/corrupted Hard Disk.
 - Replace Hard Disk (73830)
- ∅ Poor connection between the PC-104 and the Hard Disk.
 - Check connections on ribbon cable and replace if needed.

Error 002 **IMBALANCE FAULT**

Imbalance signal from accelerometer is greater than threshold (5% over rotor max).

Major fault: run will terminate and rotor will brake to stop; fault can be cleared after stop.

Possible Causes:

- ∅ Unbalanced load in rotor.
 - Make sure that opposing compartment loads are balanced according to instructions in the Rotor Manual.
 - Make sure that tubes/bottles are orientated correctly and that they are properly loaded according to instructions in the Rotor Manual.
 - Make sure that the rotor cover (if any) is properly installed on the rotor, that the rotor is properly seated on the tapered drive spindle, and that the rotor holddown screw is tightened securely.
- ∅ Tapered drive spindle or gyro is damaged.
 - Check the condition of the tapered spindle and replace if necessary (73330).
 - Check that the tapered spindle is secured to the gyro shaft properly.
 - Check the gyro shaft for damage by removing the tapered spindle and inspecting the gyro shaft. Replace both the tapered spindle (73330) and the gyro assembly (73446) if the shaft is damaged.

Error 003 **ACCELEROMETER FAULT**

Accelerometer i/o error; invalid signal or accelerometer not responding.

Major fault: run will terminate and rotor will brake to stop; fault can be cleared after stop.

Possible Causes:

- ∅ Check the connection between the accelerometer (imbalance sensor) and the drive interface printed circuit board.
- ∅ Inspect the accelerometer (imbalance sensor) cable for damage (cuts or crushing).
 - Replace the accelerometer (imbalance sensor) assembly if necessary (73558).
- ∅ Component failure on accelerometer (imbalance sensor) assembly.
 - Replace the accelerometer (73558).

Error 004 **CLOSE DOOR**

Door open while running; START pressed with door open.

Major fault: run will terminate and rotor will brake to stop; fault can be cleared after stop.

Possible Causes:

- ∅ “START” was pressed with chamber door open. Close door, select the appropriate rotor, then press START.
- ∅ Improper signal received from the door sensor printed circuit board, check signals from the door hall effect sensors.
 - If the signals are missing, replace the door sensor printed circuit board (73362).
- ∅ Check to see if magnets are damaged or missing from the door and door latch arm.

Error 005 **DOOR NOT LOCKED**

Door not locked after lock command or door latch state change during run (as if mechanical override used)

Major fault: run will terminate and rotor will brake to stop; fault can be cleared after stop.

Possible Causes:

- ∅ Door latch arm is obstructed.
 - Remove obstruction, clear the fault and restart.
- ∅ Improper signal received from the door sensor printed circuit board, check signals from the door hall effect sensors.
 - If the signals are missing, replace the door sensor printed circuit board (73362).
- ∅ Check to see if magnets are damaged or missing from the door and door latch arm.
- ∅ Door latch has failed.
 - Replace door latch assembly (73452)

Error 006 **DOOR NOT UNLOCKED**

Door sensor indicates door still locked after unlock command (no state change).

Minor fault/advisory: operation will continue; message can be cleared at any time.

Possible Causes:

- ∅ Door latch arm is obstructed and is unable to move. Make sure that the door is not pressing against the door latch arm.
 - Close the door fully, clear the fault, and open the door.
- ∅ Door latch solenoid has failed.
 - Replace the door latch assembly (73452).
- ∅ Make sure that the door latch solenoid shaft is not bent.
 - If the shaft is bent, replace the door latch assembly (73452)
- ∅ Incorrect signals are received from the door sensor printed circuit board.
 - Replace the door sensor printed circuit board (73362).

Error 008 **ROTOR OVER TEMP**

Estimated sample temperature was more than 10°C over SET for 10 minutes.

Major fault: run will terminate and rotor will brake to stop; fault can be cleared after stop.

Possible Causes:

- Ø Centrifuge refrigeration failure.
 - Check refrigeration system for the correct charge. If leak is discovered, repair the leak and re-charge the refrigeration system.
- Ø Compressor not running.
 - Check for the proper voltage at the compressor terminals. If voltage is present, replace the condensing assembly (73326)
- Ø Compressor relay has failed.
 - If the voltage is not present at the compressor, check the compressor relay and replace if necessary (68794)
- Ø Hot gas solenoid has failed.
 - Check for proper electrical operation of the hot gas solenoid. Replace the hot gas solenoid if defective (92774).
- Ø Refrigeration interface printed circuit board has failed.
 - If the refrigeration relay is not receiving the signal to turn on, replace the refrigeration interface printed circuit board (73334).
- Ø Temperature sensor has failed.
 - Replace the temperature sensor (73360)

Error 010 **ROTOR UNDER TEMP**

Estimated sample temperature was more than 10°C under SET for 10 minutes.

Major fault: run will terminate and rotor will brake to stop; fault can be cleared after stop.

Possible Causes:

- Ø Cool solenoid has failed causing the loss of temperature control.
 - Replace the expansion valve assembly (73458).
- Ø Refrigeration interface printed circuit board has failed.
 - Replace the refrigeration interface printed circuit board (73334).
- Ø Temperature sensor has failed.
 - Replace the temperature sensor (73360)

Error 011 **KE I/O ERROR**

Ke board i/o error; board not responding.

Major fault: run will terminate and rotor will brake to stop; fault can be cleared after stop.

Possible Causes:

- Ø Ke printed circuit board has failed.
 - Replace the Ke printed circuit board (73333).

Error 012 **NO AIR SENSOR**

Air sensor i/o error; invalid signal or sensor not responding.

Major fault: run will terminate and rotor will brake to stop; fault can be cleared after stop.

Possible Causes:

- ∅ Poor or no connection between the temperature sensor and the refrigeration interface printed circuit board.
 - Check connector and make sure that it is plugged in properly.
- ∅ Temperature sensor ribbon cable is cut or pinched.
 - Replace the temperature sensor (73360).
- ∅ Component failure on the temperature sensor assembly.
 - Replace the temperature sensor (73360).
- ∅ Refrigeration interface printed circuit board has failed.
 - Replace the refrigeration interface printed circuit board (73334).

Error 013 **POWER FAILURE**

A power outage occurred during the last run, speed was below 1000 rpm when power was restored; run brakes to stop.

Minor fault/advisory: operation will continue; message can be cleared at any time.

Possible Causes:

- ∅ Loss of power to the centrifuge during the run and the power was restored while the rotor was spinning less than 1000 rpm. Current run was terminated.
 - Clear the fault and the run can be re-started.

Error 014 **POWER RESUMED**

A power outage occurred during the last run, but speed was still above 1000 rpm when power was restored; run resumed.

Minor fault/advisory: operation will continue; message can be cleared at any time.

Possible Causes:

- ∅ Loss of power to the centrifuge during the run and the power was restored while the rotor was spinning greater than 1000 rpm. Current run was resumed.

Error 015 **FAILED TO MAKE SPEED**

Centrifuge unable to reach SET speed in ten minutes.

Minor fault/advisory: operation will continue; message can be cleared at any time.

Possible Causes:

- ∅ Installed rotor does not match SET rotor; SET speed was calculated to be lower than the centrifuge energy limit, but higher than rotor windage will allow.
 - Make sure the rotor specified on the control panel matches the installed rotor.
- ∅ Motor damaged.
 - Check the motor back EMF, if different from the value marked on the motor tag replace the motor (73448)
- ∅ Drive control error.
 - If the measured motor K_e agrees with the tag on the motor, replace the drive control module (72913).
- ∅ PFC error.
 - Check the PFC voltage (~~400 Vdc~~ ^{405 vdc}). If not ~~400 Vdc~~ ⁴⁰⁵ +/- ~~15 Vdc~~ ^{+/- 5 vdc} replace the PFC (72886).

Error 016 **MOTOR TOO HOT**

Motor back emf voltage indicates that the motor temperature is greater than 150°C.

Major fault: run will terminate and rotor will brake to stop; fault can be cleared after stop.

Possible Causes:

- ∅ If multiple runs have been performed while using a large rotor with short rest periods, allow the motor to cool then restart run. Allowing more time between runs can prevent recurrence.
- ∅ Motor cooling fan has stopped operating.
 - Check fan supply voltage. If fan voltage is present and fan is not operating, replace the motor cooling fan (92921)
 - If fan supply voltage is not present, check the centrifuge wiring.
- ∅ Motor is defective.
 - Replace drive motor (73448)
- ∅ Gyro failure.
 - Failure of gyro bearings could cause motor to draw excess current, replace Gyro assembly (73446).

Error 017 **SPEED LIMITED RUN**

During acceleration, the Energy Management System was unable to determine the energy of the rotor in the chamber. Torque delivered by the motor is cut back to a level equivalent to that of an RC-5C Plus. Acceleration will be slowed and it will take longer to get to set speed; the achievable rotor top speed may be limited by windage created in the centrifuge chamber. Situation poses no hazard to the user.

Minor fault/advisory: operation will continue; message can be cleared at any time.

Possible Causes:

- ∅ Observed performance of the installed rotor is out of range for the rotor that is programmed.
 - Make sure the rotor specified on the control panel matches the installed rotor, and that the installed rotor loads are according to the instructions in the rotor manual.
- ∅ Ke is programmed incorrectly.
 - Make sure that the Programmed in the centrifuge is the same as the motor Ke. (Motor Ke can be found on a tag on the motor wires near the connector at the drive control module)
- ∅ System Ke is not measured correctly by the Ke printed circuit board.
 - Replace the Ke printed circuit board (73333).

Error 018 **ENERGY EXCEEDED**

During acceleration, the Energy Management System determined that, at SET speed, the energy of the installed rotor would exceed the centrifuge maximum.

Major fault: run will terminate and rotor will brake to stop; fault can be cleared after stop.

Possible Causes:

- ∅ Rotor that is programmed is not the rotor that is spinning in the centrifuge. The calculated energy that would develop at the set speed could cause a rotor failure that the centrifuge might not contain.
 - Make sure the rotor specified on the control panel matches the installed rotor, and that the installed rotor loads are according to the instructions in the rotor manual.
- ∅ Motor is overheated.
 - Refer to Error 016, MOTOR TOO HOT.
- ∅ Ke is programmed incorrectly.
 - Make sure that the Programmed in the centrifuge is the same as the motor Ke. (Motor Ke can be found on a tag on the motor wires near the connector at the drive control module).
- ∅ System Ke is not measured correctly by the Ke printed circuit board.
 - Replace the Ke printed circuit board (73333).

Error 019 **NO TACH SIGNAL**

No tach signal for more than 5 seconds after START.

Serious malfunction: run will terminate and rotor will coast to stop; cannot be cleared –cycle power OFF/ON, if fault recurs, contact Kendro Service.

Possible Causes:

- Ø Poor connection to motor.
 - Check motor wires at the drive interface printed circuit board.
- Ø Defective motor.
 - Replace motor (73448)

Error 020 **SPEED CHANGE TOO LARGE**

Rotor speed change improbable or loss/faulty tach signal during run.

Serious malfunction: run will terminate and rotor will coast to stop; cannot be cleared –cycle power OFF/ON, if fault recurs, contact Kendro Service.

Possible Causes:

- Ø Centrifuge started without a rotor on the gyro shaft.
 - Install correct rotor.
- Ø Motor coupling has broken.
 - Replace the motor coupling (73450)

Error 021 **OVER SPEED**

Rotor speed was greater than 500 rpm over SET.

Major fault: run will terminate and rotor will coast to stop; fault can be cleared after stop.

Possible Causes:

- Ø Defective drive control module.
 - Check drive PWM at the drive interface printed circuit board. If pulses are present or if the signal is low, replace the drive control module (72913).
- Ø Defective drive interface printed circuit board.
 - Check drive PWM at the drive interface printed circuit board. If the signal is high, replace the drive interface printed circuit board (73332).

Error 022 **SPEED CEILING EXCEEDED**

Rotor speed was greater than 26 500 rpm

Major fault: run will terminate and rotor will coast to stop; fault can be cleared after stop.

Possible Causes:

- Ø Defective drive control module.
 - Check drive PWM at the drive interface printed circuit board. If pulses are present or if the signal is low, replace the drive control module (72913).
- Ø Defective drive interface printed circuit board.
 - Check drive PWM at the drive interface printed circuit board. If the signal is high, replace the drive interface printed circuit board (73332).

Error 023 **SPEED CLIMB IN DECEL**

Rotor speed increased by more than 10 rpm after 10 seconds of deceleration.

Major fault: run will terminate and rotor will coast to stop; fault can be cleared after stop.

Possible Causes:

- ∅ Defective drive control module.
 - Check Direction signal at TP-7 on the drive interface printed circuit board. If signal is low, the drive control module should be driving reverse. Replace the drive control module (72913).
- ∅ Defective drive interface printed circuit board.
 - Check Direction signal at TP-7 on the drive interface printed circuit board. If signal is high, the drive control module is being told to drive forward. Replace the drive interface printed circuit board (73332).

Error 024 **OVER ROTOR SPEED**

Rotor speed was more than 500 rpm over the rotor maximum.

Major fault: run will terminate and rotor will coast to stop; fault can be cleared after stop.

Possible Causes:

- ∅ Defective drive control module.
 - Check drive PWM at the drive interface printed circuit board. If pulses are present or if the signal is low, replace the drive control module (72913).
- ∅ Defective drive interface printed circuit board.
 - Check drive PWM at the drive interface printed circuit board. If the signal is high, replace the drive interface printed circuit board (73332).

Error 025 **PFC SCI FLT**

PFC fault 1; loss of pfc internal communications.

Minor fault/advisory: operation will continue; message can be cleared at any time.

Possible Causes:

- ∅ Internal fault in the PFC box, replace PFC box (72886).

Error 026 **PFC 400 V FLT**

PFC fault 2; less than 385 V, current overload, bus energy storage cap (drivebox damage)

Minor fault/advisory: operation will continue; message can be cleared at any time.

Possible Causes:

- ∅ Bad PFC Capacitor.
 - Check connections to the PFC capacitor located behind the drive control module assembly; repair poor connections.
 - Check PFC capacitor. If defective, replace the capacitor (72850).
- ∅ Defective drive control module.
 - Replace drive control module (72913).

Error 027 **PFC B V FLT**

PFC fault 3; low supply voltage (less than 175 Vac).

Minor fault/advisory: operation will continue; message can be cleared at any time.

Possible Causes:

- Ø Incoming line voltage too low.
 - Check supply voltage. Make sure that the incoming loaded line voltage is within centrifuge requirements (187–253 Vac).

Error 028 **PFC 18 V FLT**

PFC fault 4; internal 18 V supply out of range (replace pfc).

Minor fault/advisory: operation will continue; message can be cleared at any time.

Possible Causes:

- Ø Defective PFC box.
 - Replace PFC Box (72886).

Error 029 **PFC OVERLOAD**

PFC fault 5; pfc input line current too high (12A or greater) over time. Depending on overcurrent severity, fault trip point varies as follows:

- From 12 to 15 amps, faults in 60 minutes;
- From 15 to 17 amps, faults in 12 minutes;
- From 17 to 20 amps, faults in 5 minutes;
- Over 20 amps, faults immediately.

Minor fault/advisory: operation will continue; message can be cleared at any time.

Possible Causes:

- Ø Defective PFC box.
 - Replace PFC Box (72886)

Error 030 **PFC OVERTEMP**

PFC fault 6; temp too high (cooling fan failure)

Minor fault/advisory: operation will continue; message can be cleared at any time.

Possible Causes:

- Ø Defective fan.
 - Check the voltage to the PFC fan. If the voltage is present replace the PFC fan (69380).
- Ø Defective PFC box.
 - If the cooling fan is operational replace the PFC box (72886).

Error 031 **PFC I2C FLT**

PFC fault 7; I²C i/o error

Minor fault/advisory: operation will continue; message can be cleared at any time.

Possible Causes:

- Ø Defective PFC box.
 - Replace the PFC box (72886).

Error 032 **DRVBOX FAULT**

Internal drive box error, drive box reported a fault.

Major fault: run will terminate and rotor will brake to stop; fault can be cleared after stop.

Possible Causes:

- ∅ Defective drive box.
 - Replace drive box (72913)

Error 033 **AUXTACH SHUTDOWN**

Auxiliary tachometer indicates 800 rpm or more over selected rotor's top speed.

Serious malfunction: run will terminate and rotor will coast to stop; PFC disabled, compressor disabled, control panel displays will go blank as if power removed (fault message will not be displayed, but will be recorded in fault log). Cannot be cleared –cycle power OFF/ON, if fault recurs, contact Kendro Service.

Possible Causes:

- ∅ Poor connection.
 - Check the auxtach connection at the drive interface printed circuit board. Repair connection if needed.
- ∅ Defective motor.
 - Using a DVM measure the auxtach frequency at TP-13 on the drive interface printed circuit board. If the auxtach speed does not agree with the actual rotor speed, replace the motor (73448).
- ∅ Defective drive interface printed circuit board.
 - If the auxtach frequency at TP-13 on the drive interface printed circuit board agrees with the rotor speed replace the drive interface printed circuit board (73332).

Error 034 **AUXTACH I/O ERROR**

Auxiliary tachometer i/o error; I²C communication error with auxtach PIC processor.

Minor fault/advisory: operation will continue; message can be cleared at any time.

Possible Causes:

- ∅ Defective drive interface printed circuit board.
 - Replace drive interface printed circuit board (73332).

Error 035 **TACH MISMATCH ERROR**

Main and auxiliary tachometers do not agree.

Serious malfunction: run will terminate and rotor will coast to stop; cannot be cleared –cycle power OFF/ON, if fault recurs, contact Kendro Service.

Possible Causes:

- ∅ Defective motor.
 - Using a DVM measure the auxtach frequency at TP-13 on the drive interface printed circuit board. If the auxtach speed does not agree with the actual rotor speed, replace the motor (73448).
- ∅ Defective drive interface printed circuit board.
 - If the auxtach frequency at TP-13 on the drive interface printed circuit board agrees with the rotor speed, replace the drive interface printed circuit board (73332).

Error 036 **IIC BUS LOCKED**

I²C bus has locked up; no information being transferred.

Serious malfunction: run will terminate and rotor will coast to stop; cannot be cleared –cycle power OFF/ON, if fault recurs, contact Kendro Service.

Possible Causes:

- ∅ Disconnect the control console from the buss and re-boot. If the system boots up, follow the procedure below. If the system still does not boot, connect a computer to the centrifuge to determine the cause of the problem.
- ∅ Determine cause of the buss lock up by disconnecting each component from the buss one at a time re-booting each time until the centrifuge boots up.

Error 037 **BAD ROTOR FILE**

Rotor file in software has been corrupted.

Serious malfunction: system will not run. Cannot be cleared –cycle power OFF/ON, if fault recurs, contact Kendro Service.

Possible Causes:

- ∅ File is corrupted; reload rotor file using the software update kit (73339)

Error 038 **KE CAL ERROR**

Ke programmed in the Evolution RC is outside of acceptable range.

Minor fault/advisory: operation will continue; message can be cleared at any time.

Possible Causes:

- ∅ Incorrect Ke has been entered.
 - Re-enter the Ke, using the value that is recorded on the motor wires.

Error 039 **BAD RUNFILE**

Instrument runfile has been corrupted.

Minor fault/advisory: operation will continue; message can be cleared at any time.

Possible Causes:

- ∅ Re-load instrument software using the software update kit (73339).

Error 040 **KE GAIN ERROR**

Ke gain has been programmed incorrectly and is out of range.

Minor fault/advisory: operation will continue; message can be cleared at any time.

Possible Causes:

- ∅ Incorrect Ke has been entered.
 - Re-enter the Ke, using the value that is recorded on the motor wires.

Error 041 **SENSOR GAIN ERROR**

Temperature sensor gain has been programmed incorrectly and is out of range.

Minor fault/advisory: operation will continue, but sample may be subjected to extreme temperature; message can be cleared at any time.

Possible Causes:

- ∅ Temperature sensor is defective.
 - Replace the temperature sensor (73360).

Error 042 **SENSOR OFFSET ERROR**

Temperature sensor offset has been programmed incorrectly and is out of range.

Minor fault/advisory: operation will continue, but sample may be subjected to extreme temperature; message can be cleared at any time.

Possible Causes:

- ∅ Temperature sensor is defective.
 - Replace the temperature sensor (73360).

Error 043 **TEMP GAIN ERROR**

Temperature (machine) gain has been programmed incorrectly and is out of range.

Minor fault/advisory: operation will continue, but sample may be subjected to extreme temperature; message can be cleared at any time.

Possible Causes:

- ∅ Machine gain is programmed incorrectly.
 - Re-enter the machine gain (nominally, “0.00”).

Error 044 **TEMP OFFSET ERROR**

Temperature (machine) offset has been programmed incorrectly and is out of range.

Minor fault/advisory: operation will continue, but sample may be subjected to extreme temperature; message can be cleared at any time.

Possible Causes:

- ∅ Machine offset is programmed incorrectly.
 - Re-enter the machine offset (nominally, “0.00”).

Error 045 **CHAMBER TOO HOT**

Chamber air temp was 50°C or higher for 1 minute.

Major fault: run will terminate and rotor will brake to stop; fault can be cleared after stop.

Possible Causes:

- ∅ Centrifuge refrigeration failure.
 - Check refrigeration system for the correct charge. If leak is discovered, repair the leak and re-charge the refrigeration system.
- ∅ Compressor not running.
 - Check for the proper voltage at the compressor terminals. If voltage is present replace the condensing assembly (73326).
- ∅ Compressor relay has failed.
 - If the voltage is not present at the compressor check the compressor relay and replace if necessary (68794)
- ∅ Hot gas solenoid has failed.
 - Check for proper electrical operation of the hot gas solenoid. Replace the hot gas solenoid if defective (92774).
- ∅ Refrigeration interface printed circuit board has failed.
 - If the refrigeration relay is not receiving the signal to turn on replace the refrigeration interface printed circuit board (73334).
- ∅ Temperature sensor has failed.
 - Replace the temperature sensor (73360).

Error 046 **CHAMBER TOO COLD**

Chamber air temp was –20 or lower for 1 minute.

Major fault: run will terminate and rotor will brake to stop; fault can be cleared after stop.

Possible Causes:

- ∅ Cool solenoid has failed causing the loss of temperature control.
 - Replace the expansion valve assembly (73458).
- ∅ Refrigeration interface printed circuit board has failed.
 - Replace the refrigeration interface printed circuit board (73334).
- ∅ Temperature sensor has failed.
 - Replace the temperature sensor (73360)

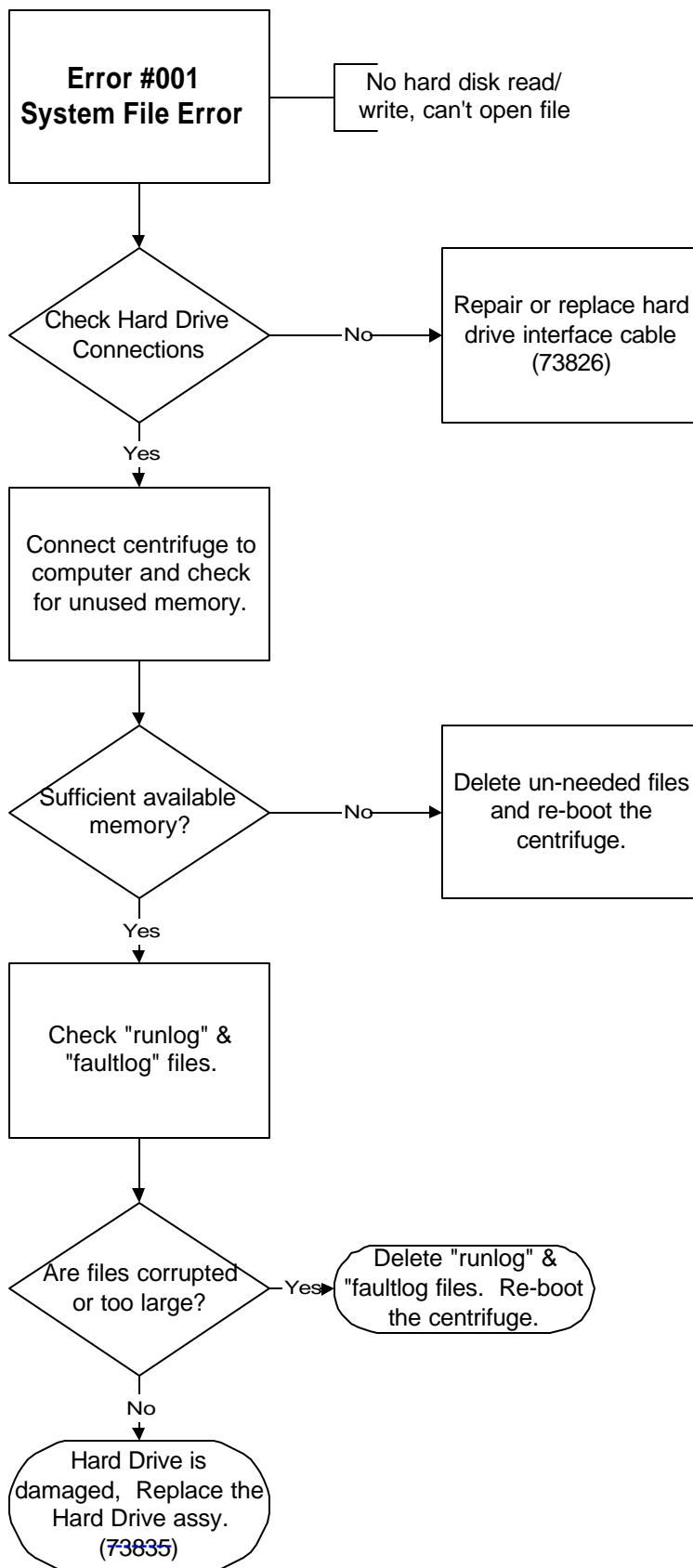
Error 047 **SPEED DRIFTING**

Instrument is not controlling properly and the rotor speed is drifting from set.

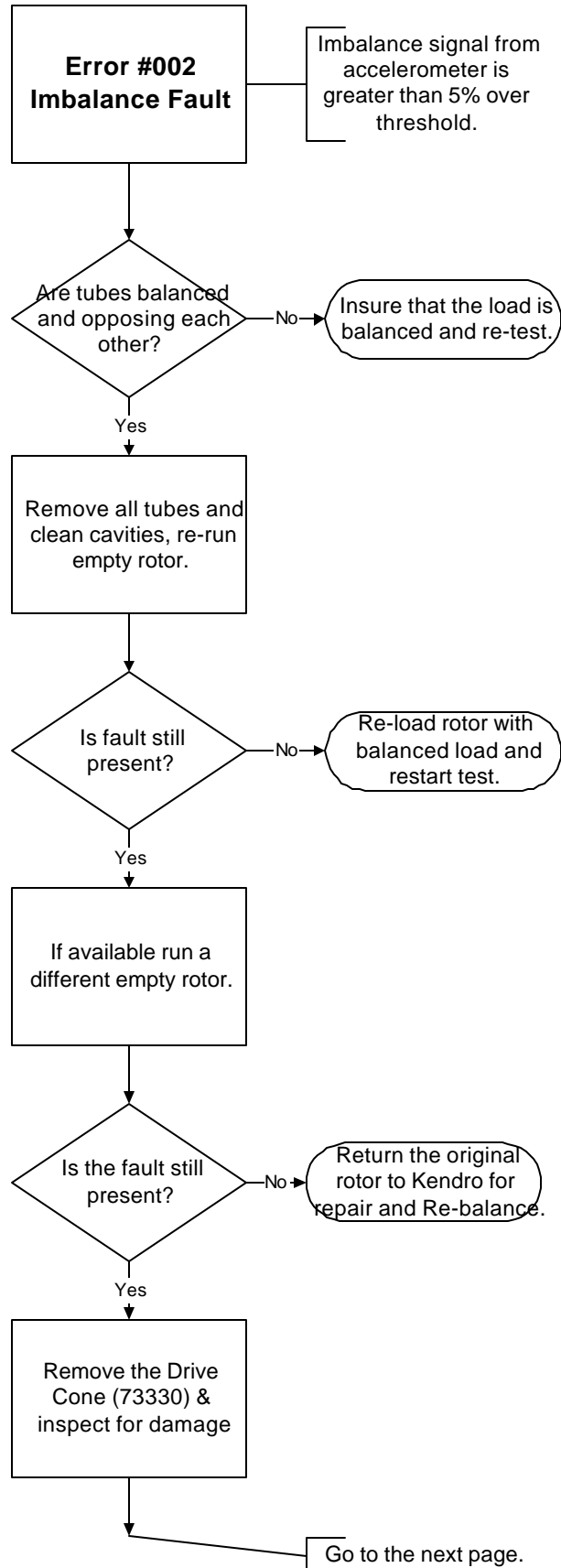
Minor fault/advisory: operation will continue; message can be cleared at any time.

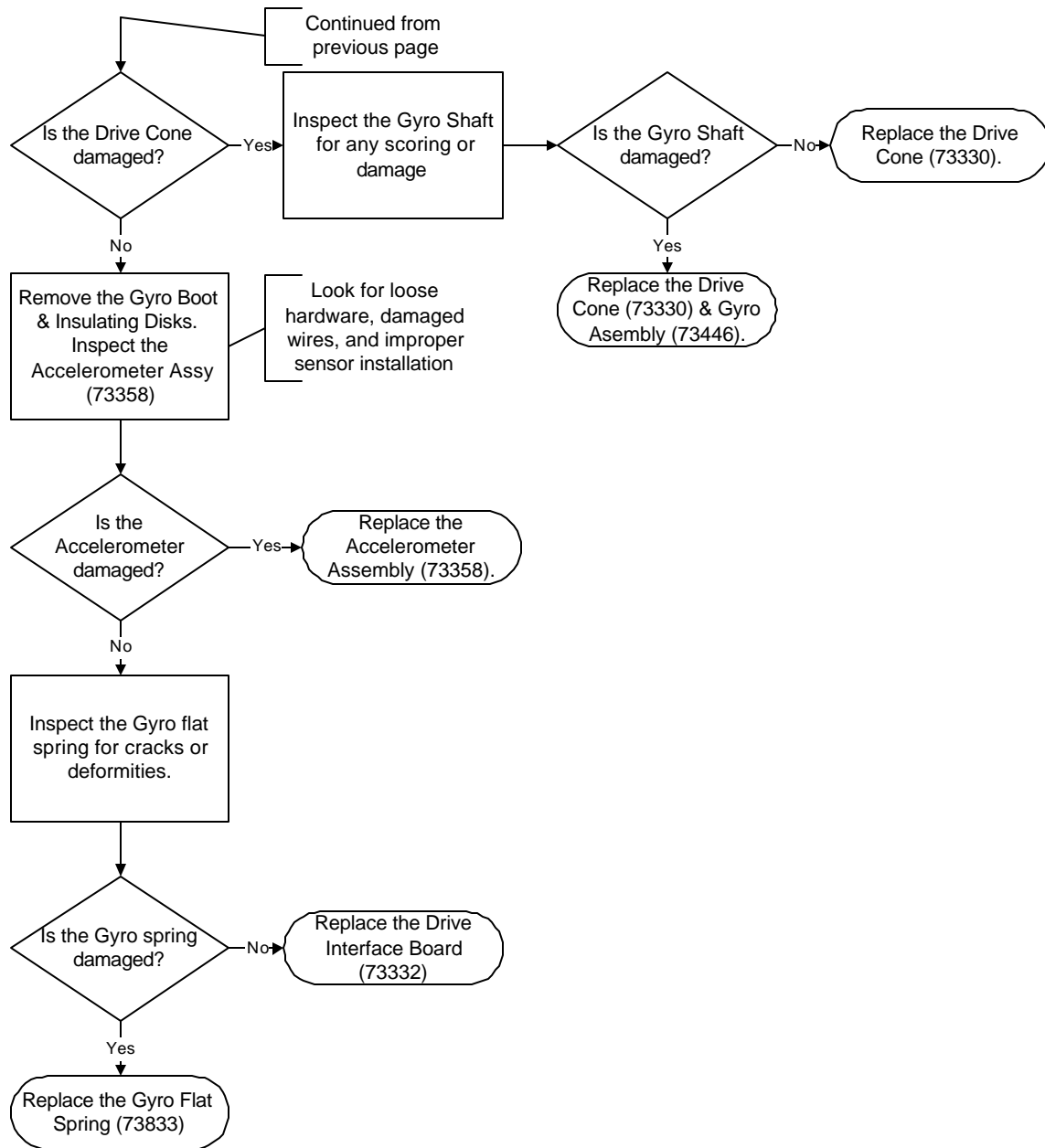
Possible Causes:

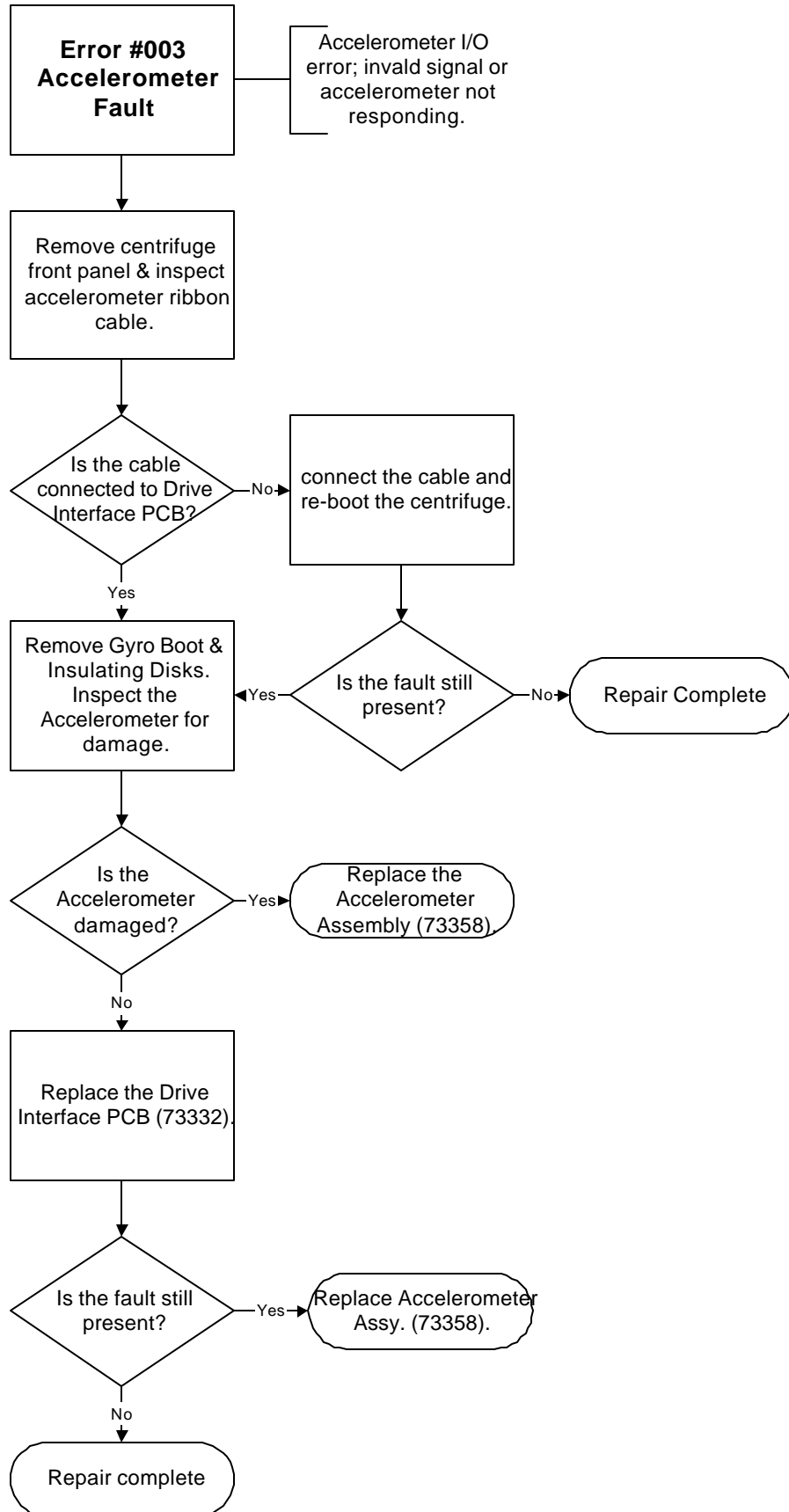
- ∅ Defective drive control module.
 - Check drive PWM at the drive interface printed circuit board. If pulses are present or if the signal is low, replace the drive control module (72913).
- ∅ Defective drive interface printed circuit board.
 - Check drive PWM at the drive interface printed circuit board. If the signal is high, replace the drive interface printed circuit board (73332).

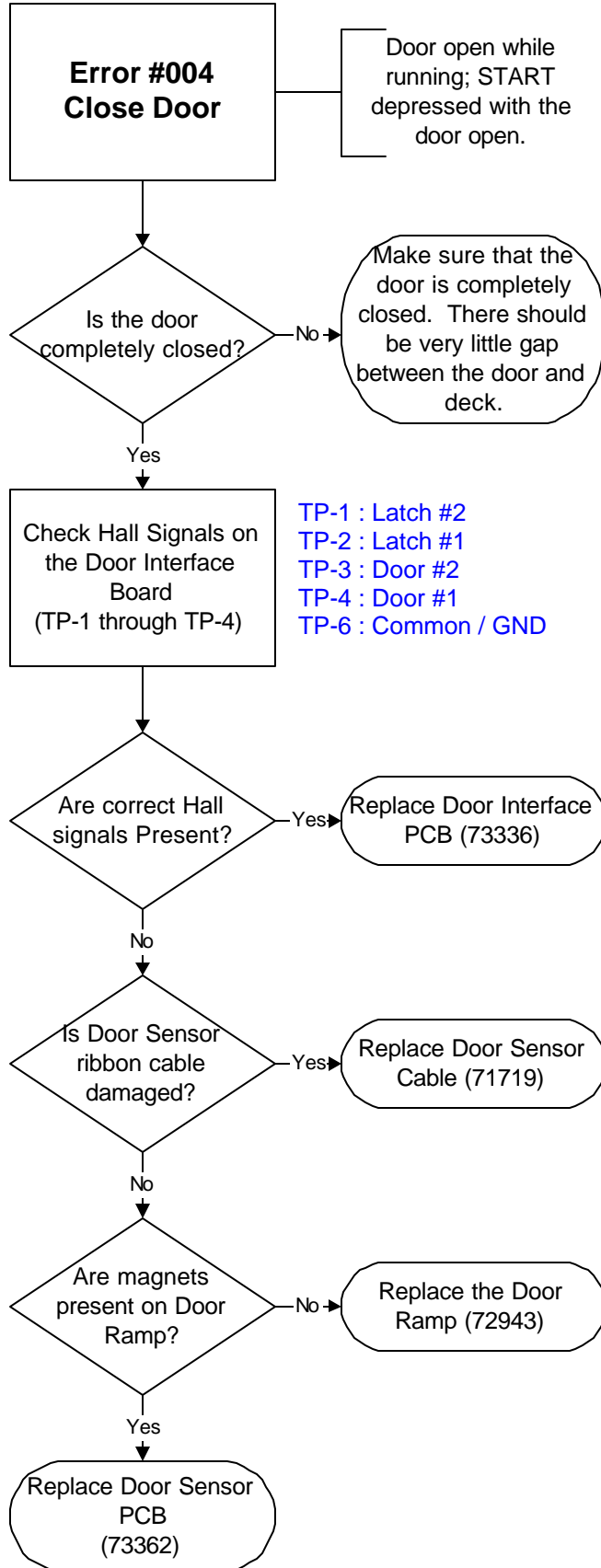


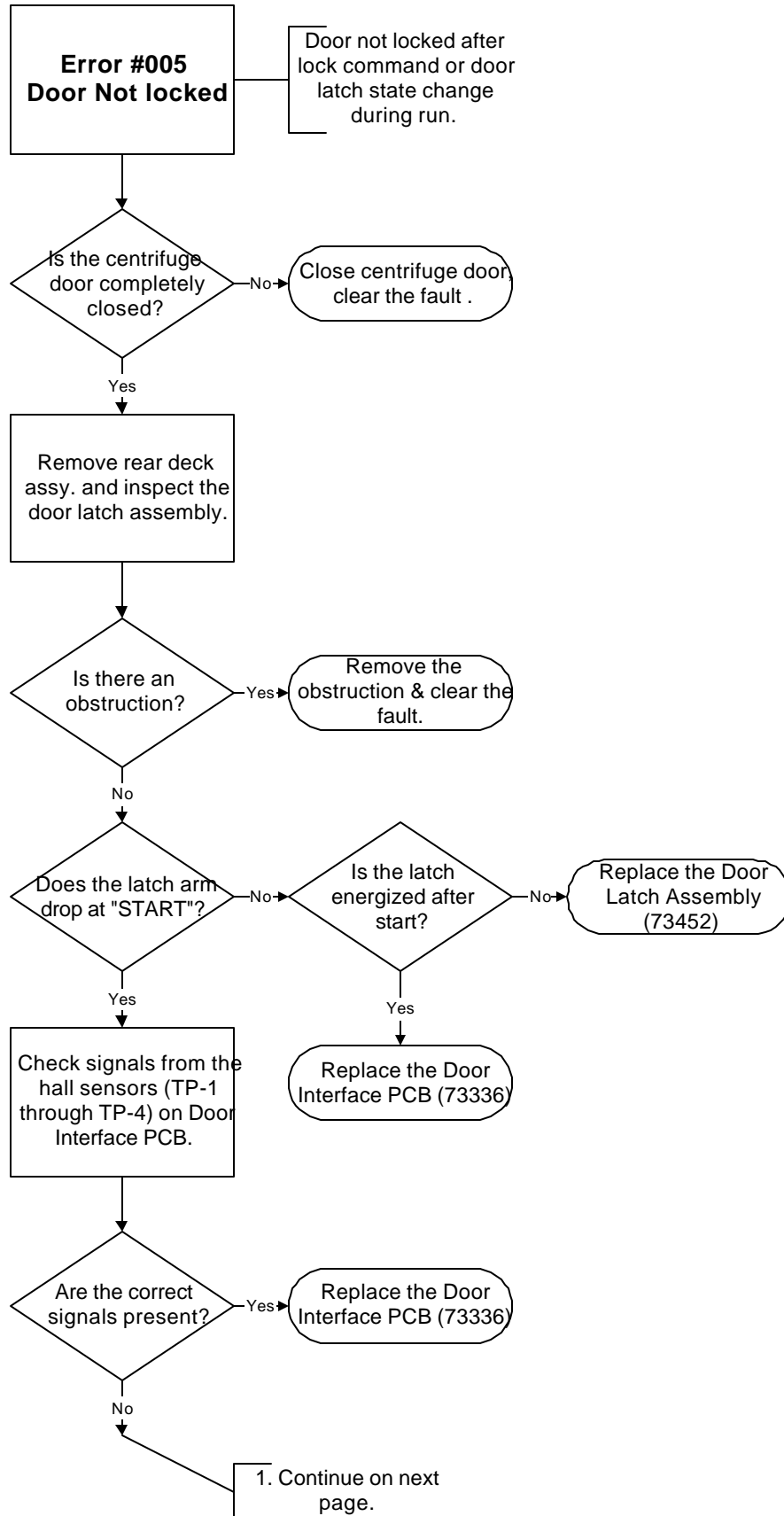
73340



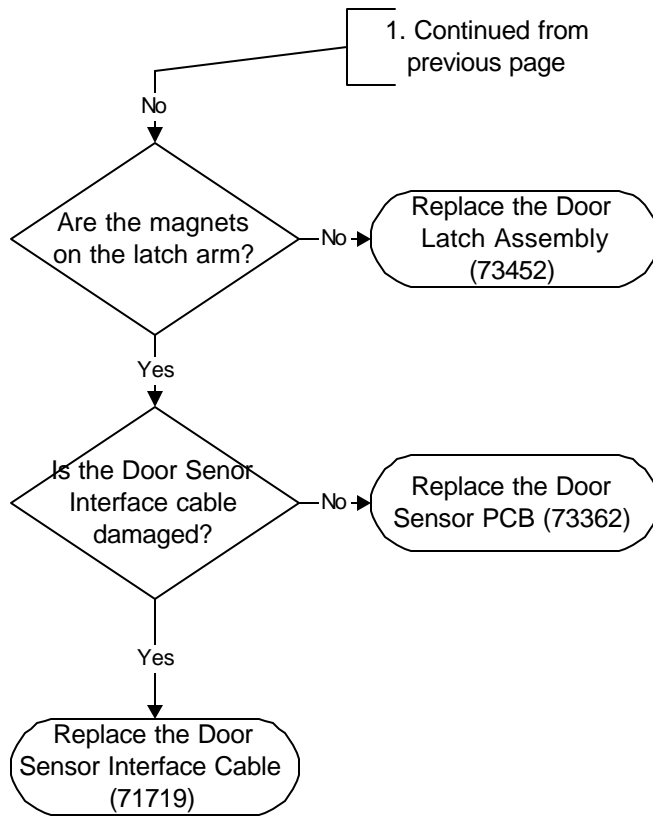


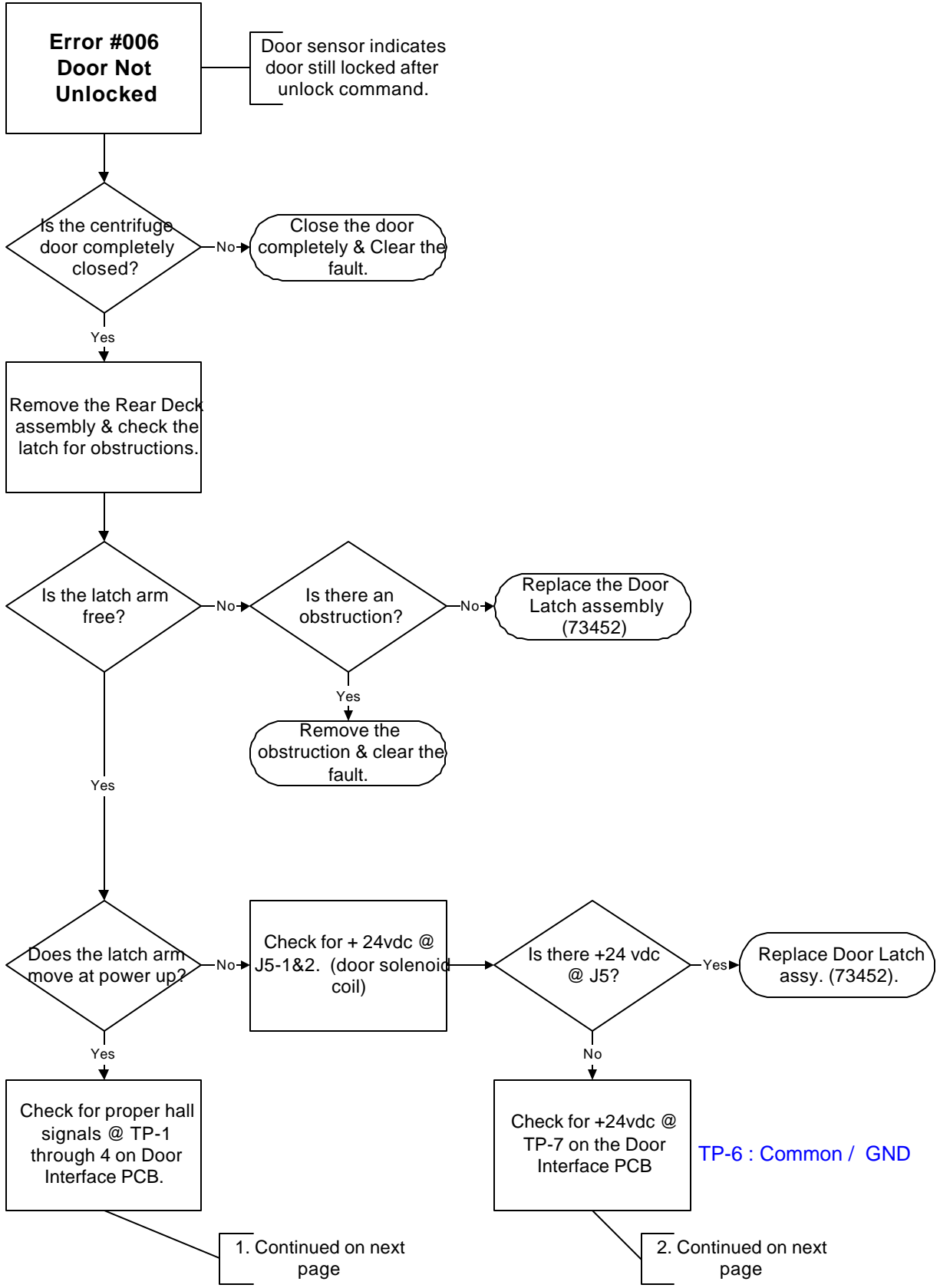


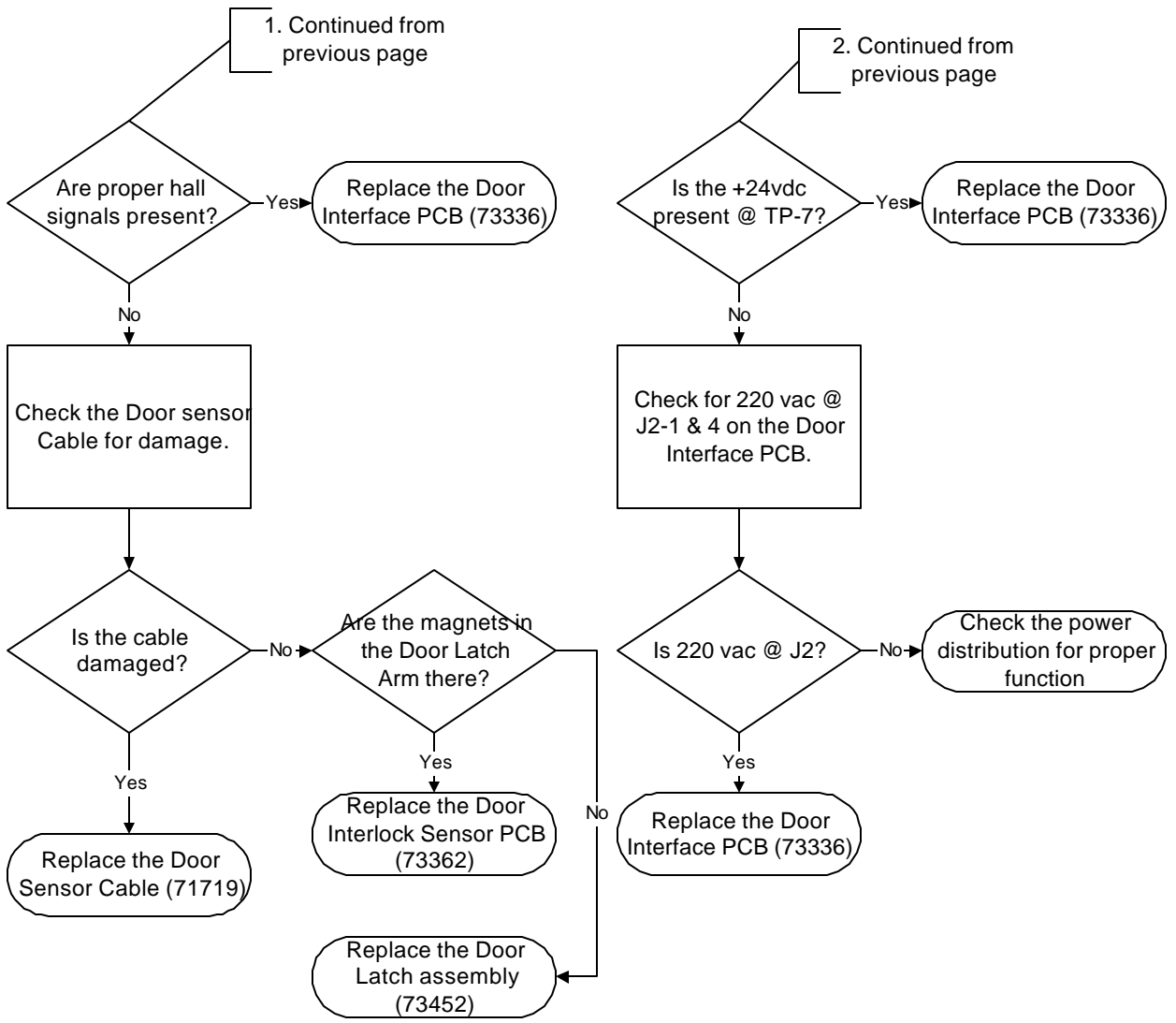


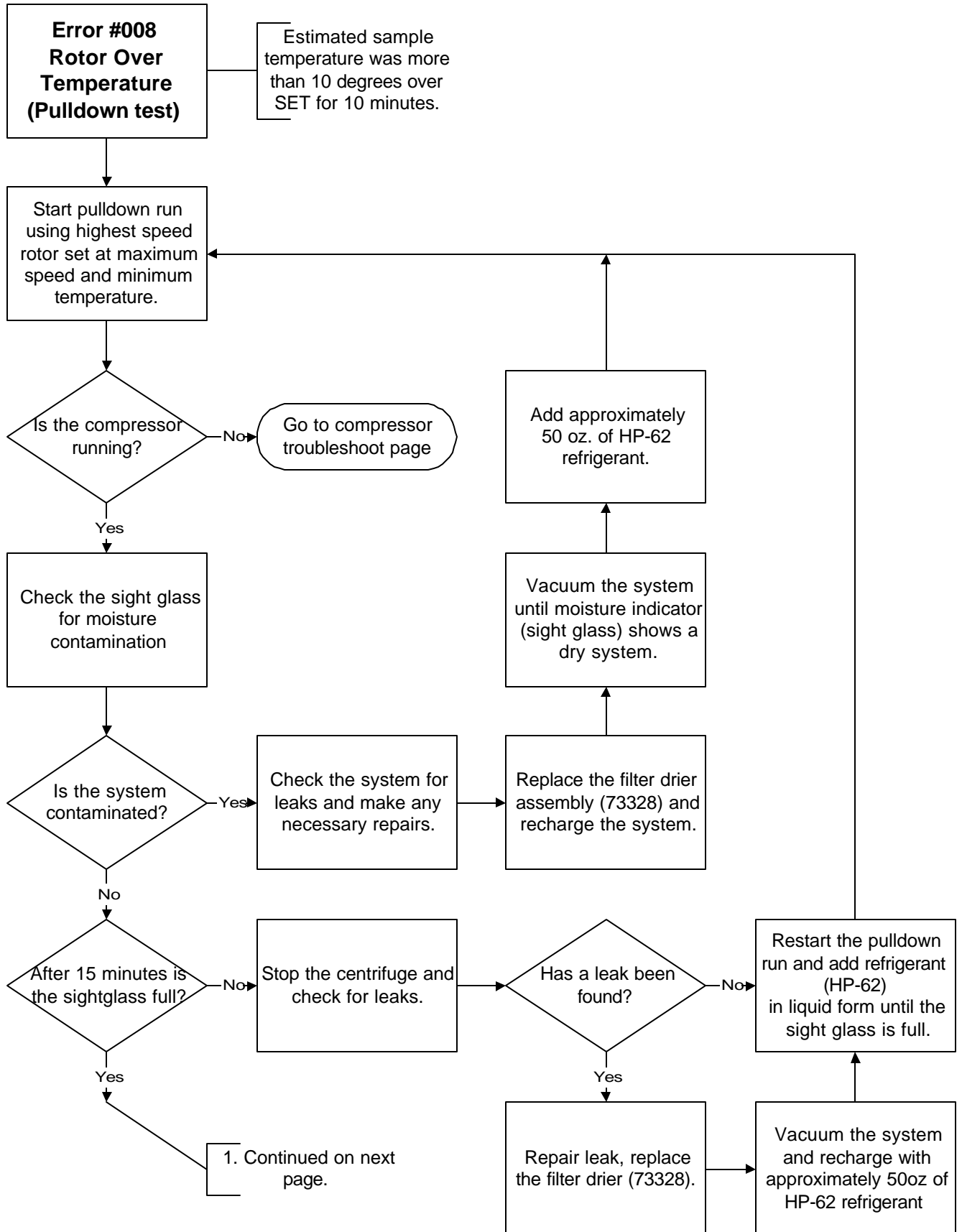


TP-1 : Latch #2
 TP-2 : Latch #1
 TP-3 : Door #2
 TP-4 : Door #1
 TP-6 : Common / GND

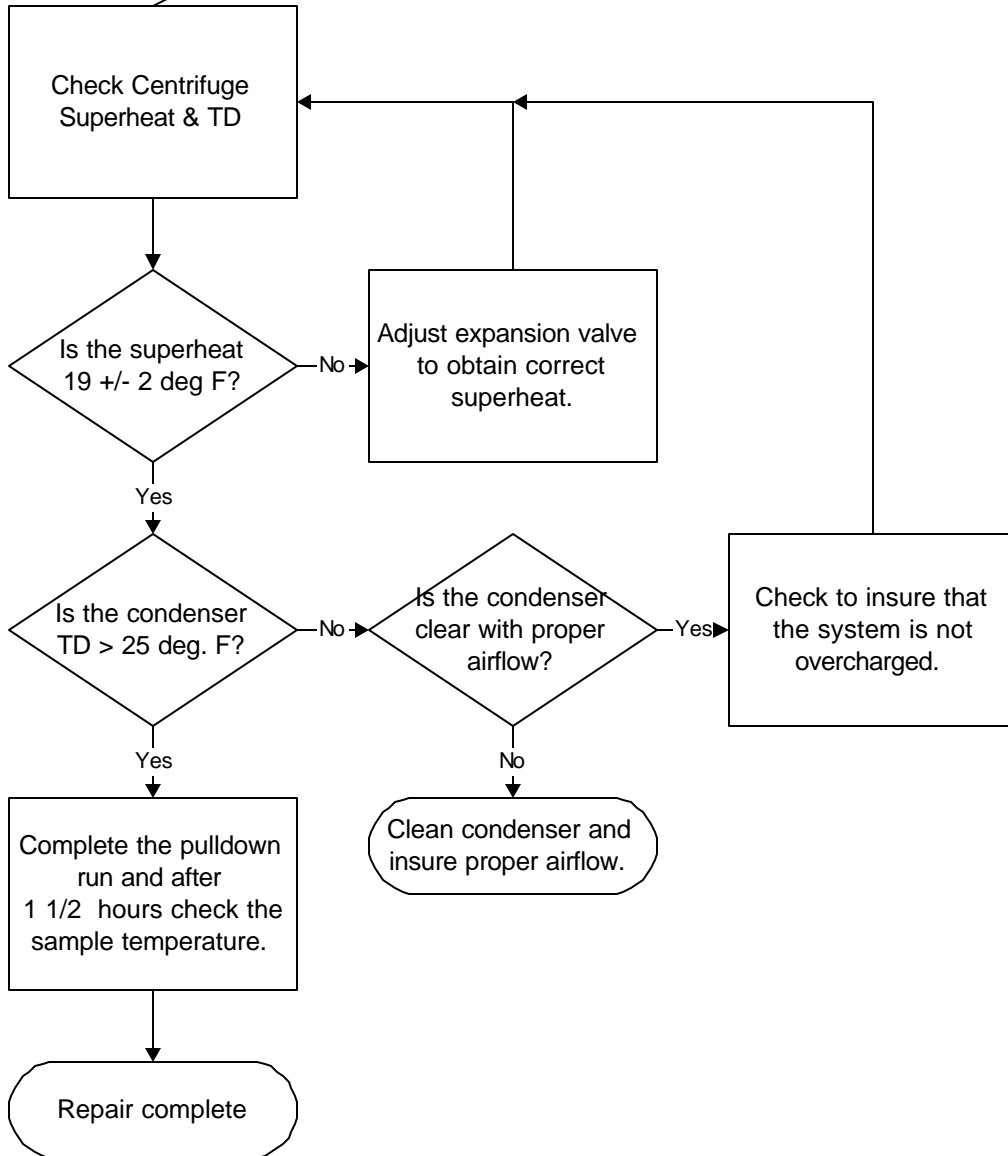


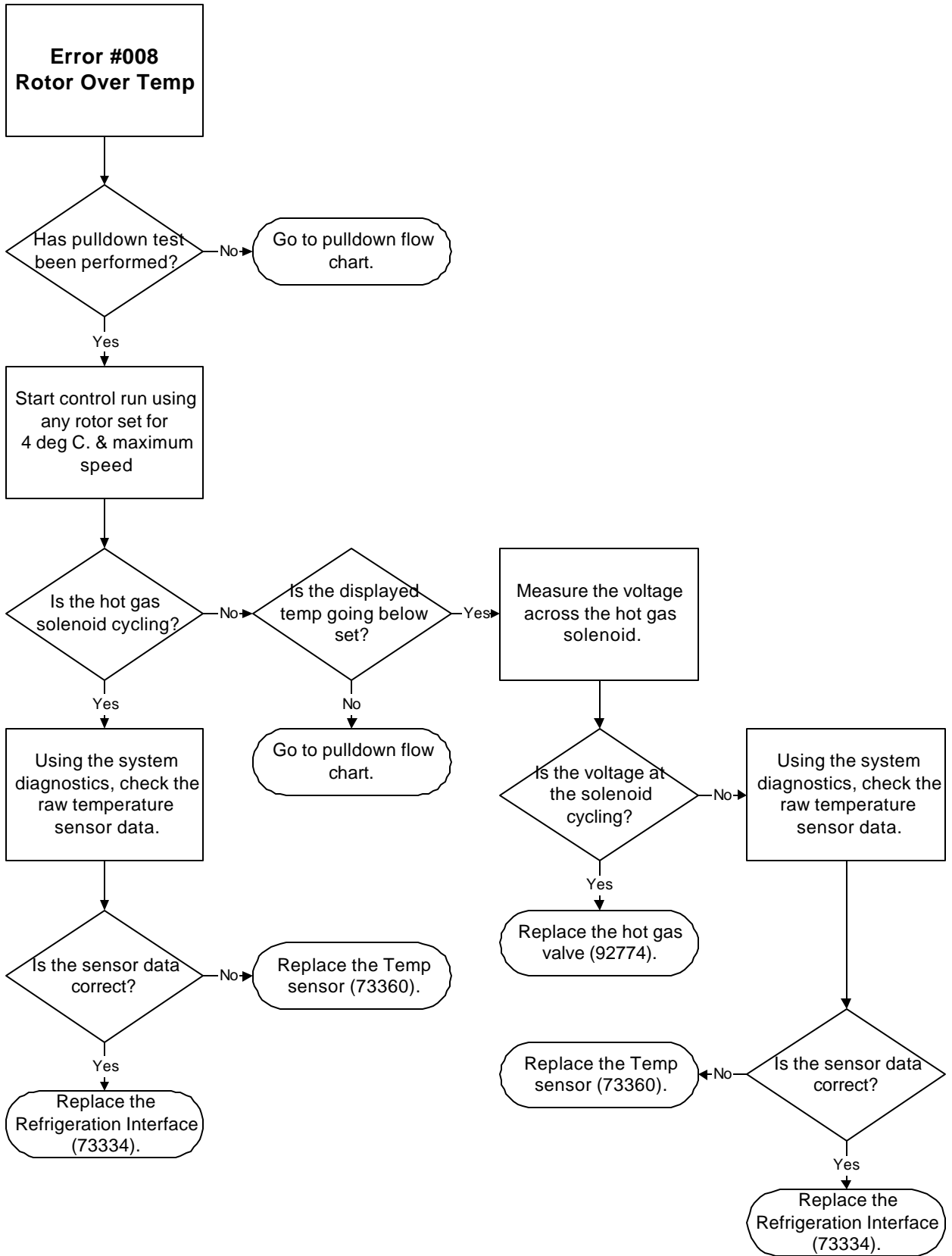


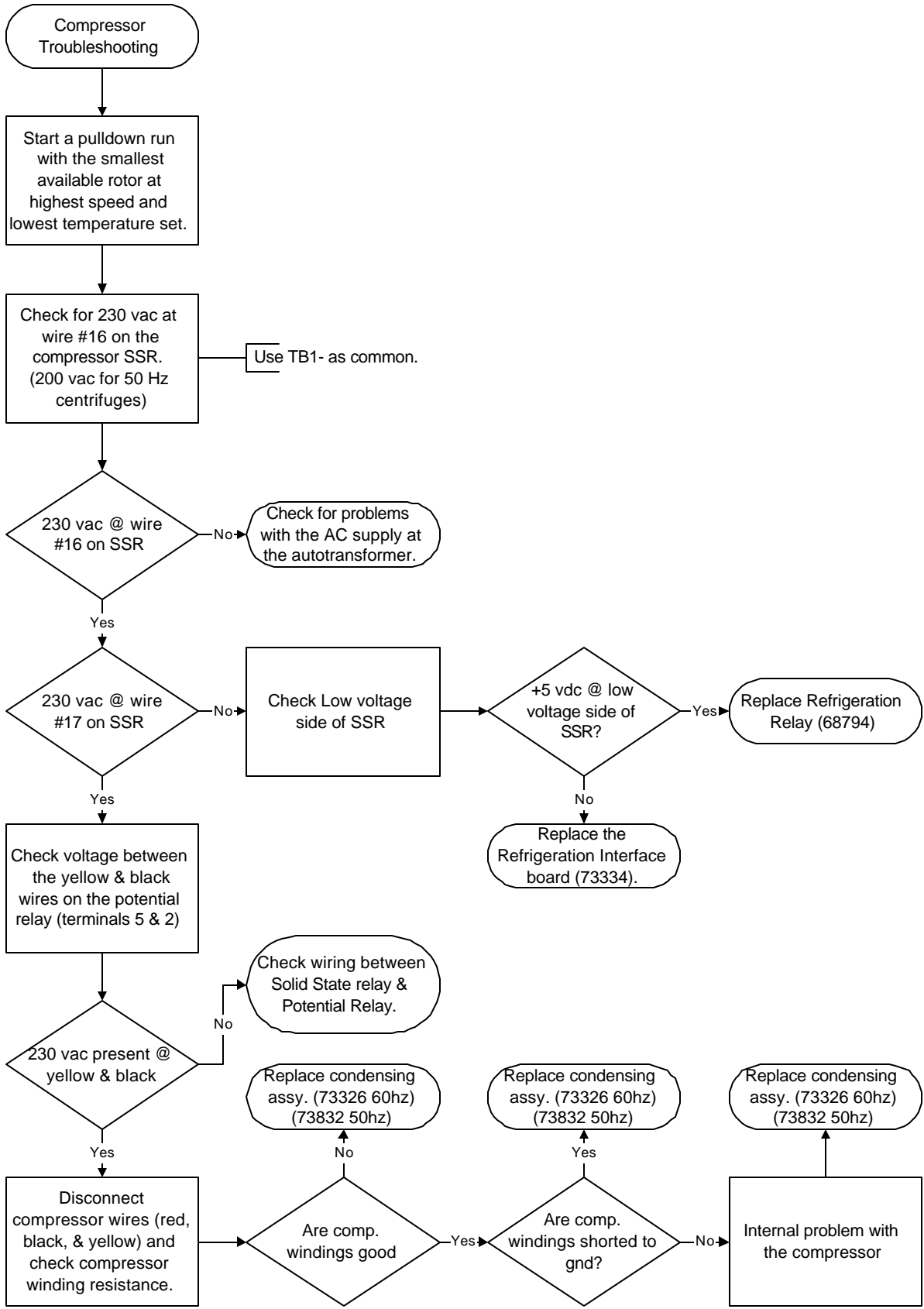


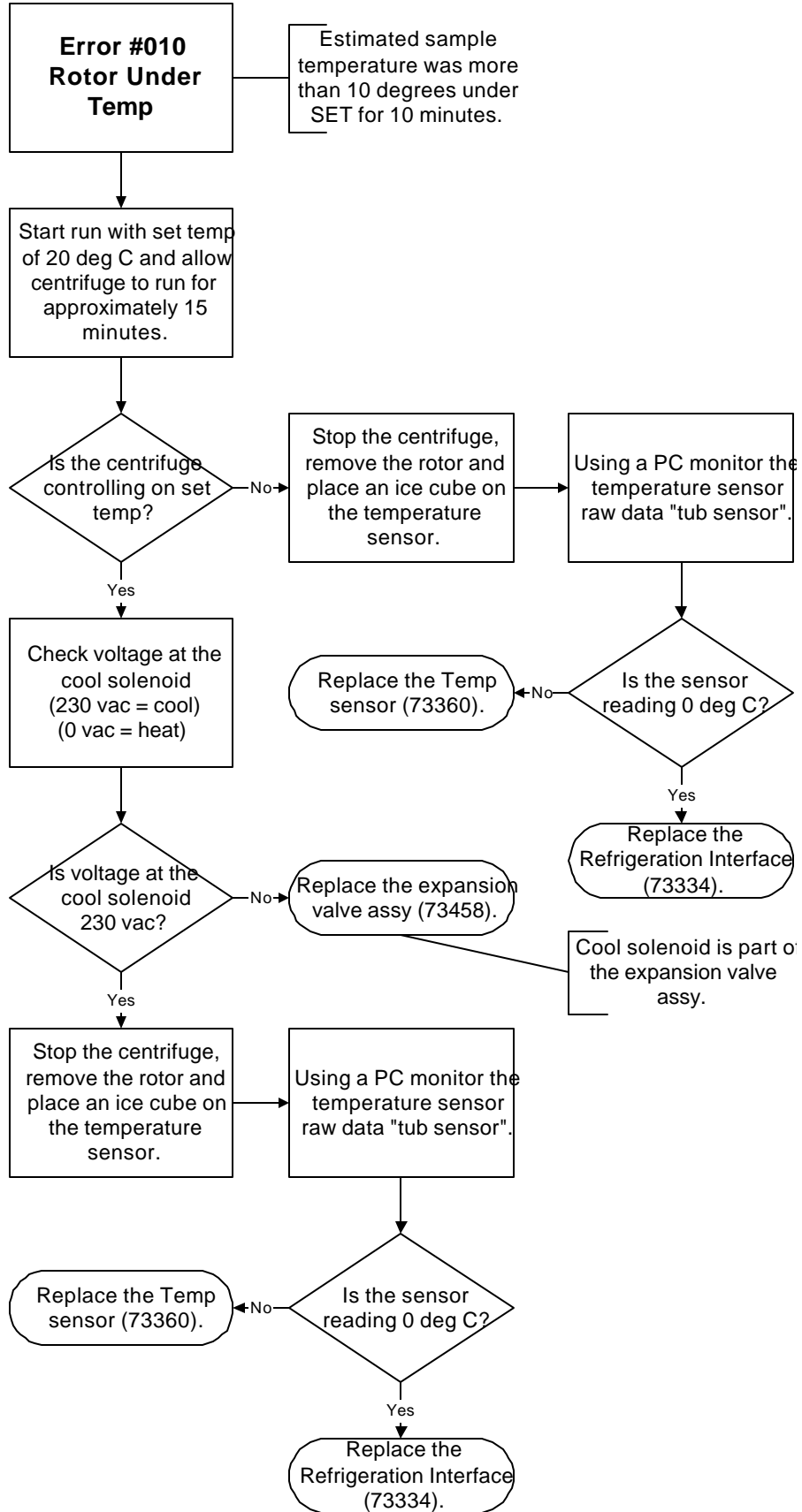


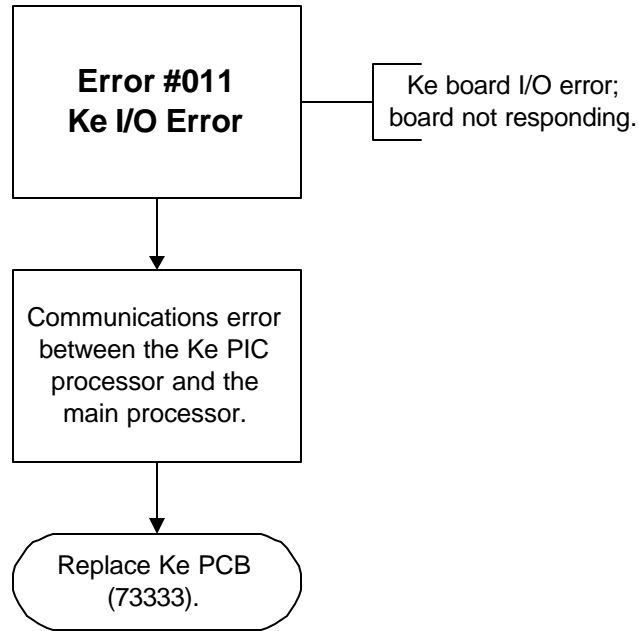
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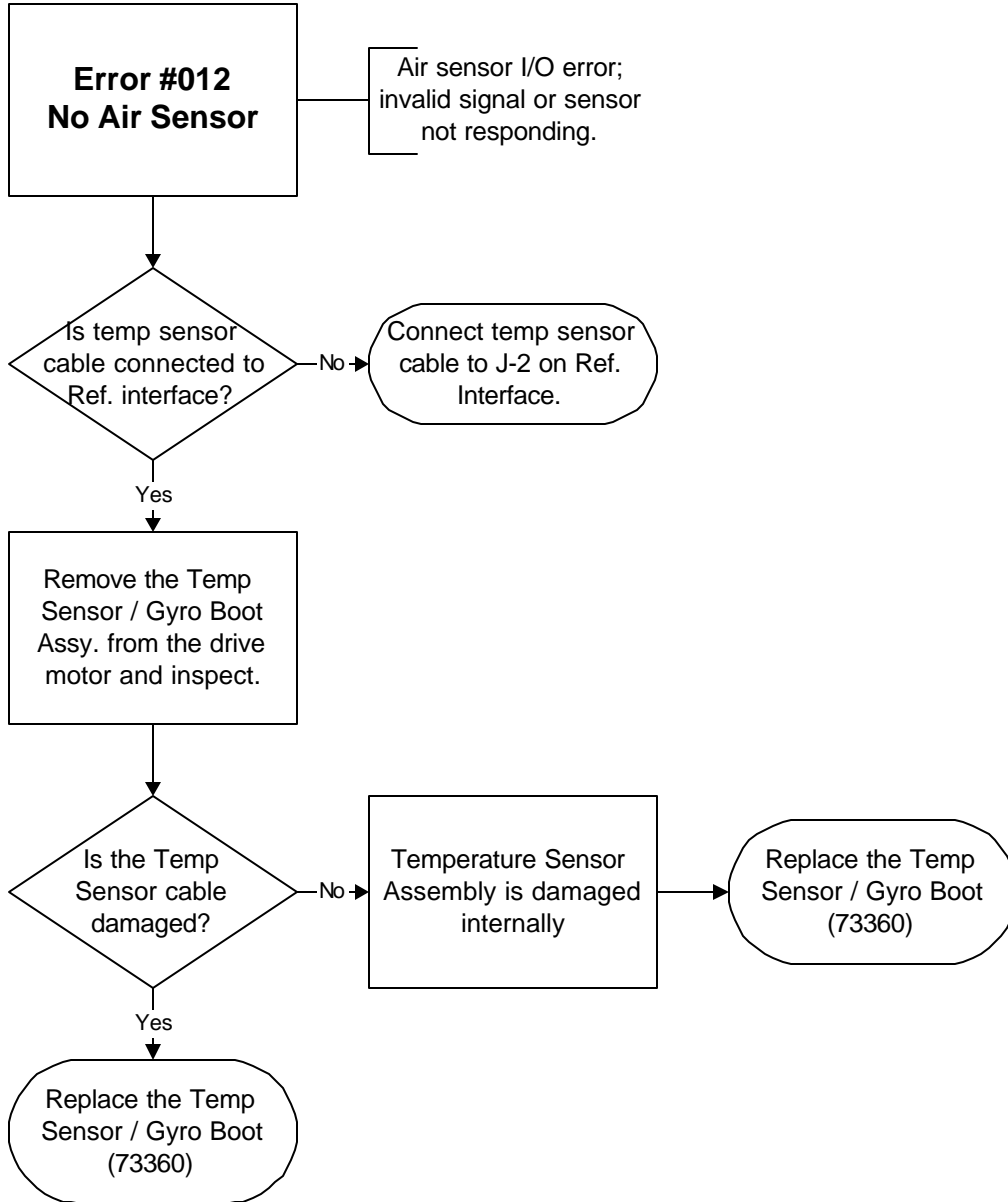


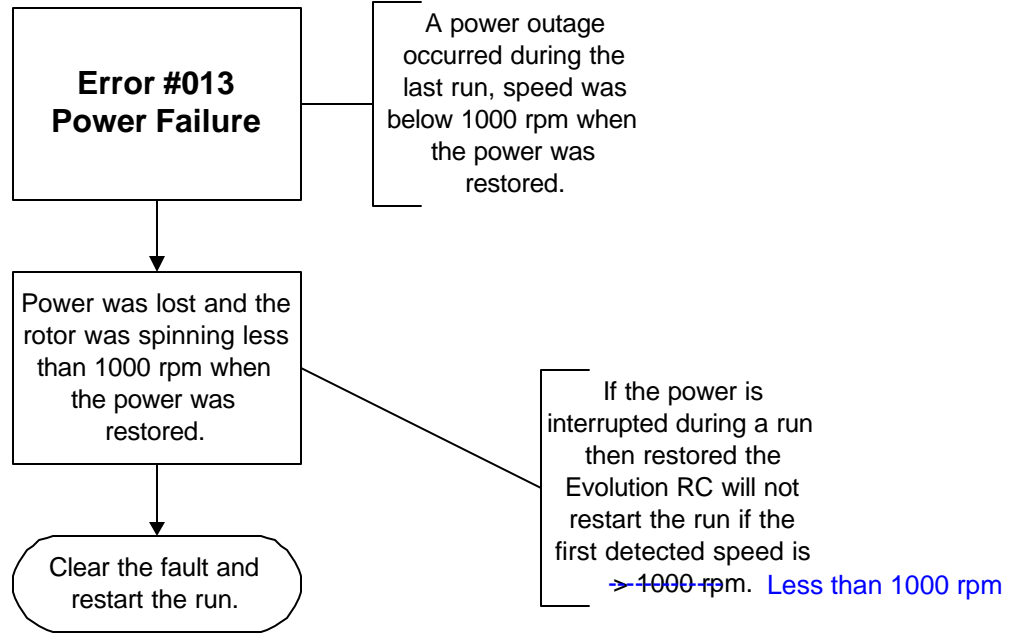


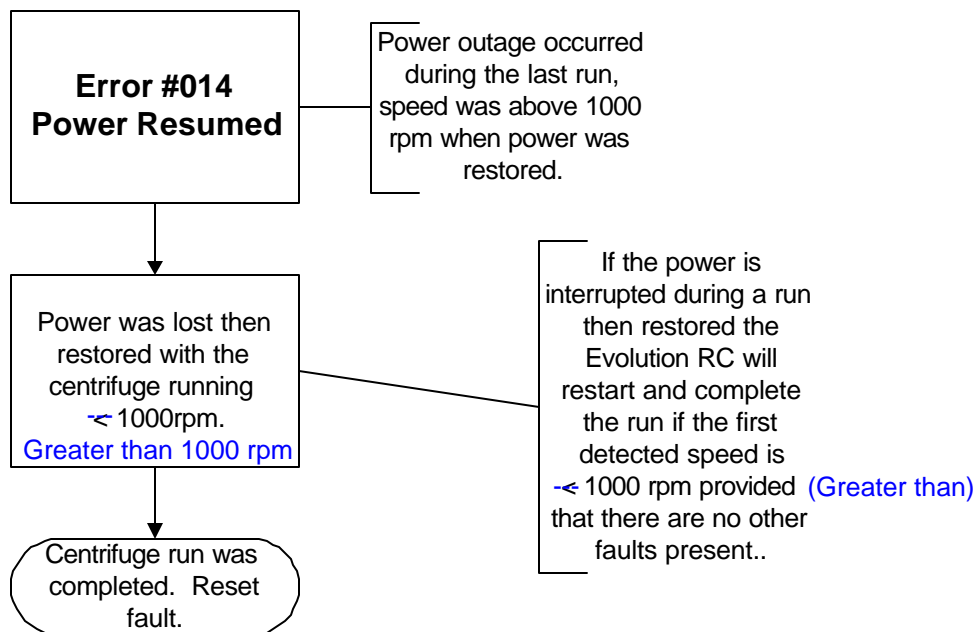


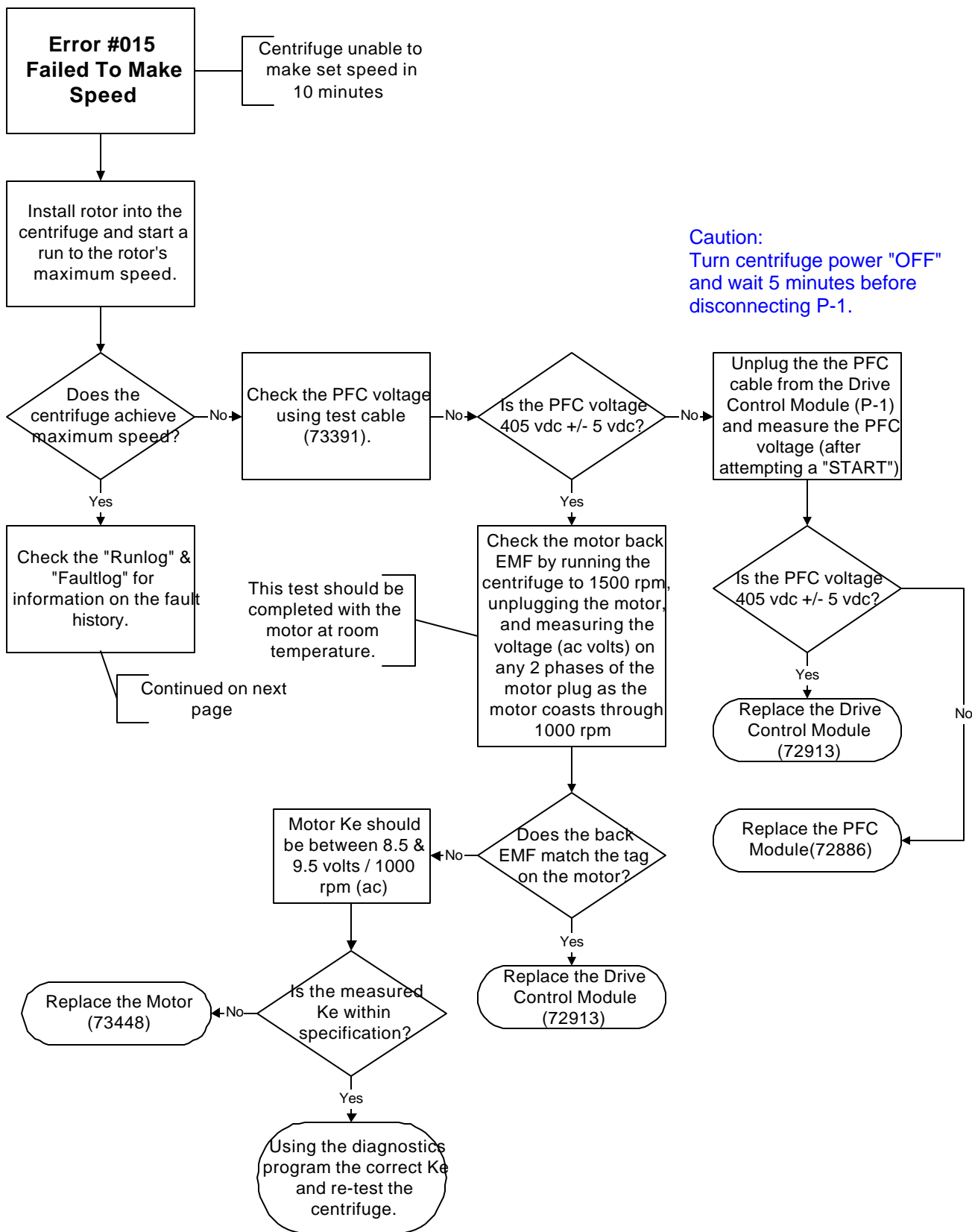


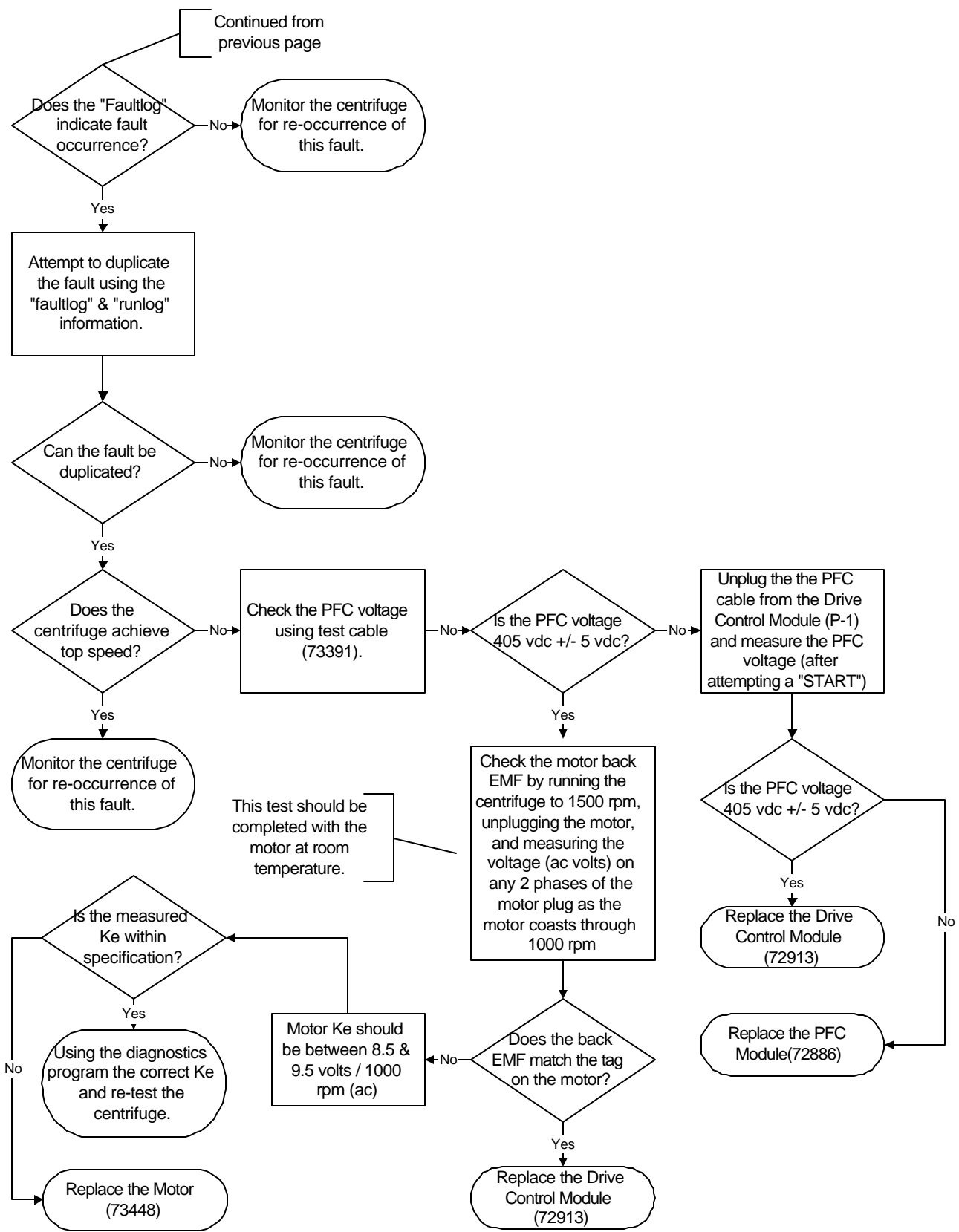


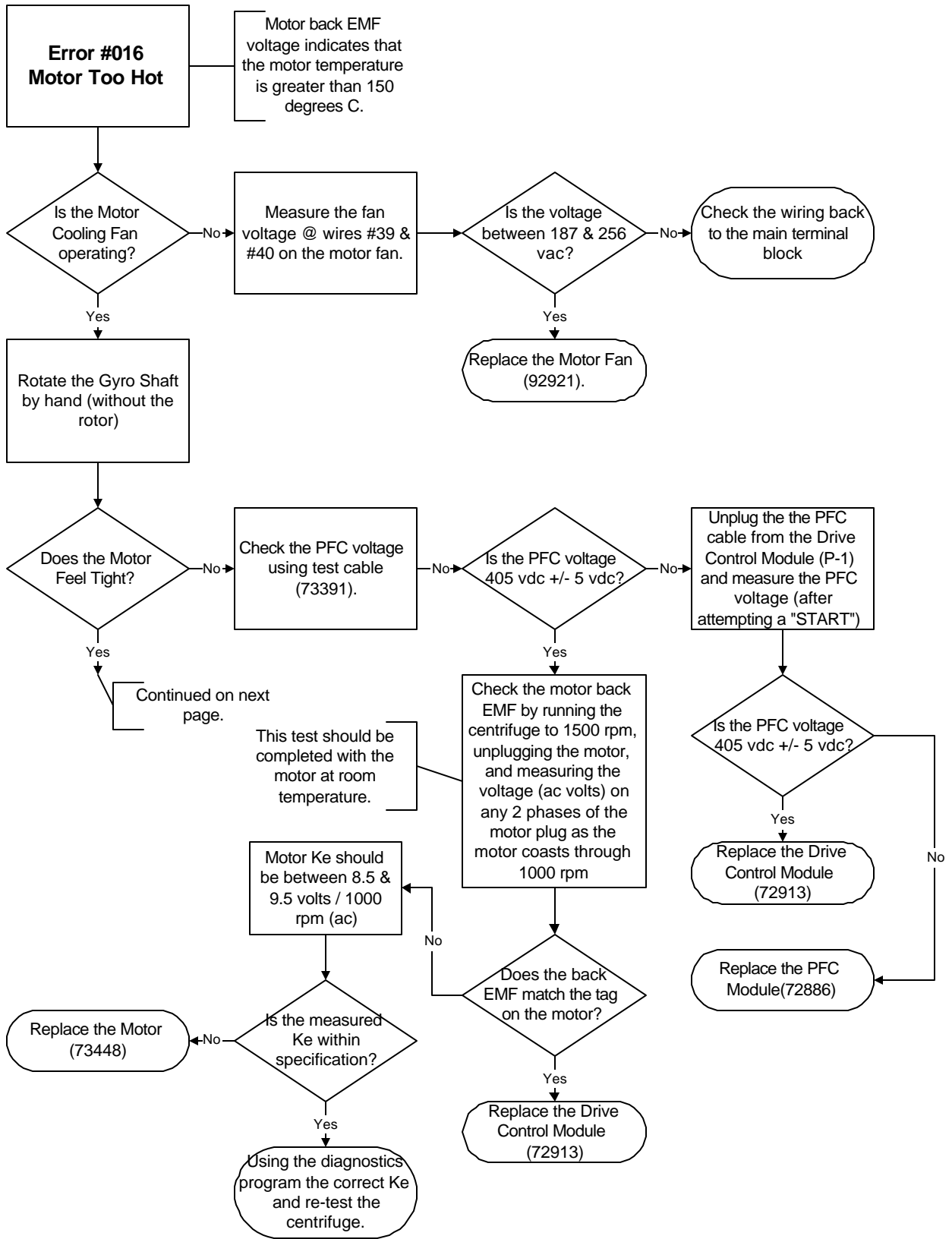




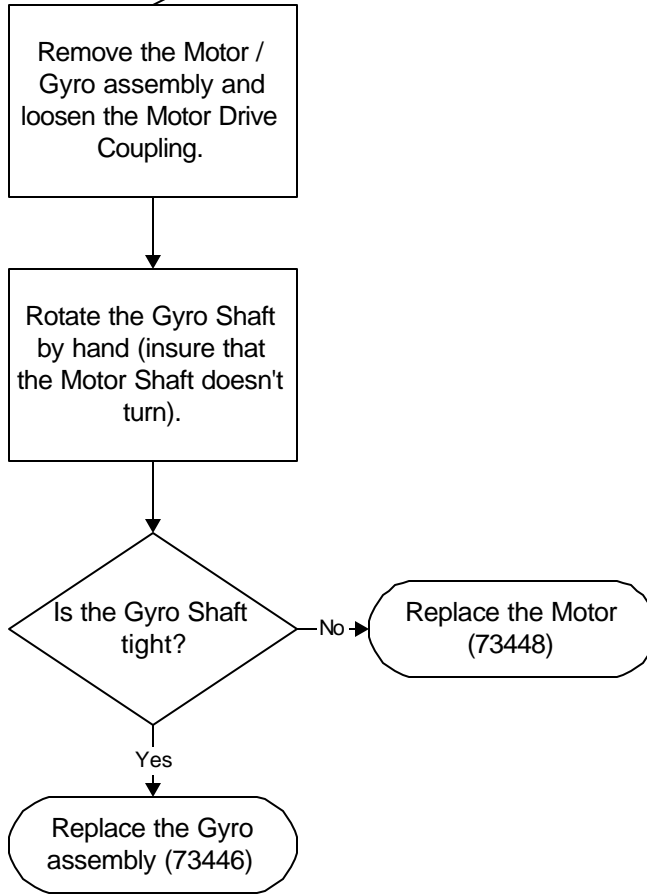


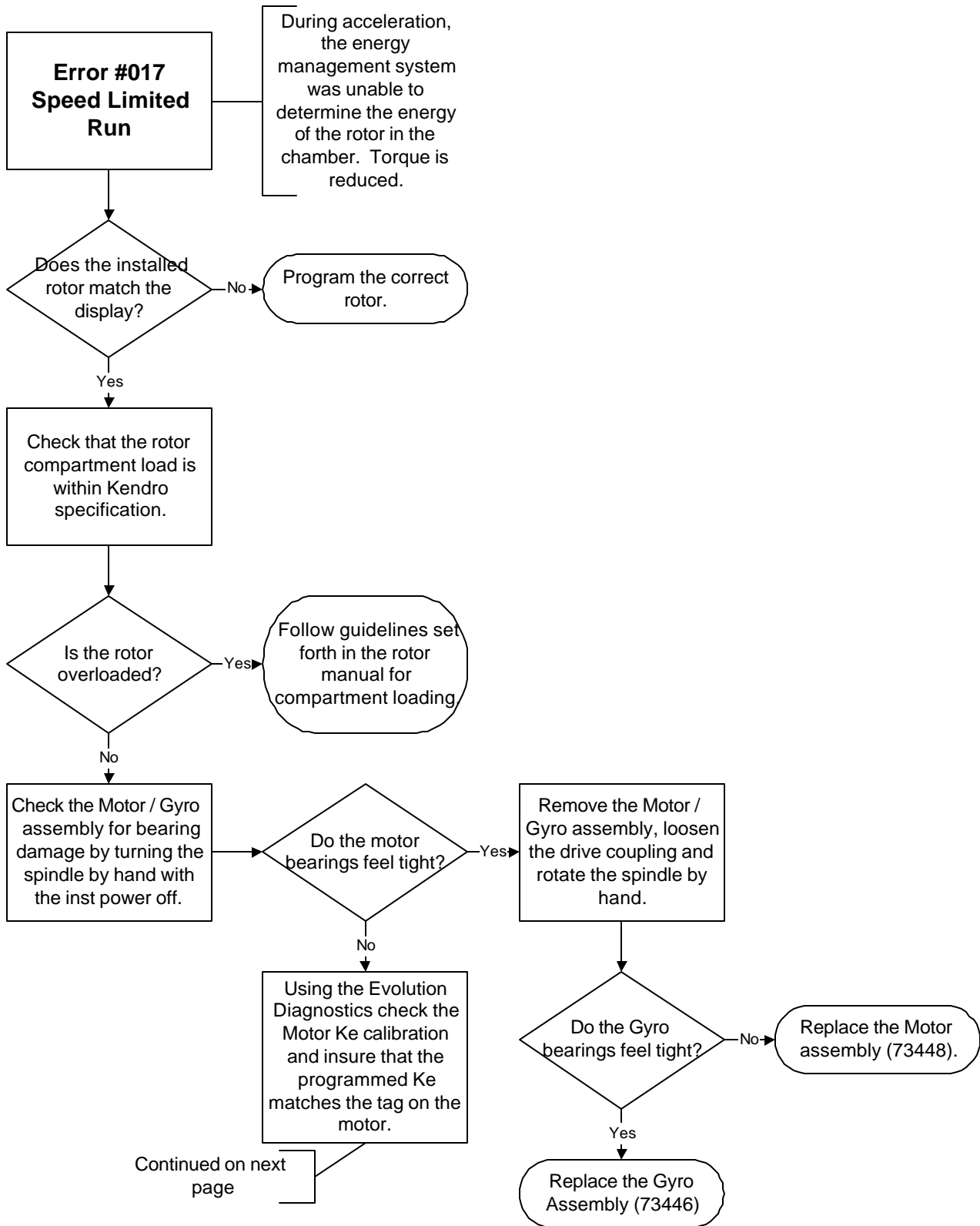


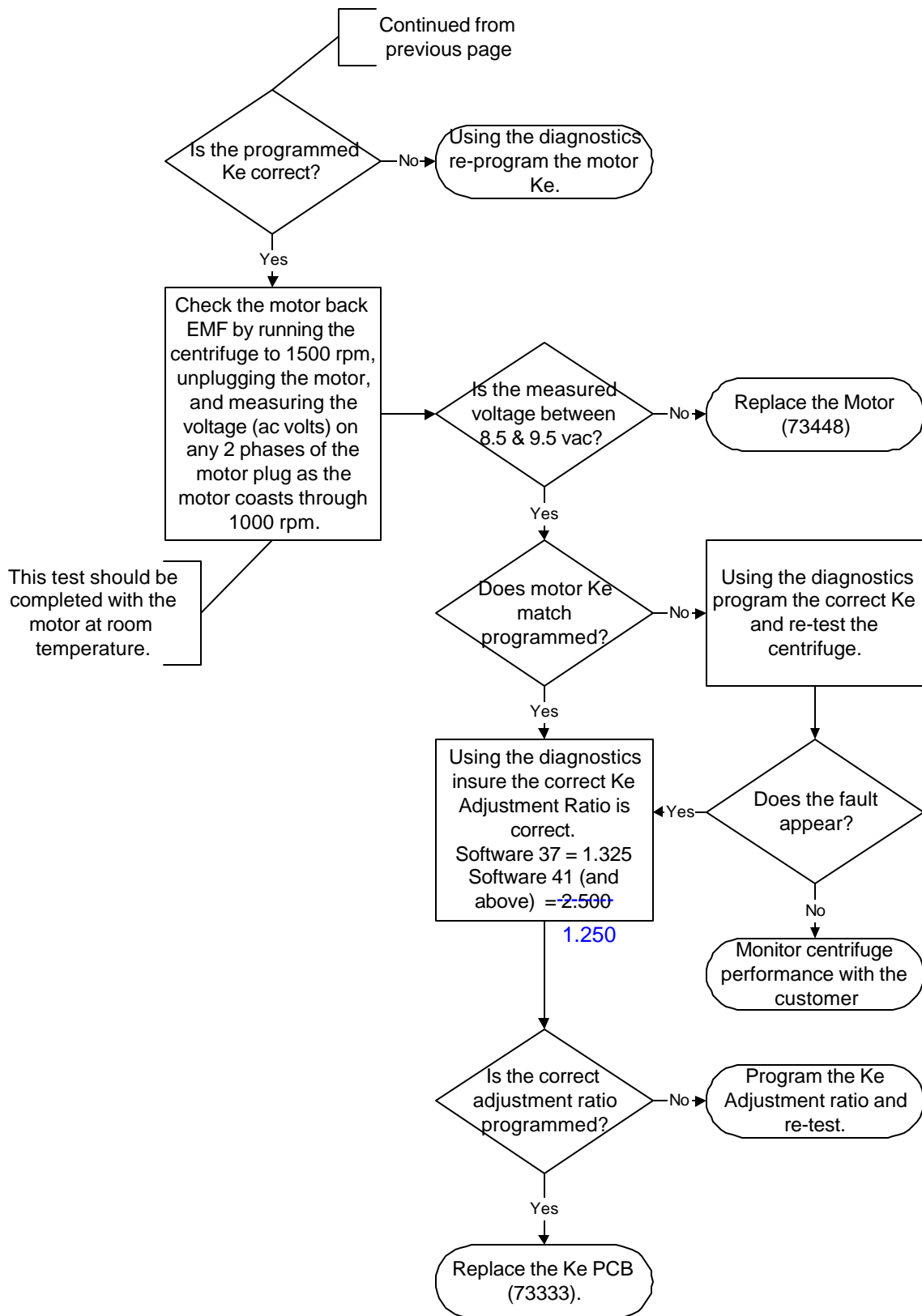


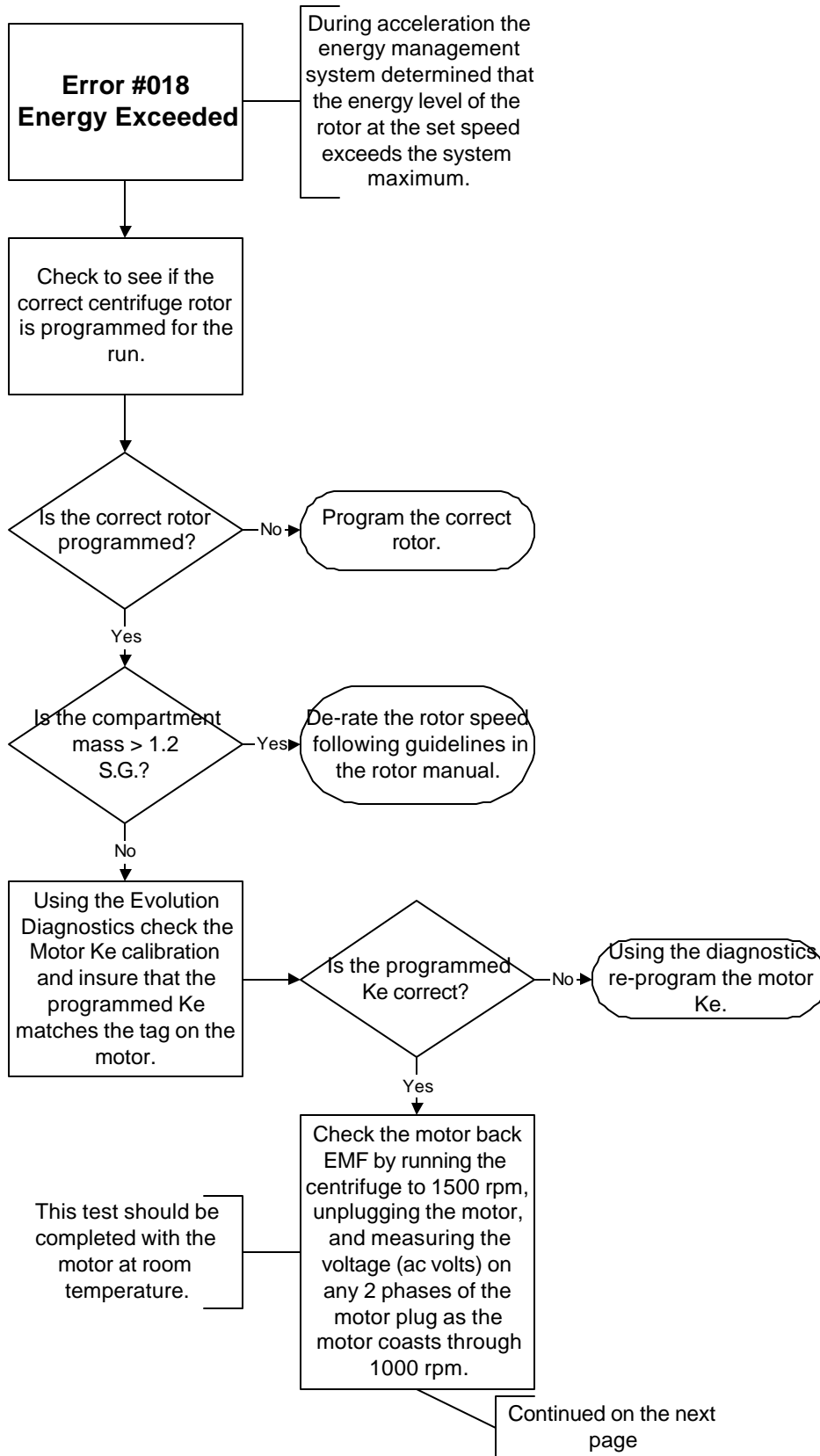


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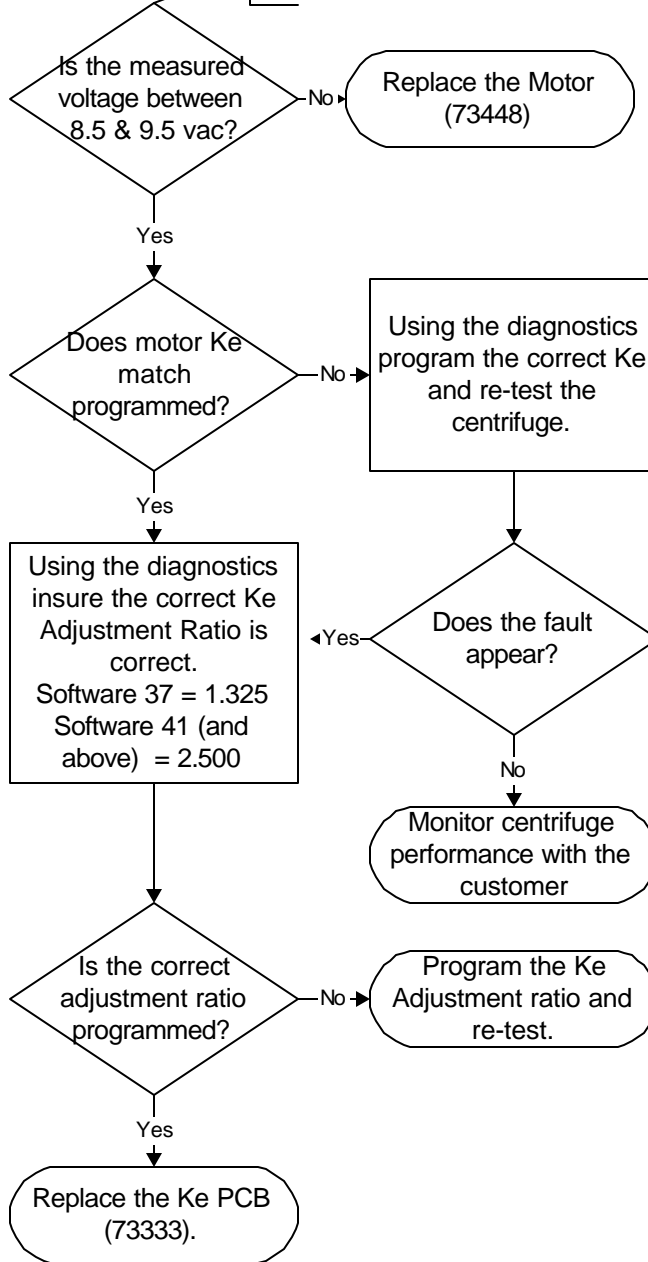


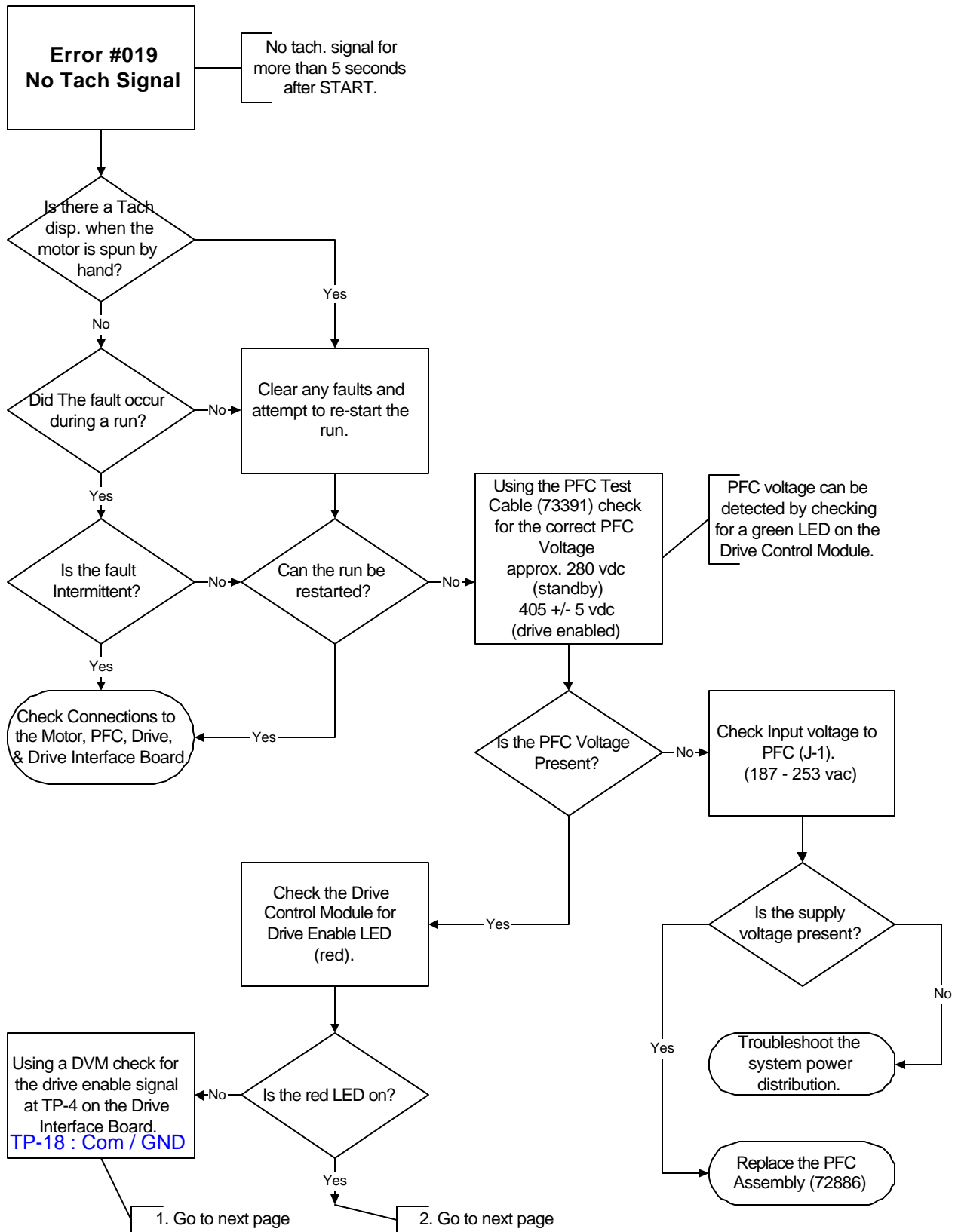


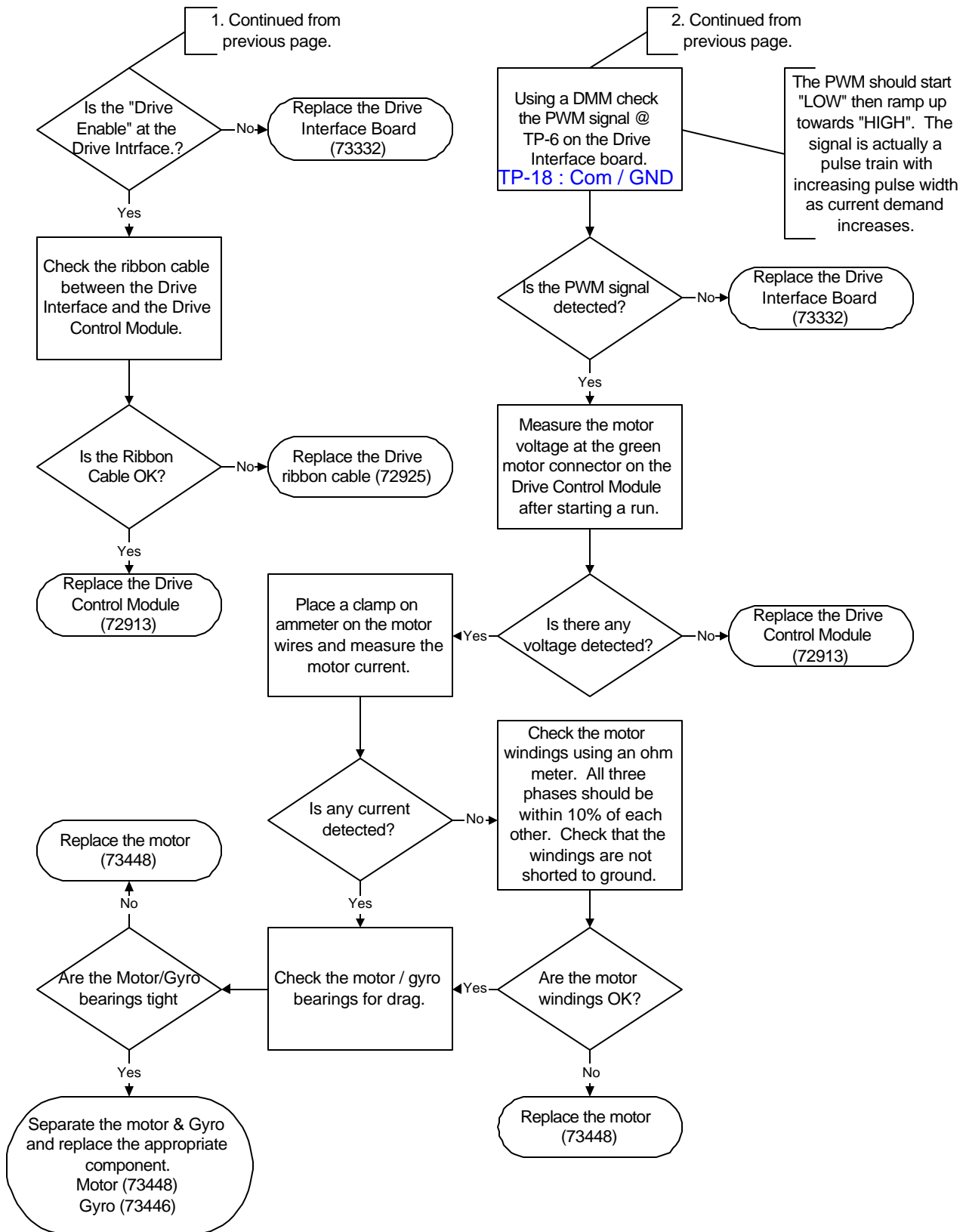


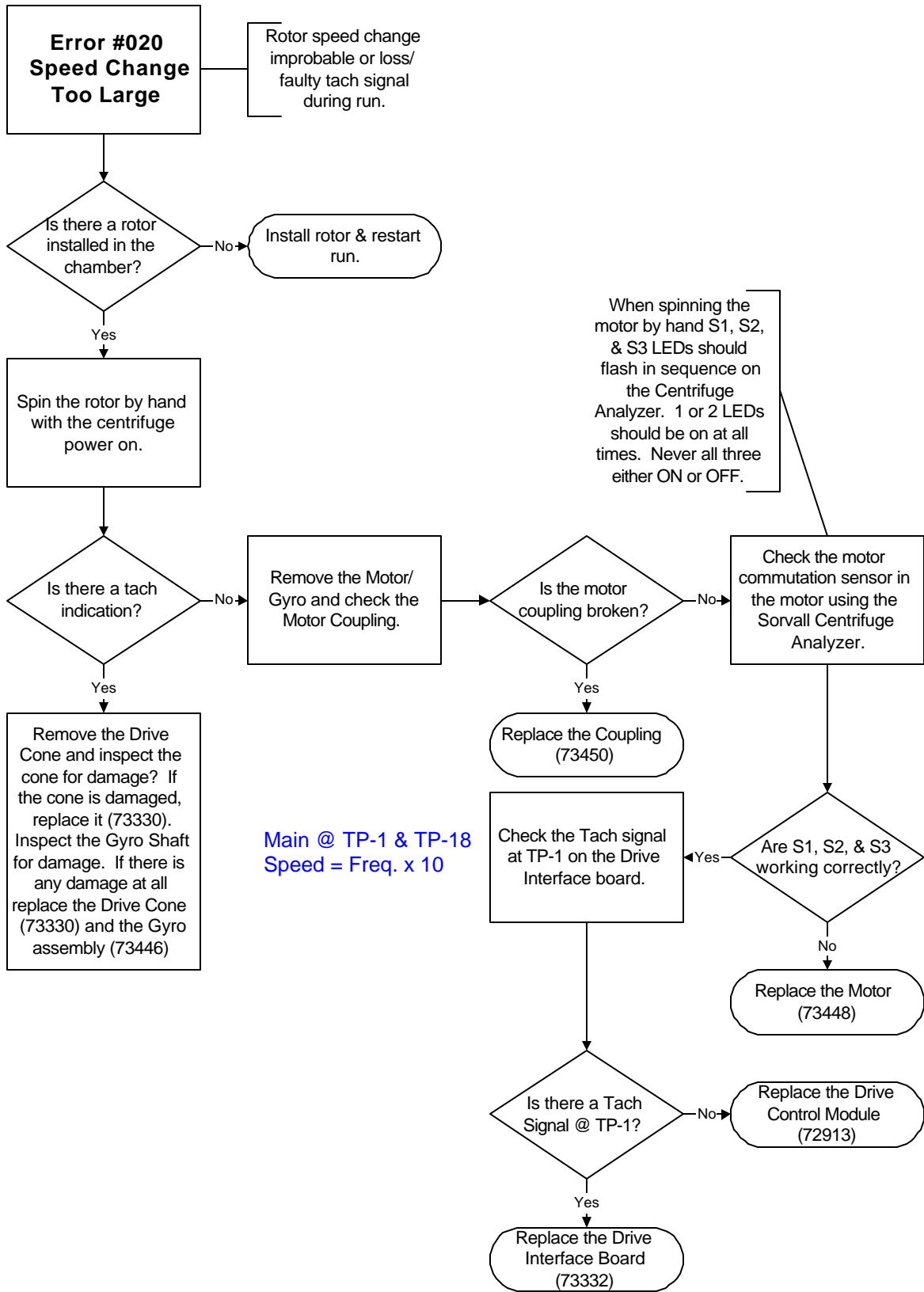


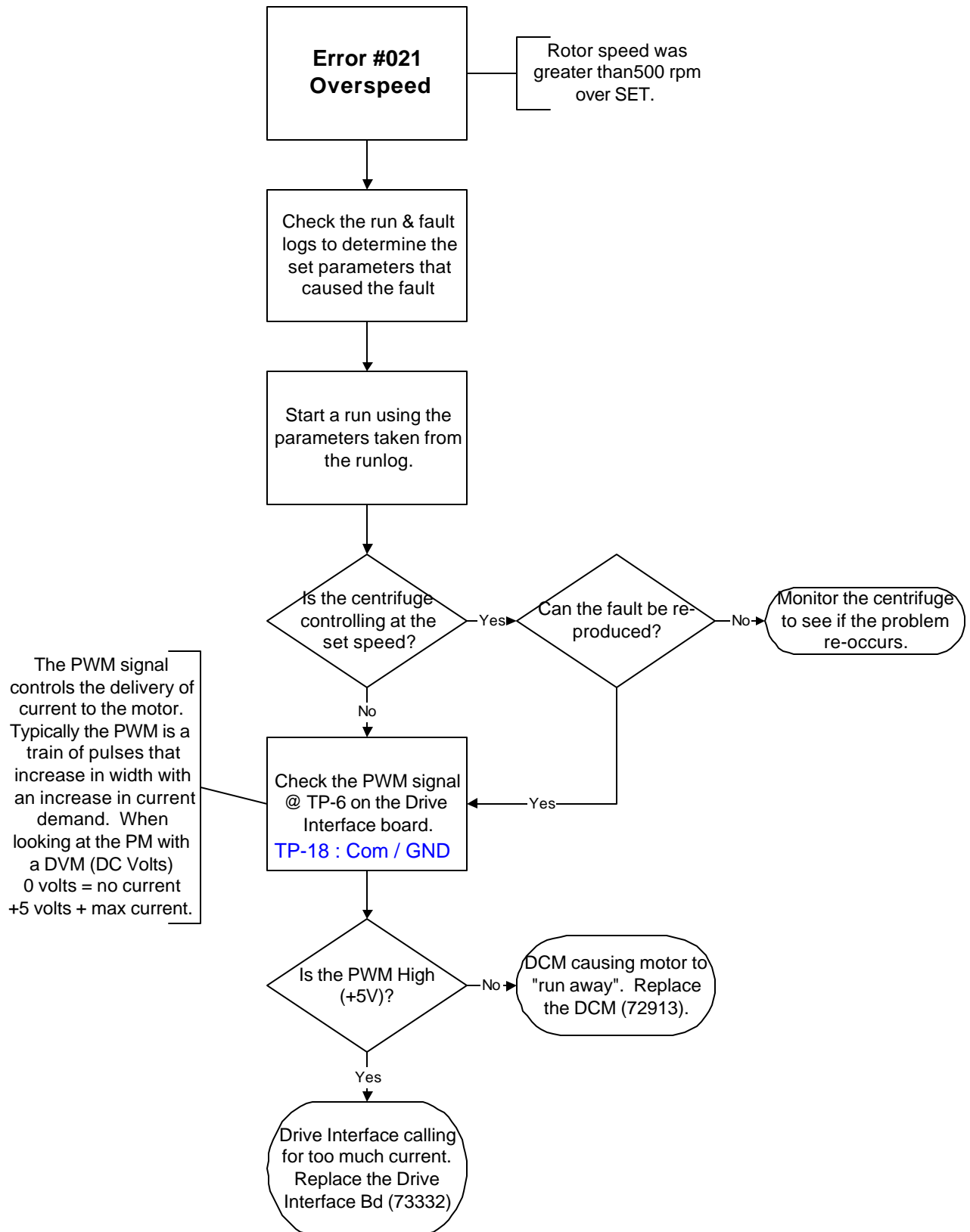
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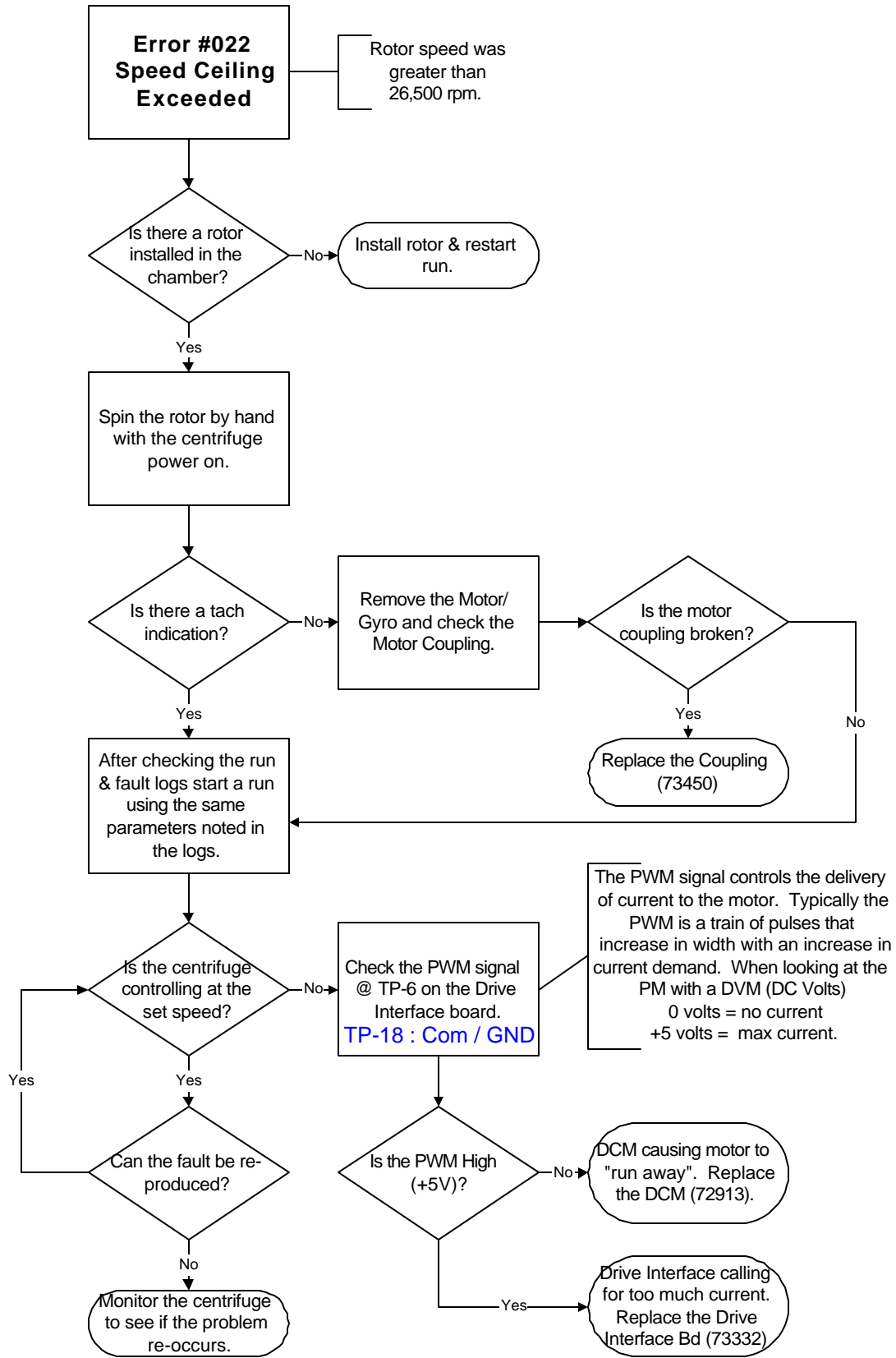


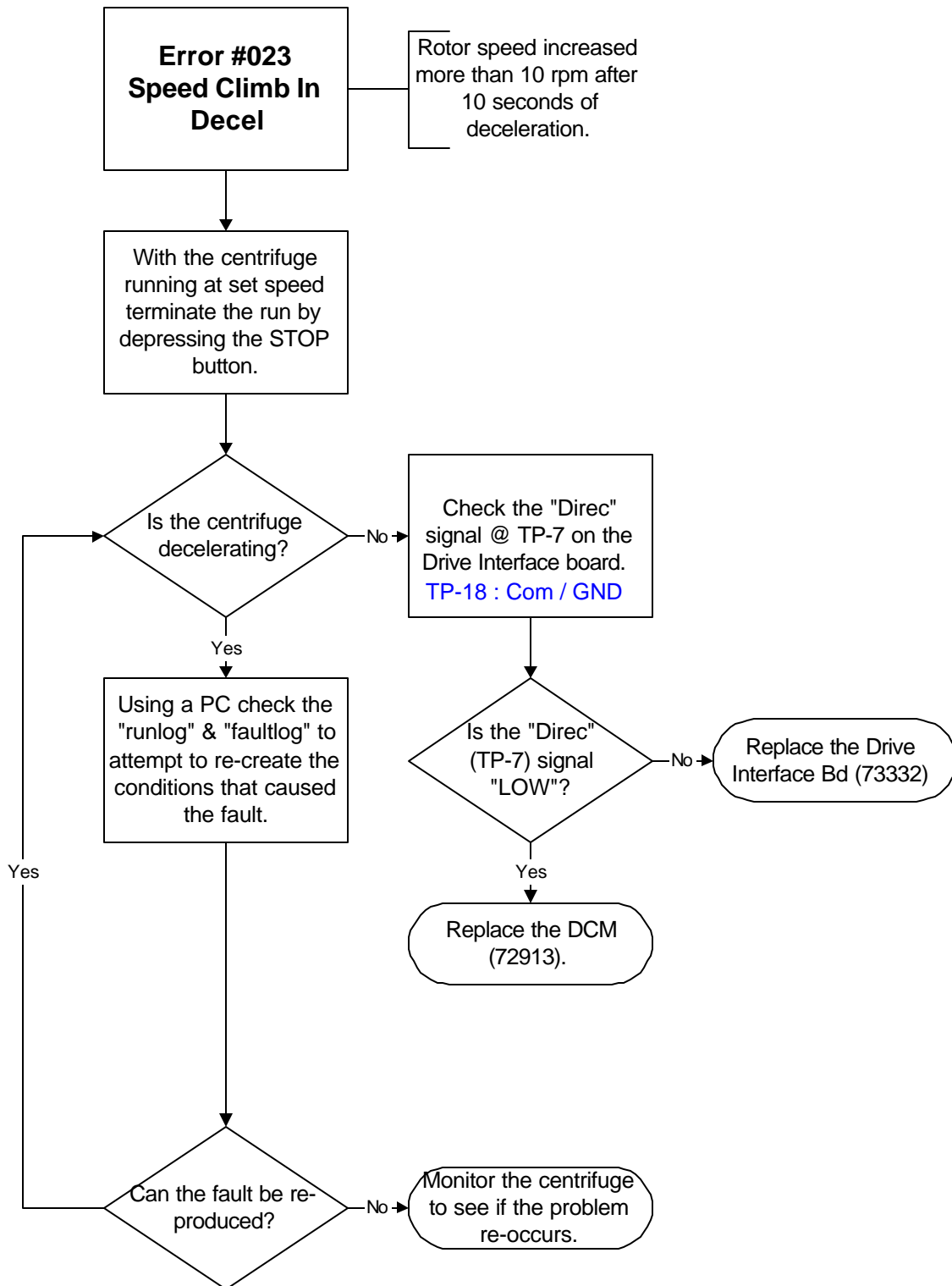


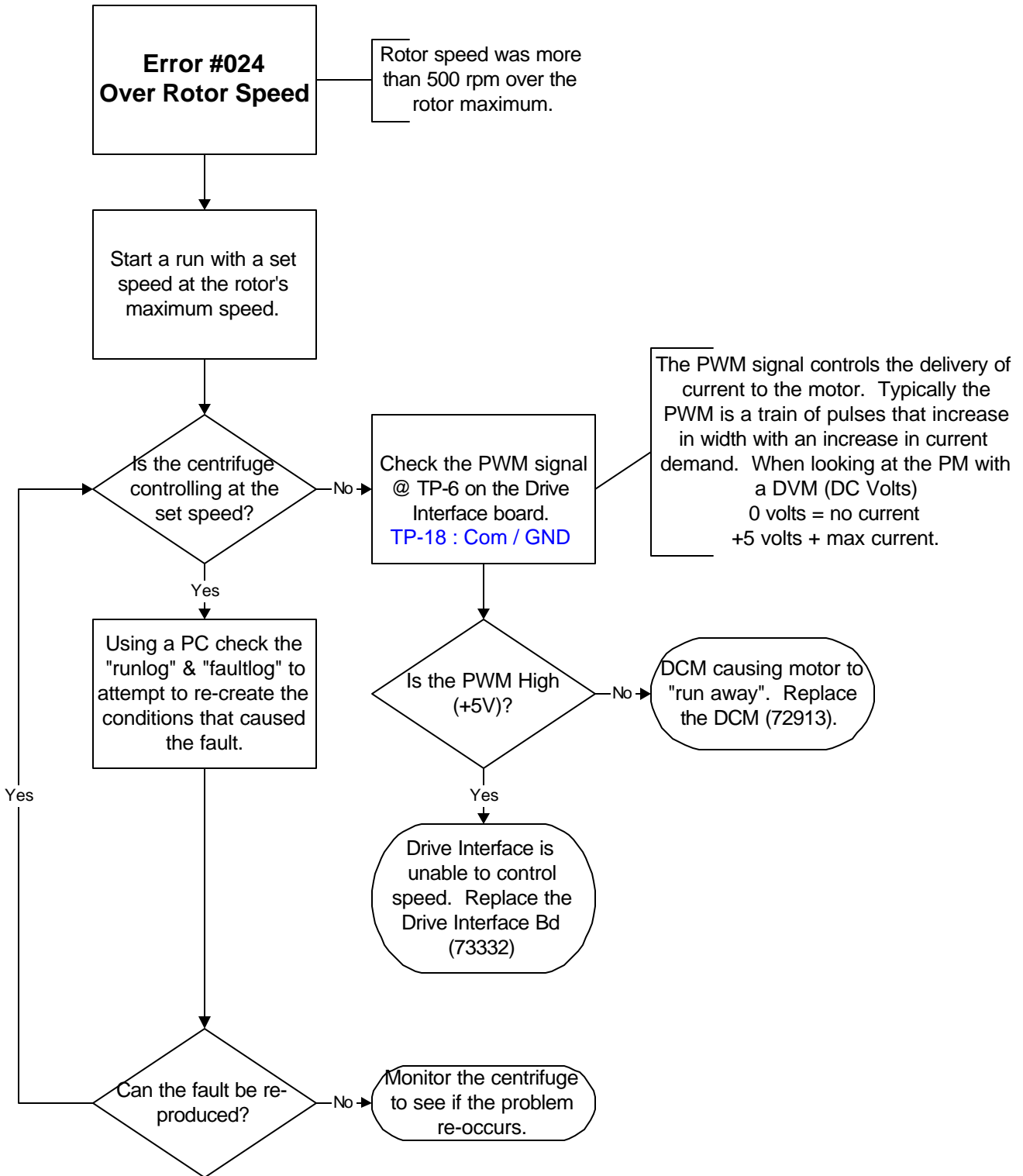


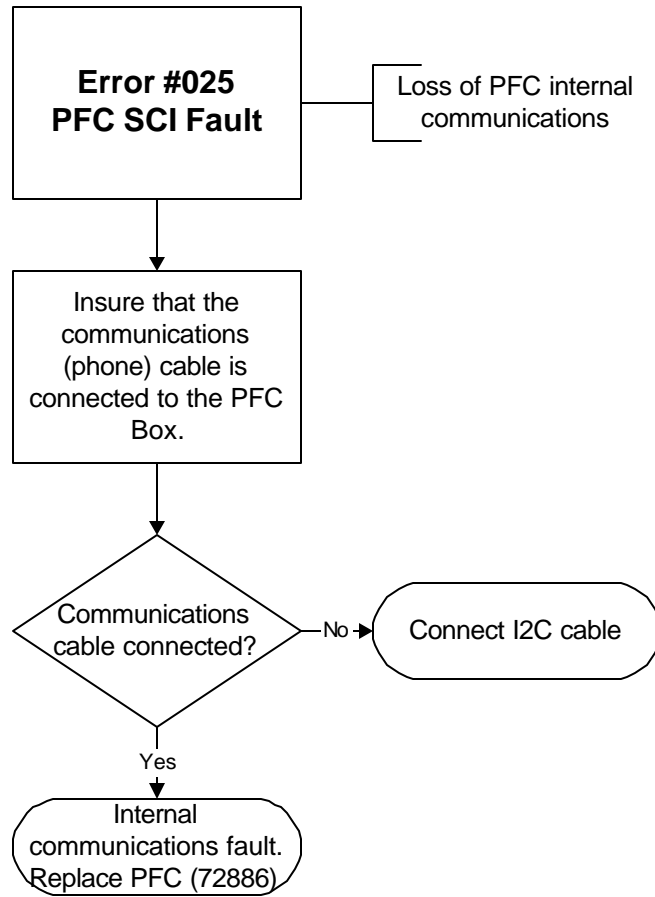


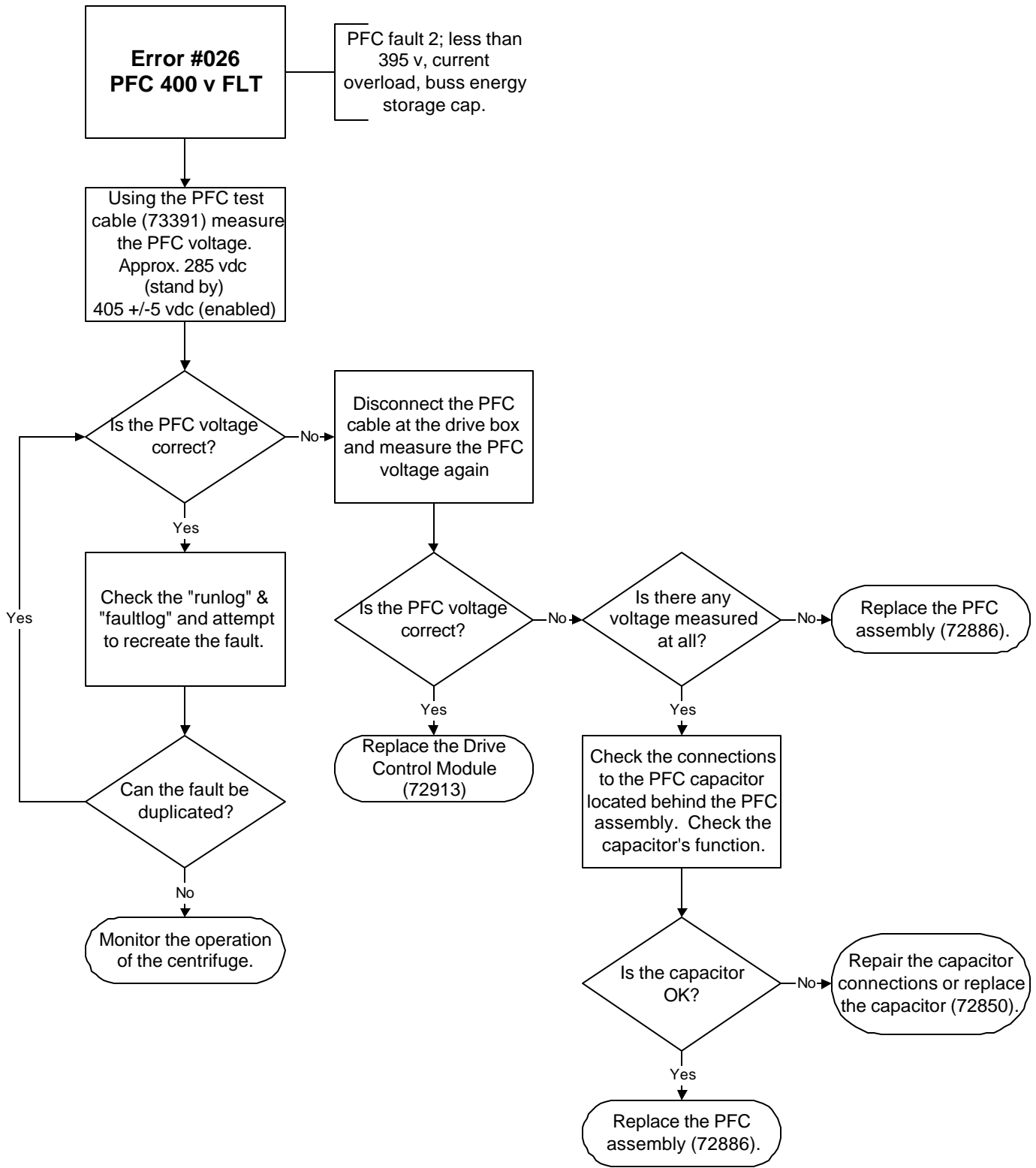


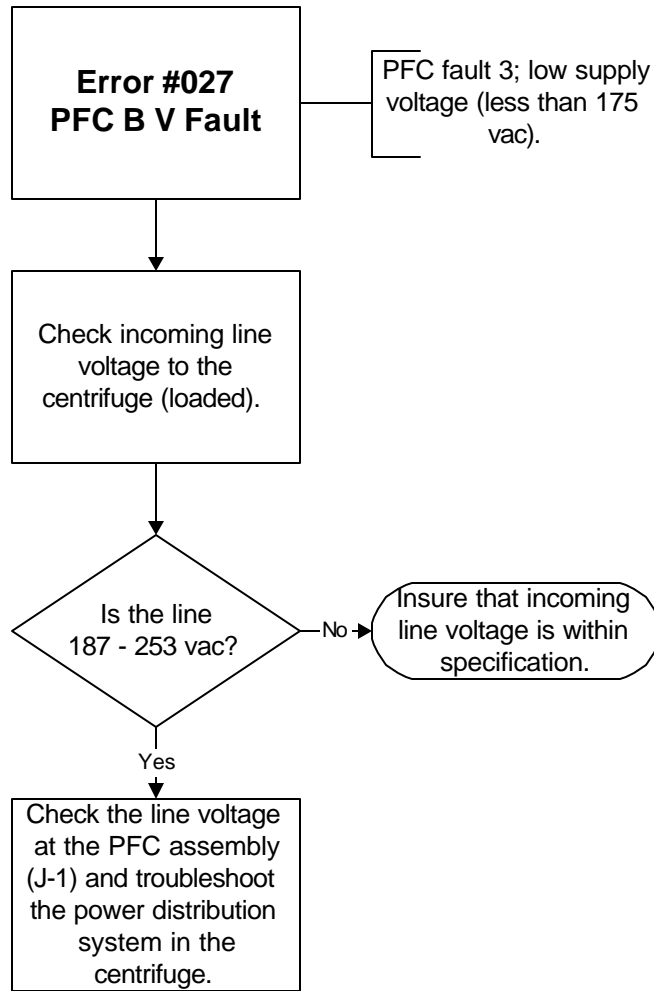


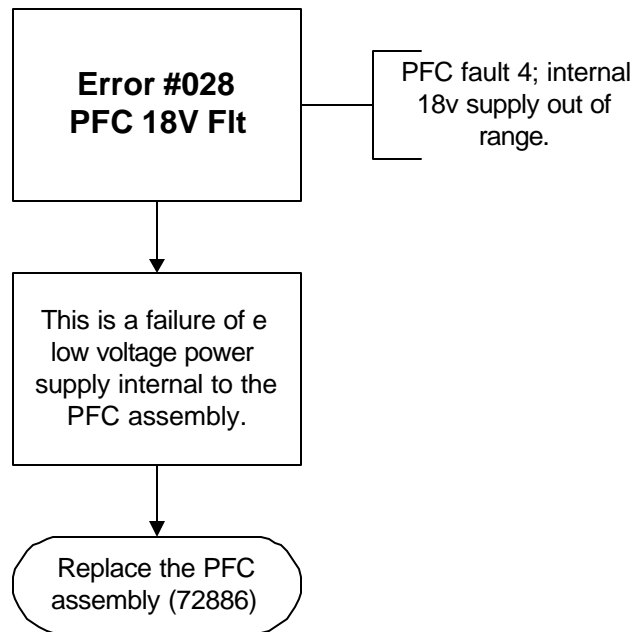


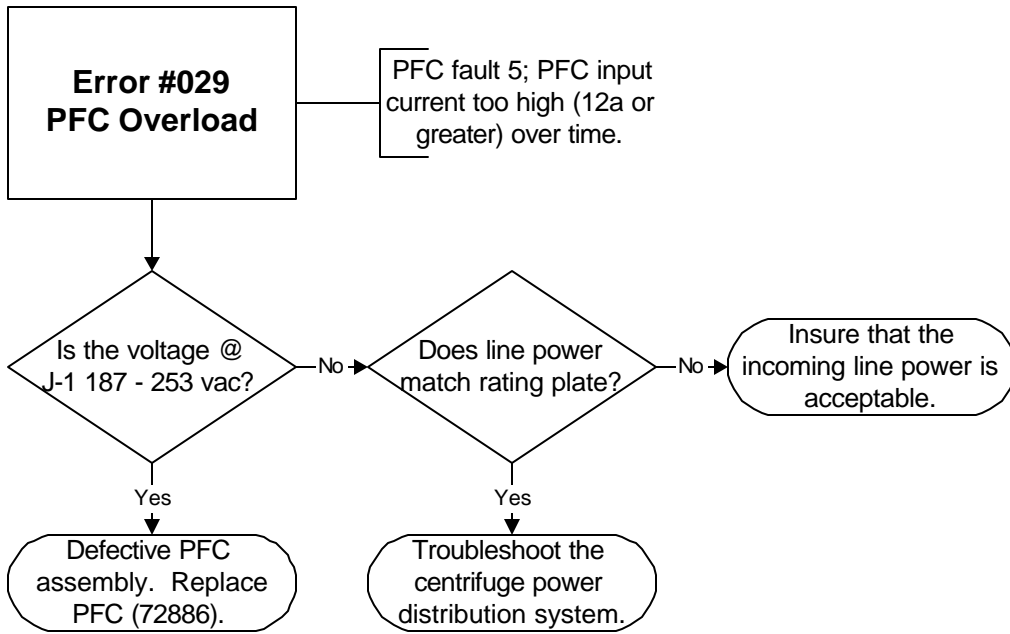


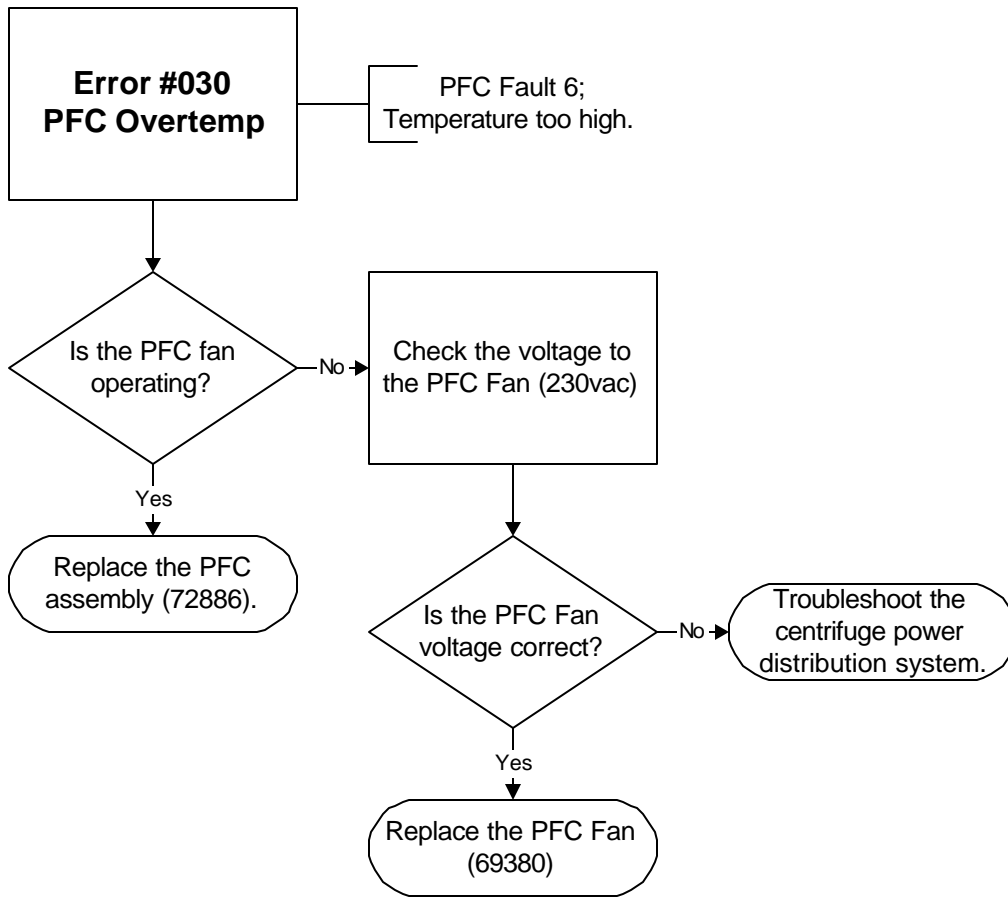


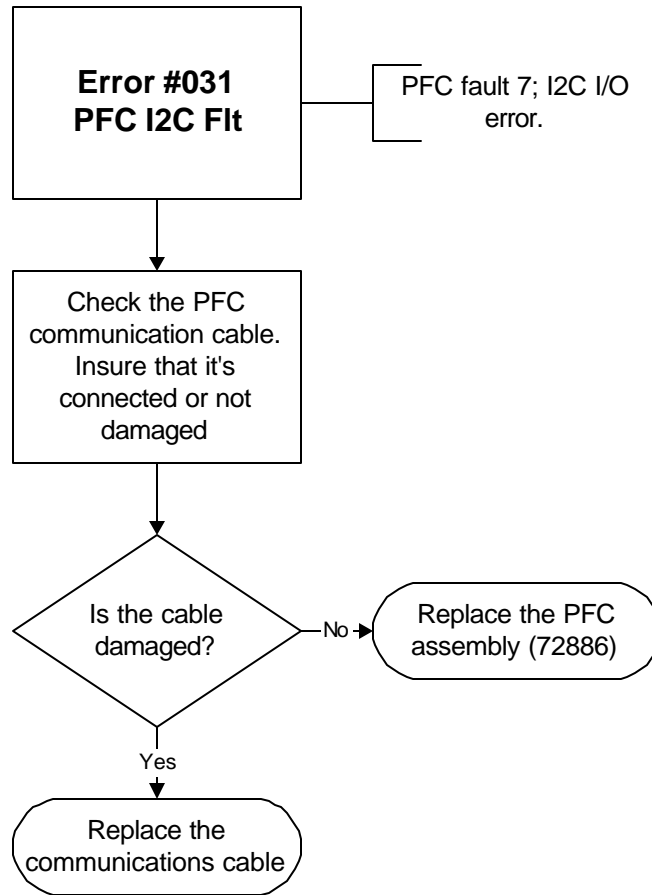


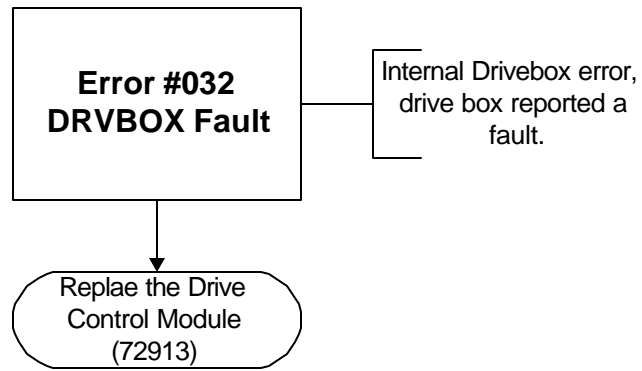


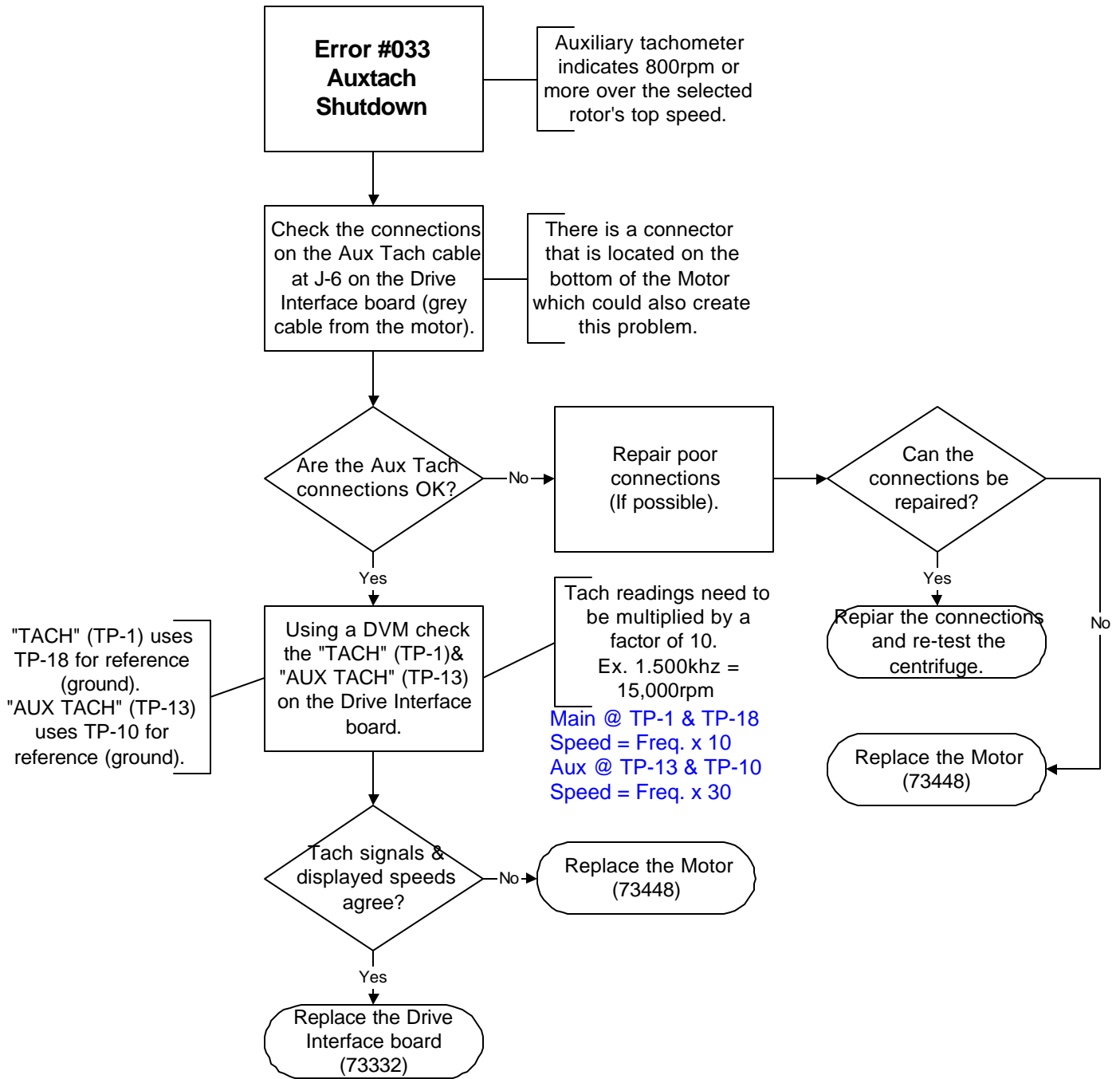


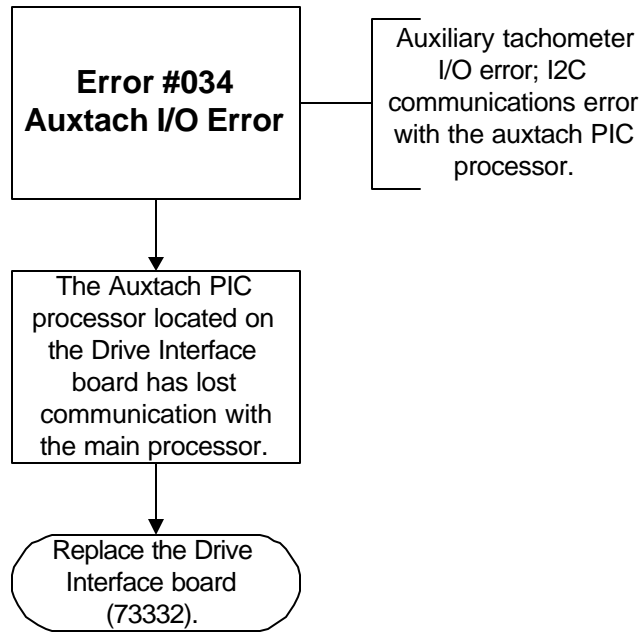


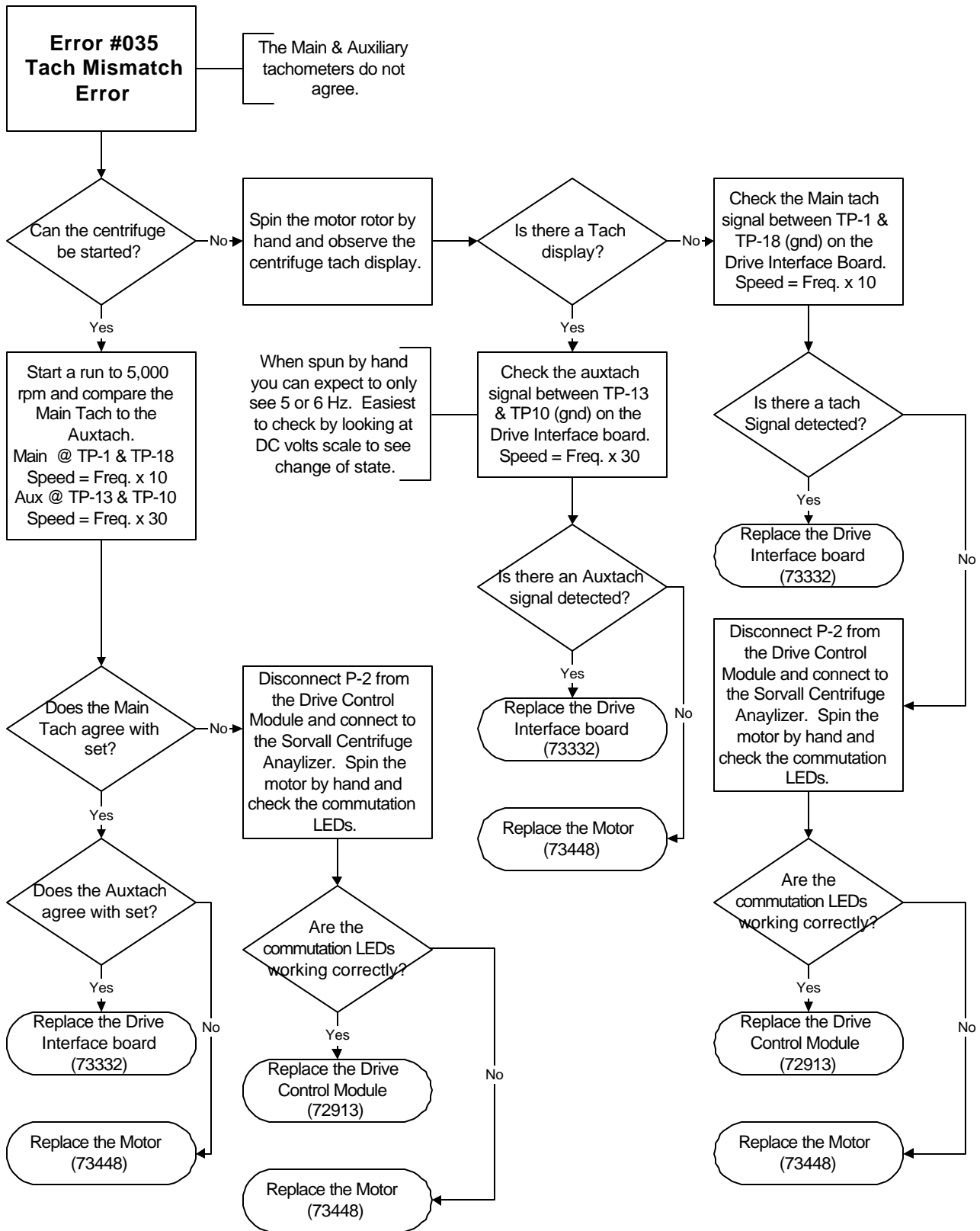


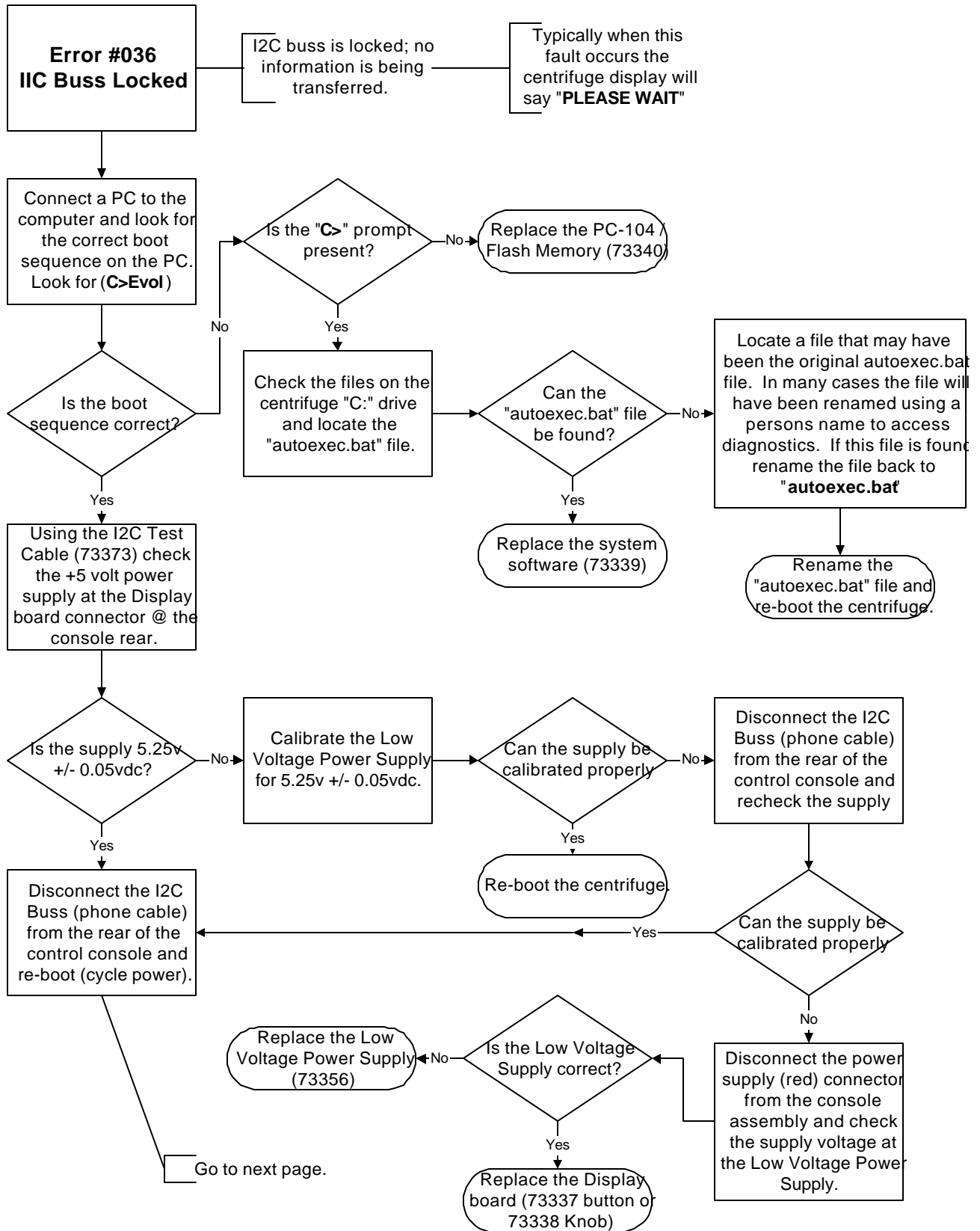


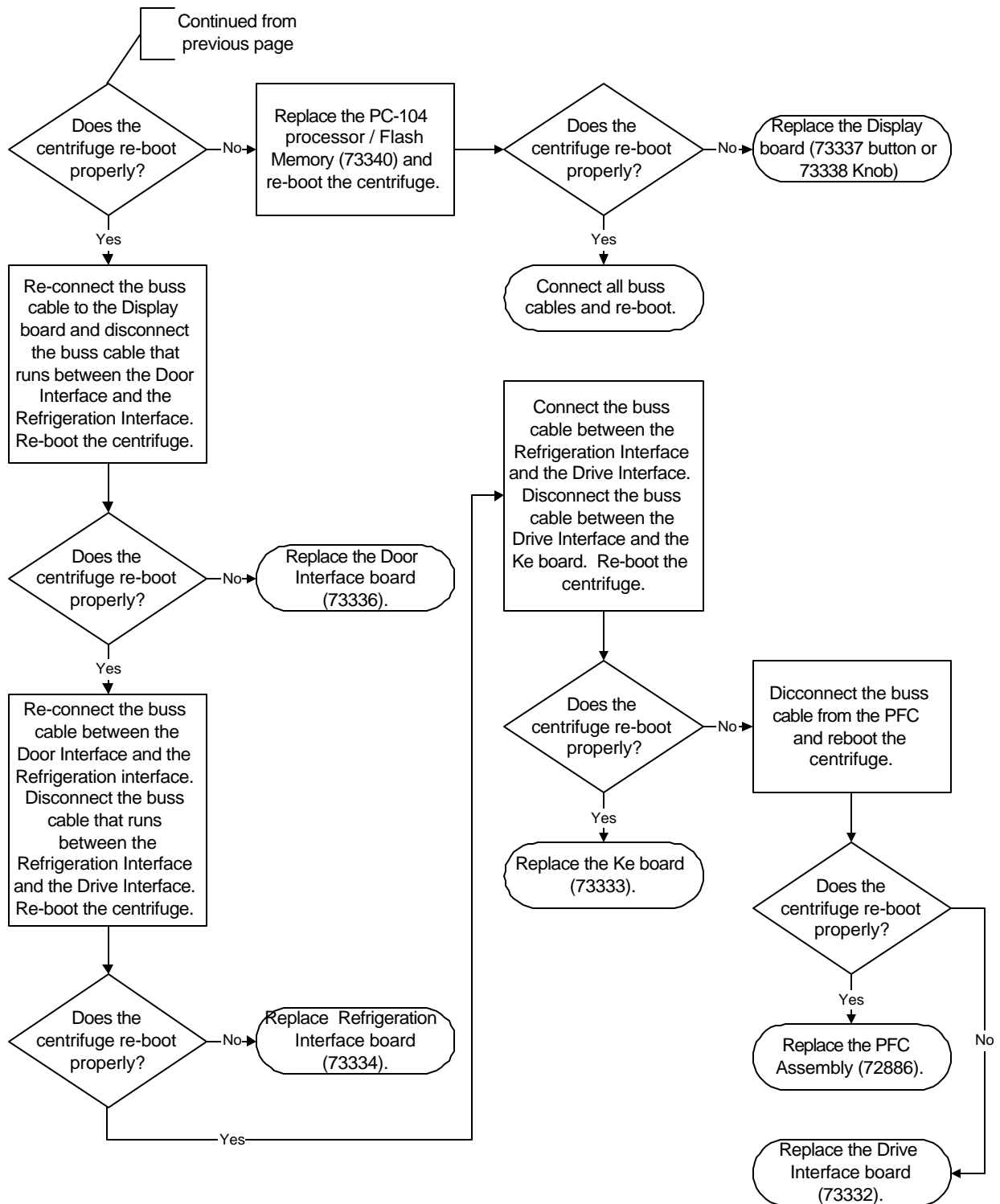


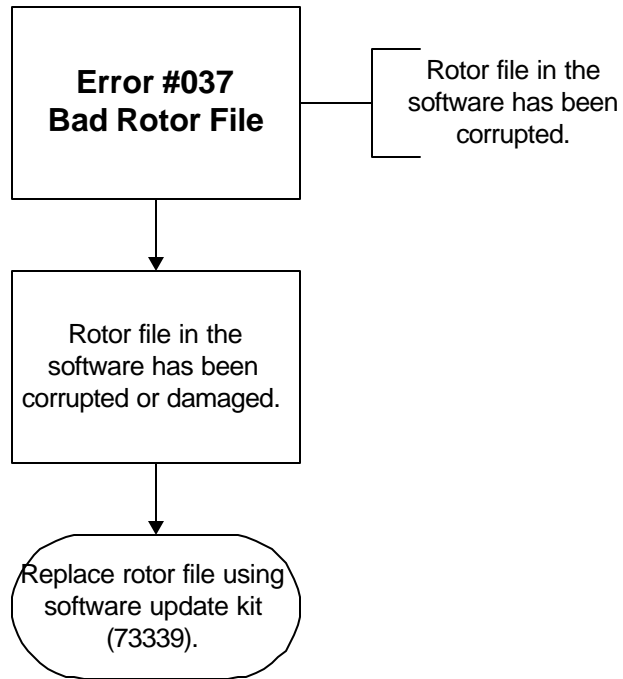


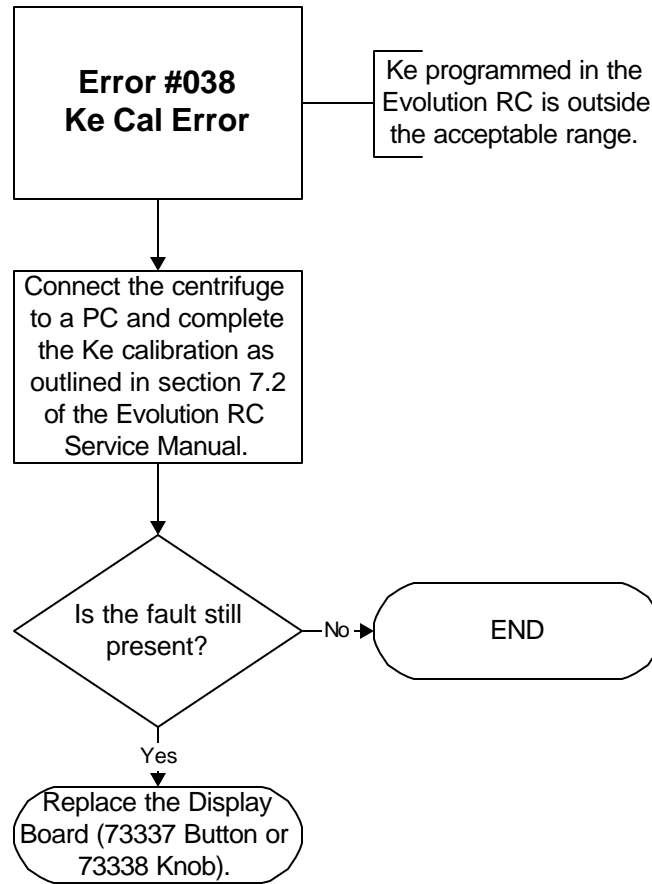


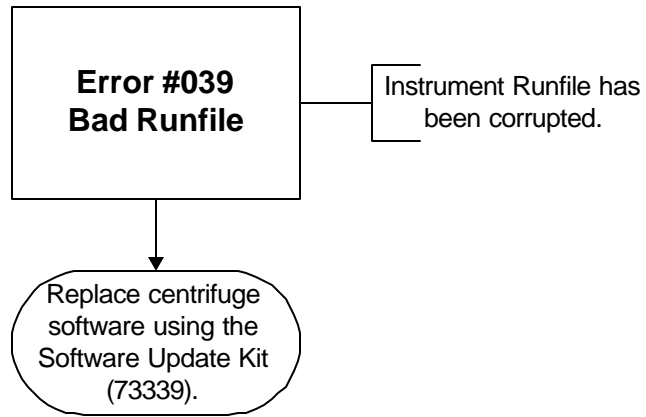


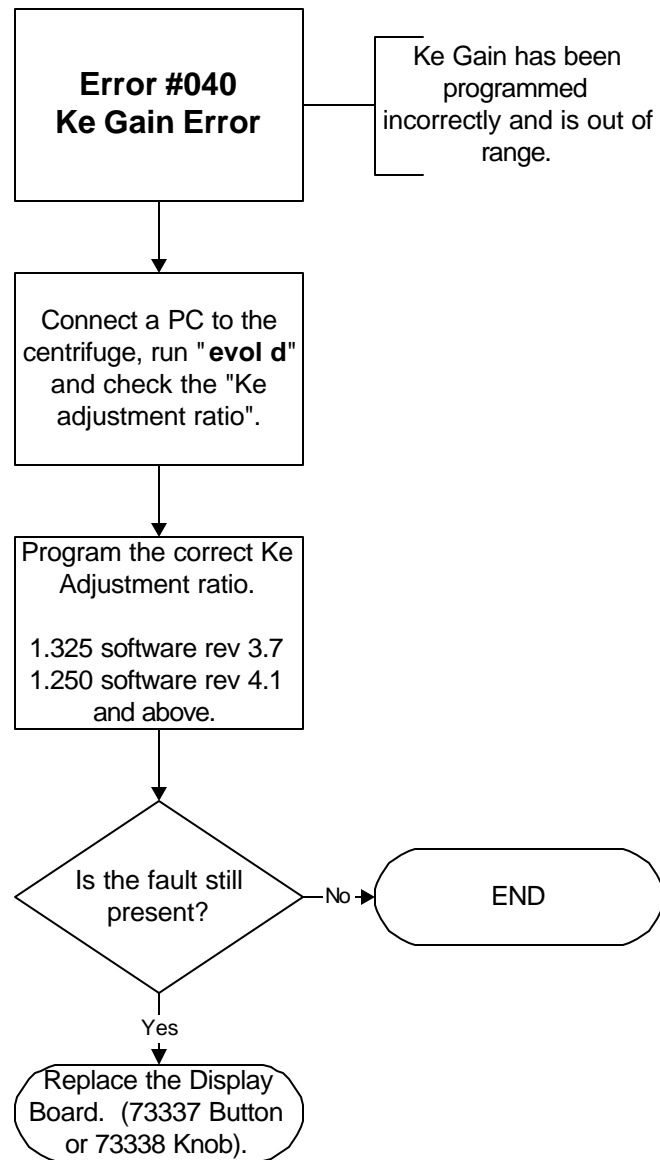


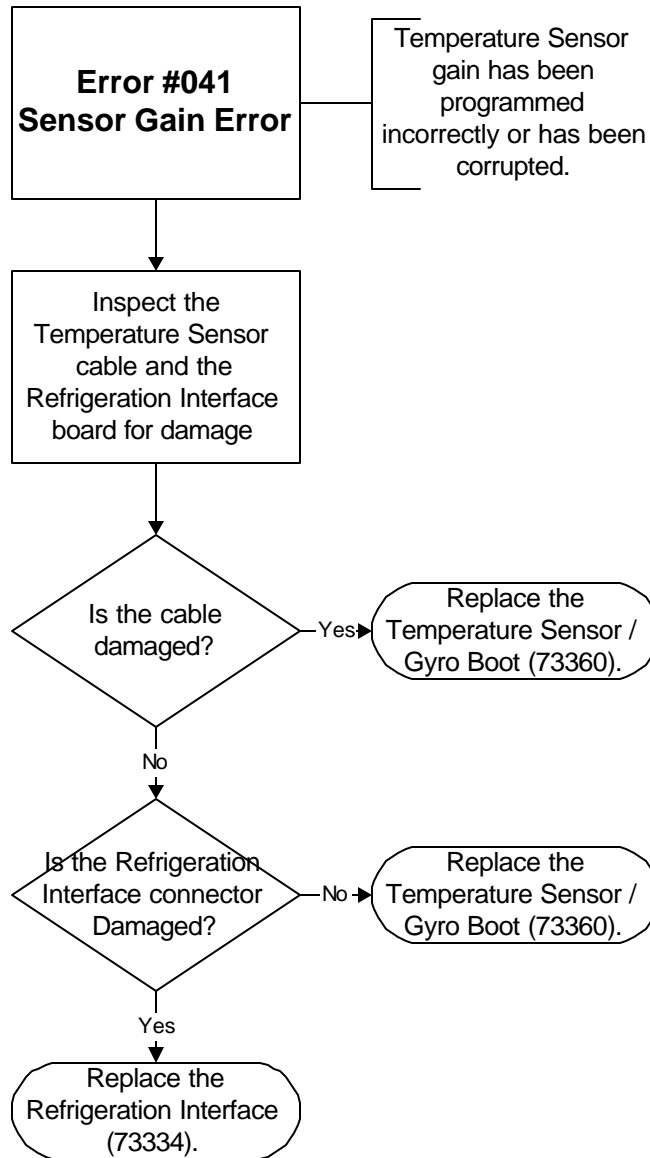


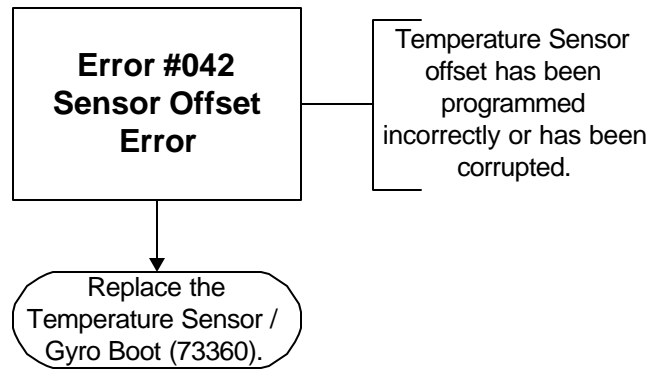


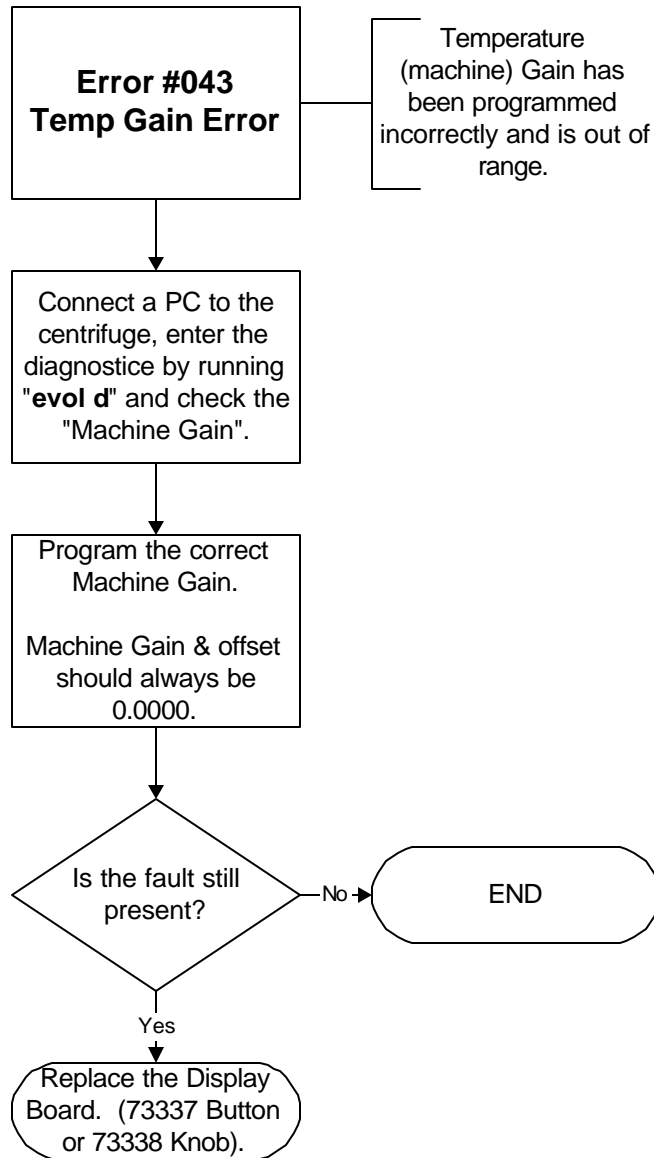


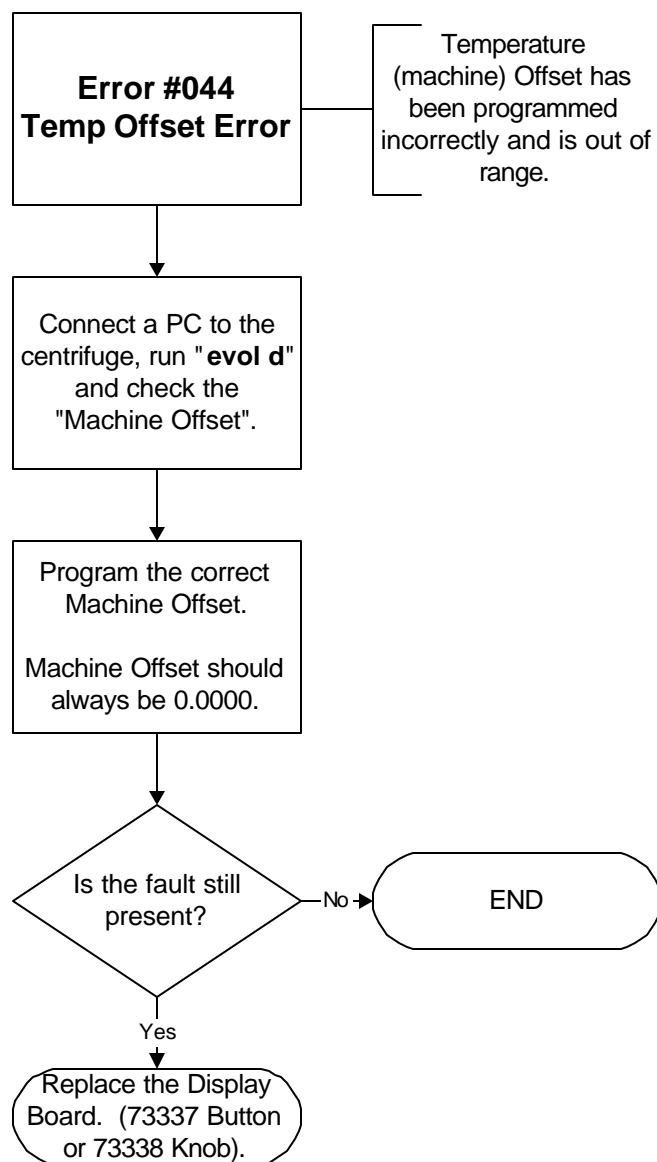


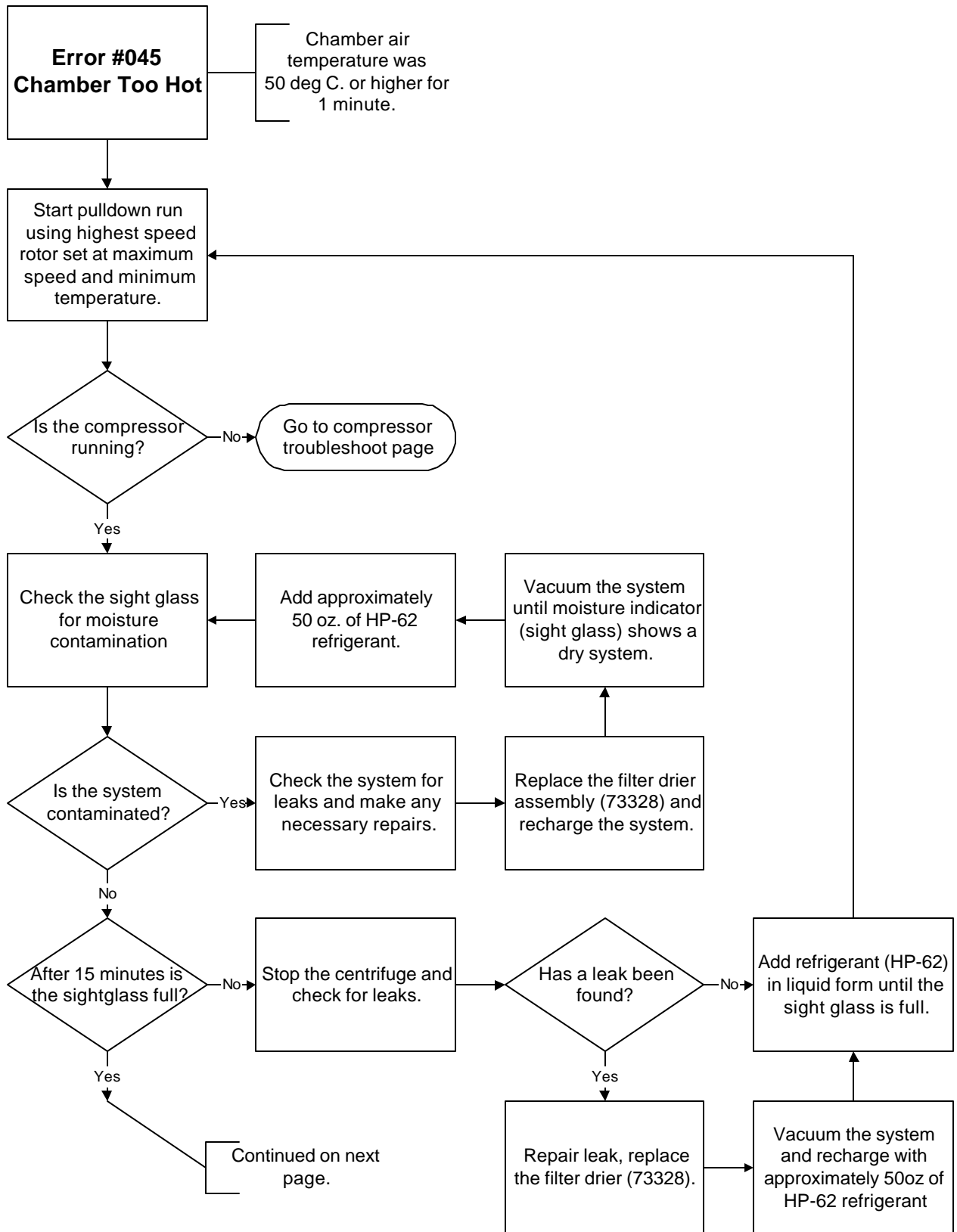




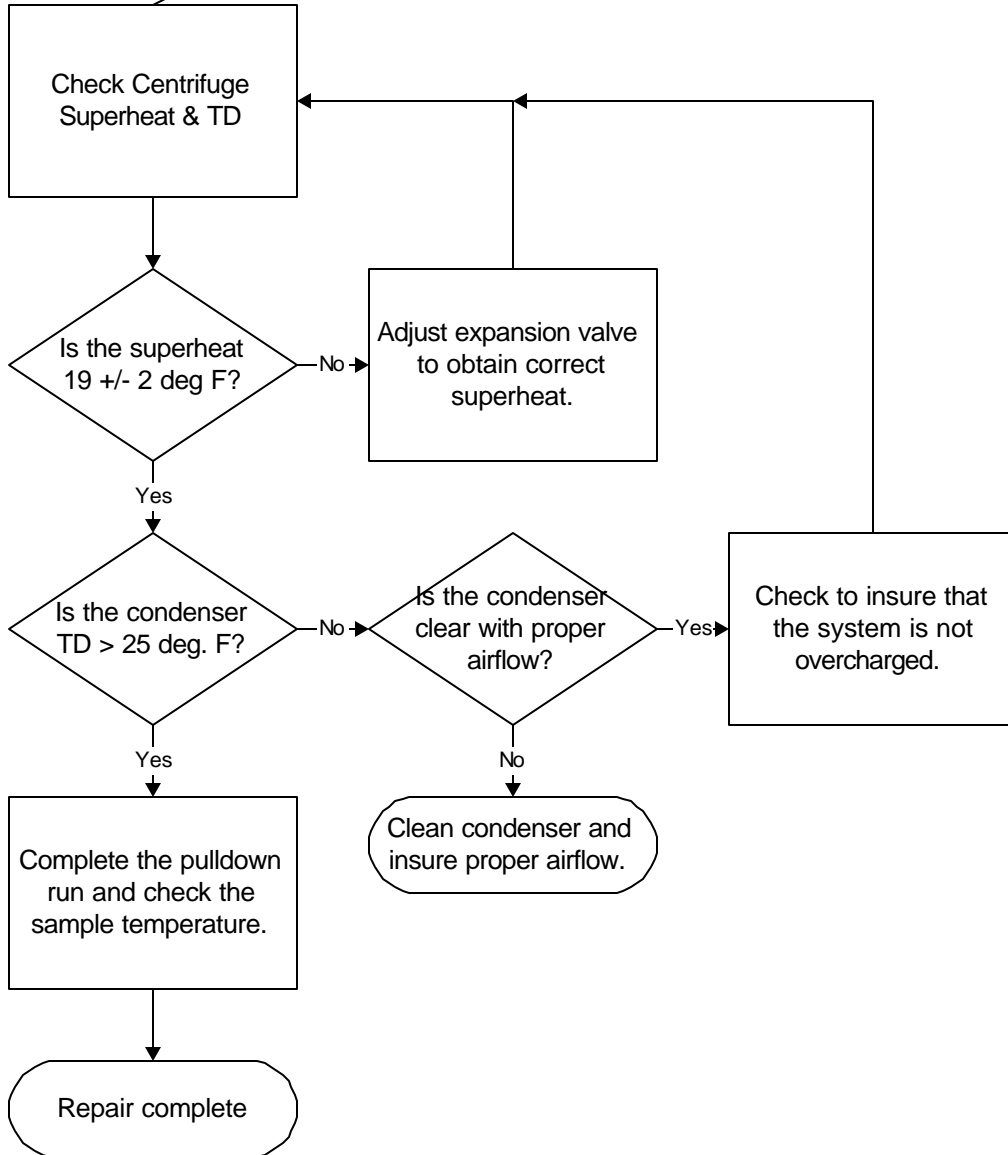


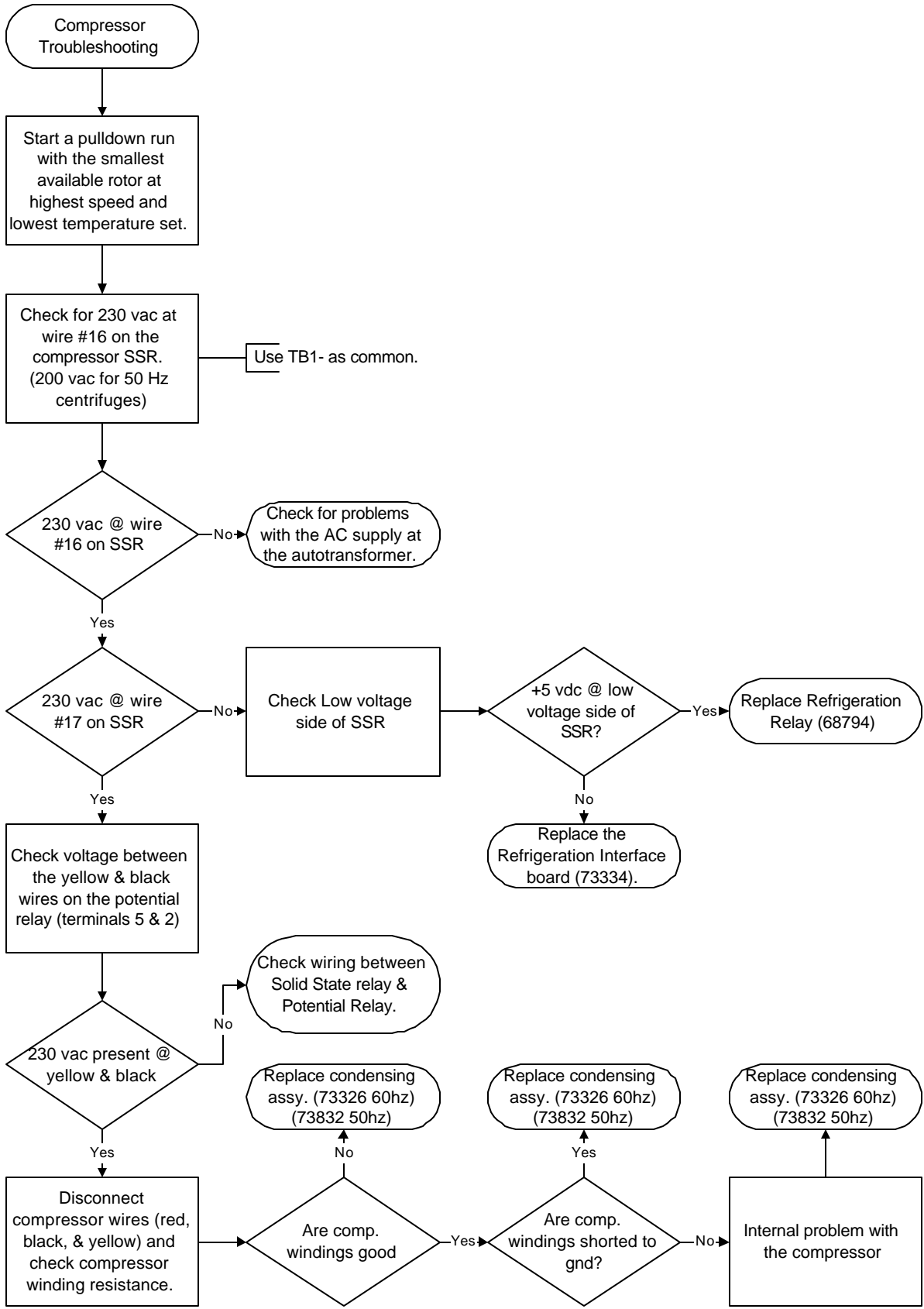


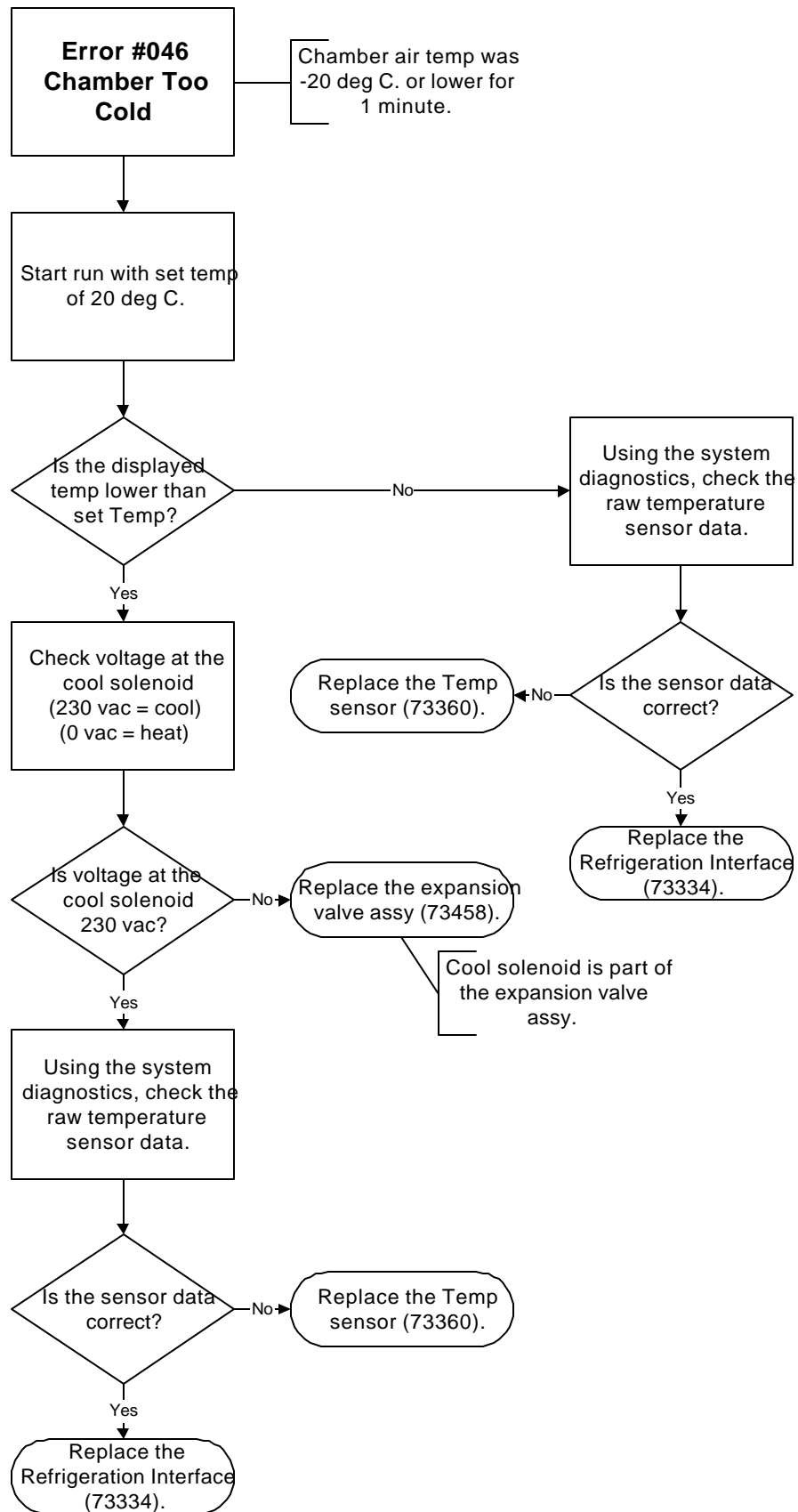


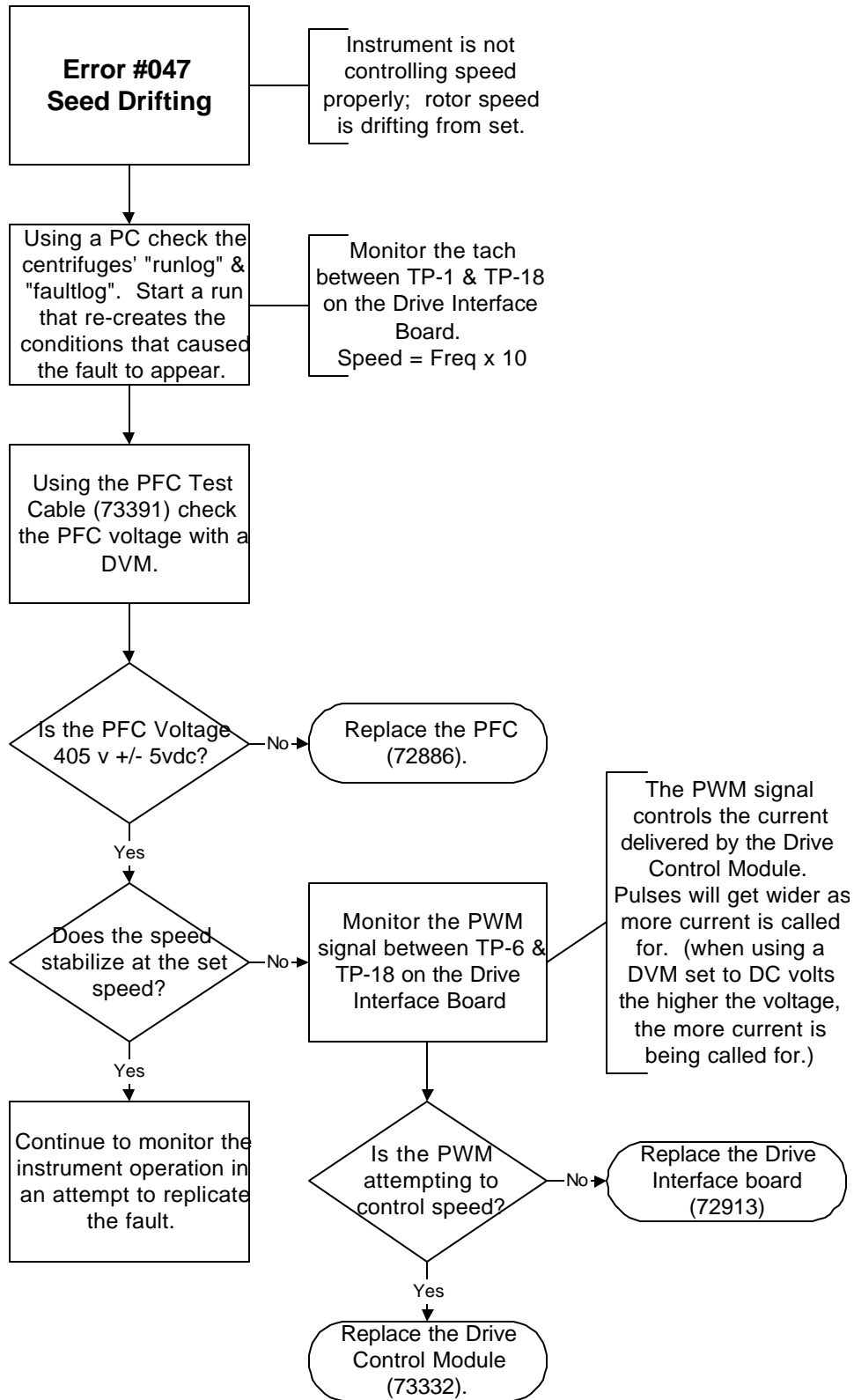


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**Error #048
Drive Fault**

Check PFC voltage at P-1 on the Drive Control Module
approx 280 vdc standby
405vdc drive enabled

Is PFC voltage Correct?

Check PFC supply at J-1 on the PFC assembly

Is PFC Supply between 200 & 240 vac?

Troubleshoot centrifuge power system

Replace PFC #72886

Check for Drive Enable (Red LED on Drive control module) after depressing "START"

Is Drive Enable LED ON?

Drive enable measured between TP-4 & TP-18 (common).
Logic High = Enabled

Check Drive Enable Signal at Drive Interface board.

Is Drive enable toggling with "START"?

Replace Drive Interface #73332

Replace Drive Control Module #72913

Replace Drive Cont Module #72913

PWM is measured between TP-6 & TP-18 (common)
Signal should ramp from 0 volts towards +5 volts.
0Vdc = no current
5Vdc = full current

Check PWM Signal at the Drive Interface board

Is the PWM signal Present?

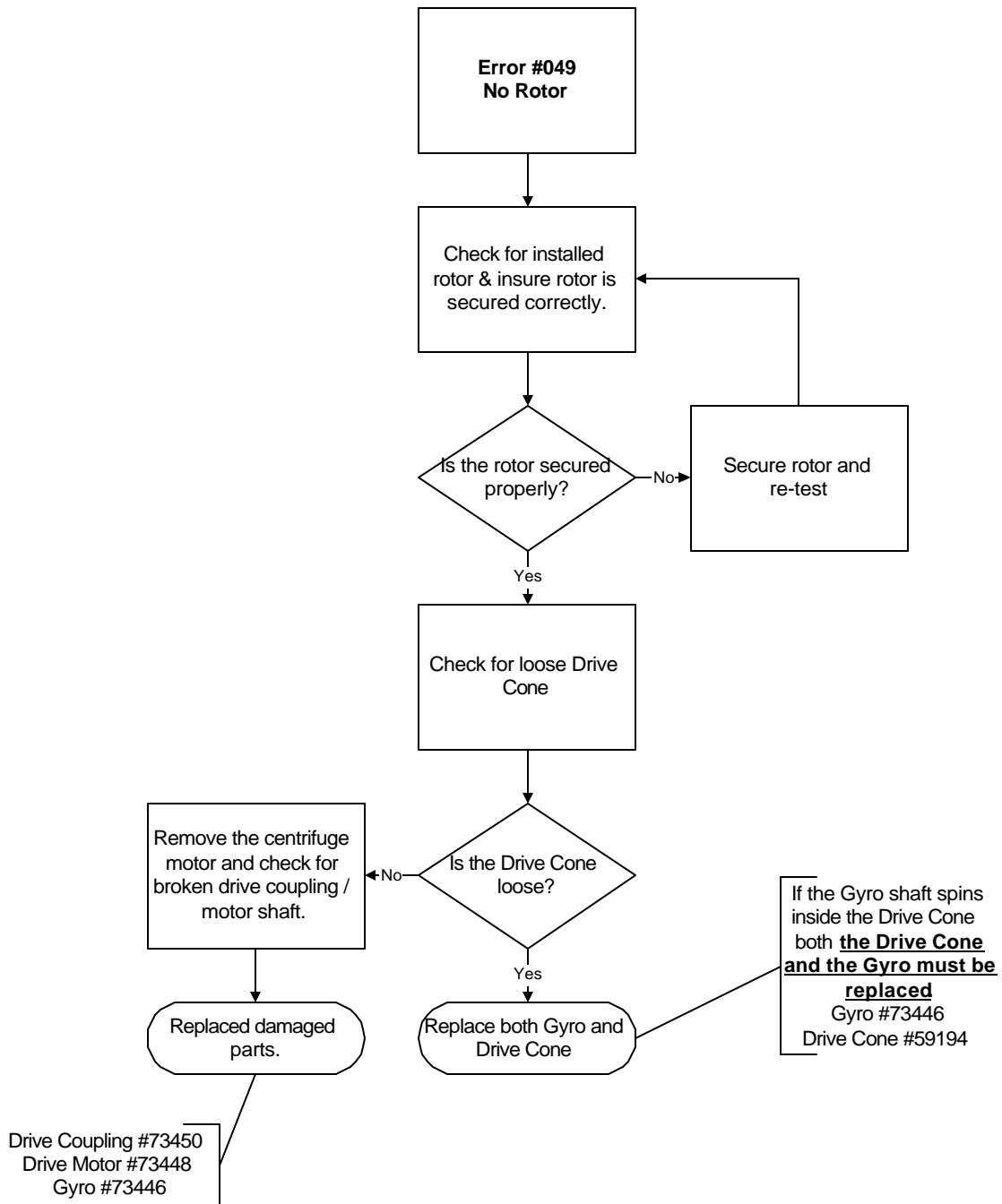
Replace Drive Interface #73332

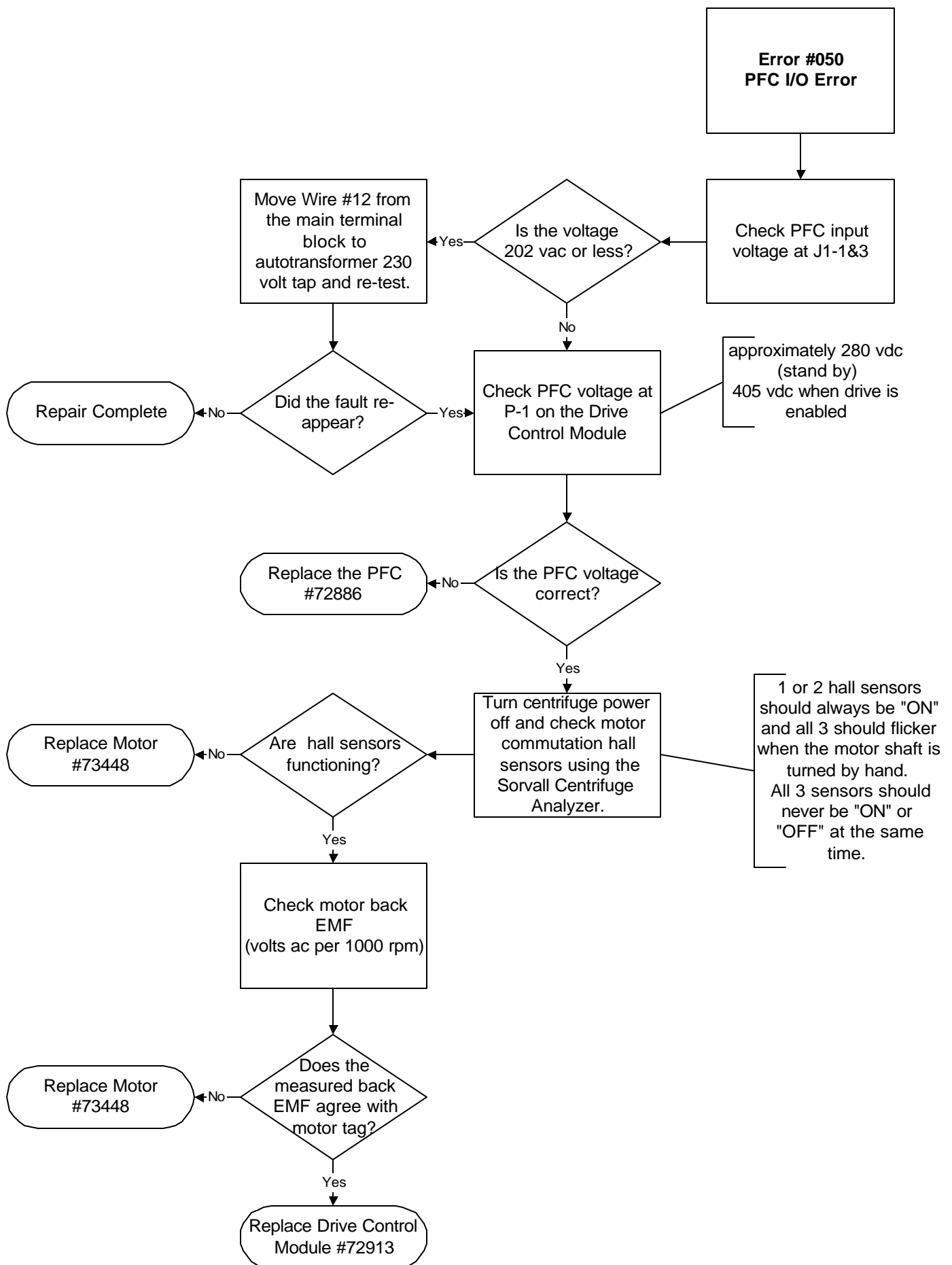
Check across any 2 phases (P2-2,3,or 4).
Voltage should ramp up greater than 25 volts DC

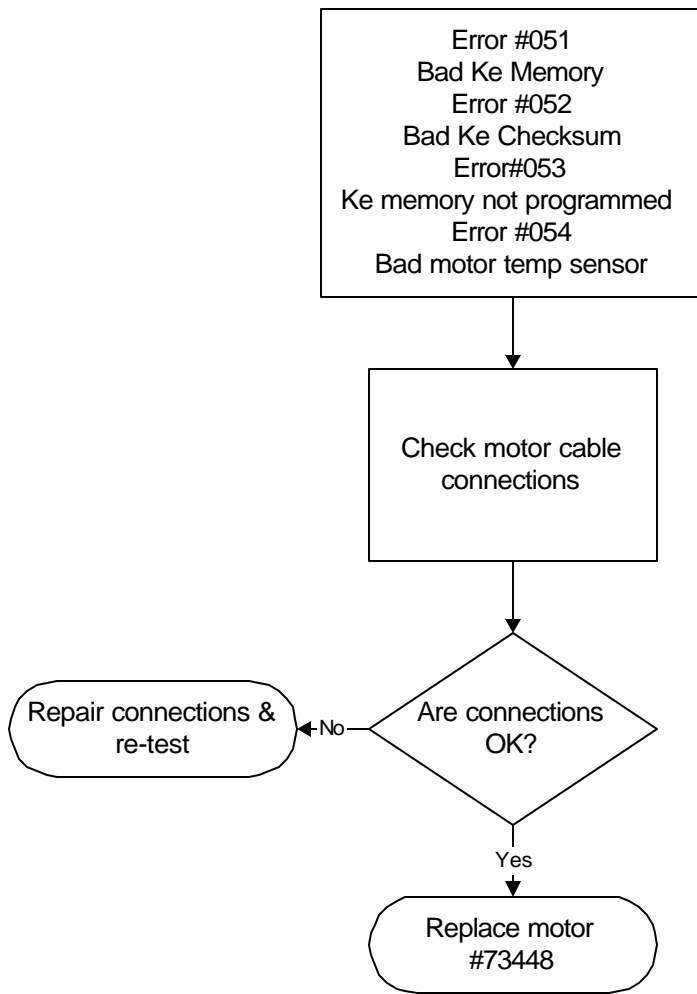
Check Voltage at the motor plug on the Drive Control Module P-2 after "START"

Is there greater than 25 volts DC?

Replace motor #73448







Evolution RC

Table of Contents

6.0 Repair & Replacement

- 6.1 Button Panel Conversion**
- 6.2 Condenser Assembly Replacement**
- 6.3 Display Board Replacement**
- 6.4 Door Repair Kit Installation**
- 6.5 Door Roller Replacement**
- 6.6 Drive Coupling Replacement**
- 6.7 Evaporator Replacement**
- 6.8 Expansion Valve / Liquid Line Replacement**
- 6.9 Filter Drier Replacement**
- 6.10 Gyro Replacement**
- 6.11 Gyro Damper Installation**
- 6.12 Gyro Spring Replacement**
- 6.13 Imbalance Sensor Replacement**
- 6.14 Knob Conversion**
- 6.15 Motor Replacement**
- 6.16 Software Update Installation**
- 6.17 Suction Line Replacement**
- 6.18 Temperature Sensor Replacement**

INSTRUCTIONS

for the

Button Conversion Kit

(Catalog No. 73841)

for the

SORVALL Evolution™ RC Centrifuge

Parts Included

Button Version Control Panel
73842 Installation Instructions

Instructions

Caution:

The printed circuit boards contained in the control console assembly are static sensitive and must be handled with the appropriate static control procedures.

Always use an anti static wrist-strap and workstation (Kendro part #73369).

1. Turn off the centrifuge power and disconnect the instrument power cord from the mains supply.
2. Disconnect the power supply cable and the IIC cable from the rear of the control console.
3. Using a 3mm Allen wrench remove the (4) socket head screws from the rear of the console assembly (1 in each corner). Remove the trim ring from the front of the control console and set aside.
4. Using a 3mm Allen wrench, remove the (4) screws that secure the control panel from the console assembly. Remove the control panel and place on a stable workbench insuring that an anti-static workstation (73369) is used.
5. Unplug the following connectors from the PC-104 processor.

Battery backup cable (73300)

Serial interface cable (73389)

Hard drive interface cable (73826)

J-10 on the display board

6. Using a 2.5mm Allen wrench, remove the (3) socket head screws that secure the PC-104 processor to the display board assembly. Using a 5.5mm wrench (nut driver) remove the remaining nut used to secure the PC-104 processor to the display board assembly.
7. Remove the PC-104 processor from the existing control panel assembly and install it on the new assembly.

Button Conversion Kit
(Catalog No. 73841)
for the
SORVALL Evolution™ RC Centrifuge

8. Using a 5.5mm wrench (nut driver) remove the (4) nuts that secure the hard disk / compact flash memory assembly to the control console assembly. Remove the hard disk / compact flash memory assembly and set aside.
9. Using a 5.5mm wrench (nut driver), remove the (4) standoffs that secure the hard disk assembly to the control console assembly. Install the standoffs onto the new console assembly.
10. Install the hard disk / compact flash memory assembly onto the new control console assembly and secure it with the (4) 5.5mm hex nuts that were removed in step #8.
11. Install the following connectors onto the PC-104 processor / display board.

J-10 on the display board
Hard disk interface cable (73826)
Serial interface cable (73389)
Battery backup (73300)

12. Install the new control panel assembly into the console using the (4) 3mm socket head screws that were removed in step #4.
13. Connect the power supply cable and the IIC cable into the rear of the control console assembly.
14. Connect the centrifuge line cord to the mains supply.
15. Locate the serial interface ribbon cable hanging just above the control console. Connect a null serial modem cable between the interface cable and the serial port on the laptop computer (null modem cable Kendro #73827).
16. On centrifuges that have the Advanced Features Option (LCD touchscreen)
17. connect the Null Modem interface cable (73389) (located inside the console assembly) to the pigtail cable that is attached to the PC-104 processor.

Button Conversion Kit
(Catalog No. 73841)
for the
SORVALL Evolution™ RC Centrifuge

Note:

On centrifuges that are using software revision #31 follow steps 18 through 22. On centrifuges that use software revisions 41 and higher skip to step #23.

18. Open the Hyperterminal program that is found in Windows 95, 98, 2000, & NT set for a baud rate of 9600. If there is a copy of the Evolution software update disk available the “Evolution Diagnostic” icon can be moved to the computer desktop and utilized.

19. Turn the centrifuge instrument power “ON”. As the Evolution RC instrument boots interrupt the boot process by depressing “CONTROL C” on the computer just after the “EVOL” program starts to run. See Figure #1.

```
HOT cable detected, Serial Loader starting.  
Press ESC to abort Hard disk boot  
Booting Hard Drive  
Loading...
```

```
DR DOS Release 5.0  
Copyright (c) 1976,1982,1988,1990 Digital Research Inc. All rights reserved.  
Ampro Computers, Inc.
```

```
C>ECHO ON  
C>evol
```

Figure #1

20. When the message displays “Halt the Batch Process” answer by typing “Y”.

21. Rename the Autoexec.bat file so that the instrument cannot be booted. (Rename the file something that will not be forgotten).

C>rename autoexec.bat steve

In this case the Autoexec was renamed “steve”.

22. Re-boot the Evolution RC instrument by cycling the power “OFF” then back “ON”.

23. The instrument will re-boot then ask for the date and the time. If no changes are to be made depress “ENTER” 2 times.

Button Conversion Kit
(Catalog No. 73841)
for the
SORVALL Evolution™ RC Centrifuge

```
HOT cable detected, Serial Loader starting.  
Press ESC to abort Hard disk boot  
Booting Hard Drive  
Loading...
```

```
DR DOS Release 5.0  
Copyright (c) 1976,1982,1988,1990 Digital Research Inc. All rights reserved.  
Ampro Computers, Inc.
```

```
Date: Sat 3-17-2001  
Enter date (mm-dd-yy):
```

```
Time: 4:00:54.87  
Enter time:
```

```
C>
```

Figure #2

24. On centrifuges that use software revision #41 and above turn the centrifuge power ON and allow the centrifuge to boot normally. To start the diagnostics type the letter “**d**” on the computer keyboard.
25. On centrifuges using software revision #37 at the “**C>**” start the Evolution Diagnostics by typing “**EVOLD**”. This will start the diagnostics program for the centrifuge and will display the menu depicted in figure #3.

```
C>evol d  
MAIN MENU  
-----  
c) configuration  
d) diagnostic tests  
s) Service Menu(s)  
a) exit menus (start application)  
e) exit application  
-----  
your choice: c
```

Figure #3

26. Select “**configuration**” by typing “**c**”. The display shown in figure #4 will show the “**configuration menu**”.

Button Conversion Kit
(Catalog No. 73841)
for the
SORVALL Evolution™ RC Centrifuge

SYSTEM CONFIGURATION MENU

p) panel
m) miscellaneous configuration
b) back to main menu

your choice: p

Figure #4

27. Select “**panel**” by typing “**p**”. The current panel configuration will be displayed. The configuration of the panel will be displayed on the first line. In the case of the instrument depicted in figure #5 the panel was set up for knobs (NVRAM knobs = 1). If the diagnostic screen indicates “**buttons = 1**” the configuration must be changed by typing “**K**”. This will change the configuration from “**buttons**” to “**knobs**”.

CURRENT PANEL CONFIGURATION

current state: NVRAM: knobs = 1
NVRAM: LM76 = 1
NVRAM: LCD = 0
NVRAM: KeValue = 9.210
NVRAM: KeGain = 1.240
NVRAM: Machine gain = 0.000 machine offset = 0.000
NVRAM: Sensor Slope = 0.0000000 Sensor offset = 0.0000000
knob panel
k) knob panel
b) button panel
5) using LM75
6) using LM76
l) LCD present
n) LCD NOT present
e) exit panel configuration

your choice:

Figure #5

28. Return to the configuration menu by typing “**e**”.

Button Conversion Kit
(Catalog No. 73841)
for the
SORVALL Evolution™ RC Centrifuge

SYSTEM CONFIGURATION MENU

- p) panel
 - m) miscellaneous configuration
 - b) back to main menu
-

your choice:

Figure #6

29. Return to the main menu by typing “b”.

MAIN MENU

- c) configuration
 - d) diagnostic tests
 - s) Service Menu(s)
 - a) exit menus (start application)
 - e) exit application
-

your choice:

Figure #7

30. Select the service menu by typing “s”.

-
- k) Read and Store Ke Value
 - r) Read and Store Ke Adjustment Ratio
 - m) Machine Temp Gain and Offset
 - s) Sensor Slope & Offset
 - a) Accelerometer menu
 - b) back to Main
-

your choice:

Figure #8

Note:

A numeric value must be entered even if it's the same as the current Ke value.

31. Select “Read and Store Ke Value” by typing “k”. The current Ke value will be displayed on the screen. Check the instrument Ke value that can be located on the motor power cable at the drive control module. Enter the motor Ke value that was read on the motor tag. After entering the motor Ke value the screen will indicate that the value was “**Completed**”. The display will return to the service menu.

Button Conversion Kit
(Catalog No. 73841)
for the
SORVALL Evolution™ RC Centrifuge

your choice: k
read and store ke value
KE value read is 9.210
Enter new value 9.210
Completed

k) Read and Store Ke Value
r) Read and Store Ke Adjustment Ratio
m) Machine Temp Gain and Offset
s) Sensor Slope & Offset
a) Accelerometer menu
b) back to Main

your choice:

Figure #9

- 32.** Select “Read and Store Ke Adjustment Ratio” by typing “r”. The display will show the Ke Adjustment Ratio that is currently in the memory. Enter the new Ke Adjustment Ratio (1.325 for software revision 37 or 1.250 for software revisions for revision 38 or above).

your choice: r
read and store Adjustment Ratio value
KE Adjustment Ratio value read is 1.325
Enter new value
b) back to menu
1.325
Completed

k) Read and Store Ke Value
r) Read and Store Ke Adjustment Ratio
m) Machine Temp Gain and Offset
s) Sensor Slope & Offset
a) Accelerometer menu
c) Compressor Selection
b) back to Main

Figure #10

- 33.** Select “Machine Temp Gain and Offset” by typing “m”. Enter the gain and offset (both must always be 0.000).

Button Conversion Kit
(Catalog No. 73841)
for the
SORVALL Evolution™ RC Centrifuge

your choice: m
Read and store Machine gain and offset values
Machine gain is 0.000 Machine offset is 0.000
Enter new gain
o) offset
b) back to menu
0.000
Enter new offset
b) back to menu
0.000
Completed

k) Read and Store Ke Value
r) Read and Store Ke Adjustment Ratio
m) Machine Temp Gain and Offset
s) Sensor Slope & Offset
a) Accelerometer menu
c) Compressor Selection
b) back to Main

Figure #11

- 34.** Select “Back to Main Menu” by typing “b”.

your choice: b
MAIN MENU

c) configuration
d) diagnostic tests
s) Service Menu(s)
a) exit menus (start application)
e) exit application

your choice: e

Figure #12

- 35.** Exit the service diagnostics by selecting exit application “e”.
- 36.** At the “C>” start the accelerometer (imbalance) diagnostic by typing “EVOLA”.

C>evol a
Are you sure that you want to calibrate the accelerometer? (y/n)

Figure #13

Button Conversion Kit
(Catalog No. 73841)
for the
SORVALL Evolution™ RC Centrifuge

Note:

Type “y” (yes) before attempting to open the centrifuge door. The door can be opened after the centrifuge display becomes active.

The Evolution RC will ask if you want to calibrate the accelerometer. Continue by answering “Y” (yes).

Insert SS34 rotor with 20 gram imbalance
Then start a run at 15,000 rpm and wait
Continue? (y/n)

Figure #14

The Evolution RC will then instruct you to place a SS-34 rotor into the instrument with a 20 gram imbalance and to start a run to 15,000 rpm. Type “Y” to continue. The Evolution RC console will now boot up and the display will display a normal start screen.

- 38.** Even though the instrument is asking to use a SS-34 rotor, any of the following rotors can be used at the weights and set speeds that are indicated.

Rotor	Imbalance Weight	Set Speed
SLC-6000	48 grams	8,500 rpm
SLA-1500	32 grams	10,000 rpm
SLA-3000	48 grams	10,000 rpm
SS-34	20 grams	15,000 rpm

Figure #15

- 39.** The Evolution RC will accelerate normally to the set speed. When the instrument reaches the set speed, the Evolution RC will run a routine that will calibrate the accelerometer. The accelerometer data will be displayed on the computer screen as is shown below.

Button Conversion Kit
(Catalog No. 73841)
for the
SORVALL Evolution™ RC Centrifuge

```
NVRAM: knobs = 1
NVRAM: LM76 = 1
NVRAM: LCD = 0
NVRAM: KeValue = 9.210
NVRAM: KeGain = 1.240
NVRAM: Machine gain = 0.000 machine offset = 0.000
NVRAM: Sensor Slope = 0.0000000 Sensor offset = 0.0000000
KE_5 windage limit
cal_numb = -381
cal_numb = -381
cal_numb = -379
cal_numb = -382
cal_numb = -382
cal_numb = -381
cal_numb = -380
cal_numb = -380
cal_numb = -380
cal_numb = -381
cal_numb = -381
cal_numb = -380
cal_numb = -380
cal_numb = -383
cal_numb = -385
cal_numb = -387
cal_numb = -388
cal_numb = -386
cal_numb = -387
Saving calibration data to Flash Disk
Accelerometer Calibrated at: -382
```

Please wait until rotor stops, then cycle power

Figure #16

- 40.** When the calibration is complete the Evolution RC will display an Imbalance Fault and will shut down. At the end of the run the Evolution RC will display “**ERROR**” in the speed display. The calibration is now complete. Cycle the Evolution RC main power “**OFF**” then back “**ON**”.
- 41.** At the “**C>**” prompt rename the Autoexec.bat file back to “**Autoexec.bat**”.
- 42.** Cycle the Evolution RC power “**OFF**” then back “**ON**”. The instrument will now boot up normally. No other calibrations are needed and the instrument should run normally.
- 43.** Disconnect the computer and tuck the interface ribbon cable into the control console. Install the trim ring using the 3mm Allen Wrench.

Button Conversion Kit
(Catalog No. 73841)
for the
SORVALL Evolution™ RC Centrifuge

44. On centrifuges with the Advanced Features Option (LCD Touch Screen) disconnect the Null Modem Interface cable (73389) from the pigtail that is connected to the PC-104 processor and tuck the cable into the cable clamp located inside the console assembly. (Failure to disconnect the interface cable will cause the LCD Touch Screen to be disabled.)
45. Install the trim ring that was removed earlier and replace the centrifuge into its original position.

INSTRUCTIONS

for the Evolution RC Condenser Assembly Kit (Kit Catalog No. 73326)

Parts Supplied

Quan	Part #	Description
1		Condenser Assembly
10 ft		Cork Insulating Tape
10 ft		Foam Insulating Tape
2 ft		Mortite Caulking Cord
2	61768	Teflon Seal, 7/8"
1	66952	Teflon Seal, 5/8"
10	69621	Cable Clip
1	59846	Label, "Danger"
1	68868	Label, "Warning"
2	91909	Label, Refrigerant, SUVA HP-62
1	90702	Loctite #222
1	65664	RTV Sealant



Warning:

Because of the presence of high voltage, untrained personnel must not attempt to test, repair, or modify any electrical circuits or systems in this unit.



Caution:

This procedure should only be attempted by a qualified technician who has been trained in the proper servicing of SORVALL® Evolution™ RC centrifuges and SORVALL® centrifuge refrigeration systems. These instructions assume that the repairer has such expertise.



Warning:

Because of the characteristics of the samples likely to be processed in this centrifuge, biological or radioactive contamination may occur. Always be aware of this possibility, and take normal precautions. The Kendro Service Decontamination Policy states that a completed Decontamination Information Certificate is required before Servicing.

Tools and Other Items Required

- Allen Wrenches, Metric: 2, 3, 4, 5, and 6 mm
- Box Wrench, Metric, 10 mm
- Open-end Wrenches, SAE: 7/8, 1, 1-1/8, 1-1/4 and 1-3/8 inch
- Open-end Wrench, Metric, 6 mm
- Torque Wrench, 68–81 N . m (50–60 ft- lb), with SAE Open-End Wrench Ends: 1-1/4 and 1-3/8 inch
- Leak-lock® Fitting Sealant
- Helium Test Kit
- Refrigeration Recovery/Charging Equipment
- Suva® HP62 (R404A) HFC Refrigerant
- Laptop Computer with serial port, running MSWindows 95® or later
- Null Modem Cable, DB9 F to DB9 F (Kendro Catalog No. 73827)

Instructions

A. Removing the Cabinet Panels

1. Open the chamber door, then turn the main power switch OFF, unplug the centrifuge, and wait four minutes before proceeding.

INSTRUCTIONS

for the
Evolution RC Condenser Assembly Kit
(Kit Catalog No. 73326)



Warning

Hazardous voltages may exist whenever power is connected and circuits are energized. To eliminate potential for serious electrical shock or component damage, turn the main power switch OFF, unplug the centrifuge, then wait four minutes before proceeding.

2. If the centrifuge is located so that there is no room to work behind or in front of the centrifuge, raise the front locking stabilizers and roll the centrifuge to a suitable working location.
3. Using a 4 mm Allen wrench, remove the two screws with washers from the louver area of the front panel, then remove the front panel.
4. Using a 6 mm Allen wrench, remove the two screws that secure the back of the top rear deck.
5. Using a 5 mm Allen wrench, remove the single screw from the center of the control console bracket, then remove the top rear deck.
6. Using a 3 mm Allen wrench, remove the six screws securing the rear panel, and remove the panel.
7. Using a 3 mm Allen wrench, remove the two screws that secure the drip tray between the door rails, then remove the drip tray.

B. Removing the Motor/Gyro Assembly

1. Working inside the evaporator chamber, using a 4 mm Allen wrench through the center hole in the tapered spindle, unscrew the captive screw, then pull the tapered spindle up and off of the gyro
2. Using a 2 mm Allen wrench, loosen the two set screws that secure the slinger to the gyro shaft, then slide the slinger up and off of the gyro shaft.
3. Remove the gyro boot (affixed with RTV adhesive): First work the circumference off of the evaporator rim, then, being careful not to stress the temperature sensor cable, pull the boot (with temperature sensor attached) straight up and off of the gyro housing.
4. Carefully, so as not to damage the gyro boot or temperature sensor cable, work to remove and discard the old RTV sealant remaining from the underside of the boot (do not remove sealant from where the sensor cable feeds through the boot). Then set the boot/sensor assembly aside on the evaporator floor.

INSTRUCTIONS

for the
Evolution RC Condenser Assembly Kit
(Kit Catalog No. 73326)

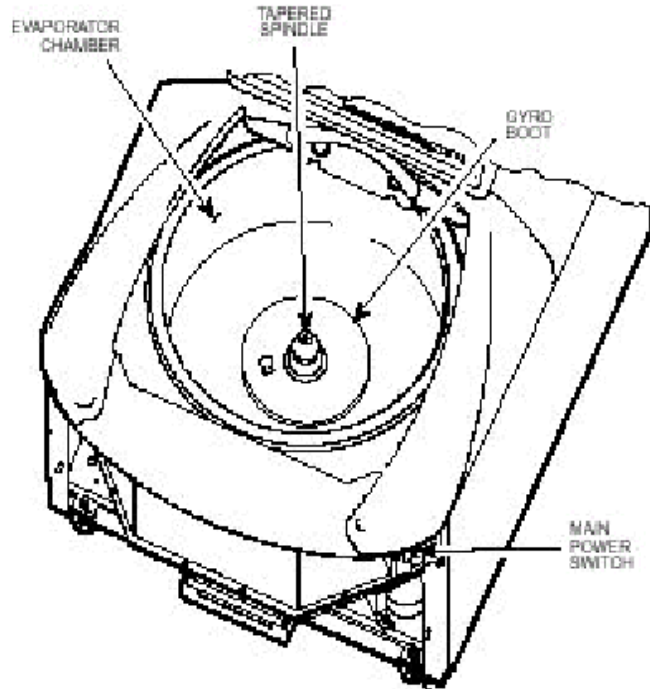


Figure 1

5. One at a time, pull the two insulating disks off of the gyro.
6. Remove the caulk from around the gyro's outer clamp ring. Discard the caulk.
7. Using a 3 mm Allen wrench, remove the two screws that secure the imbalance sensor to the gyro. Draw the cables from the imbalance and temperature sensors straight up, bend them toward the front of the centrifuge, and hook the cables over the evaporator rim (so that the sensors can stay in the bottom of the chamber and the two cables will be out of the way).
8. Using a 4 mm Allen wrench, reinstall the tapered spindle on the gyro shaft.

INSTRUCTIONS

for the
Evolution RC Condenser Assembly Kit
(Kit Catalog No. 73326)

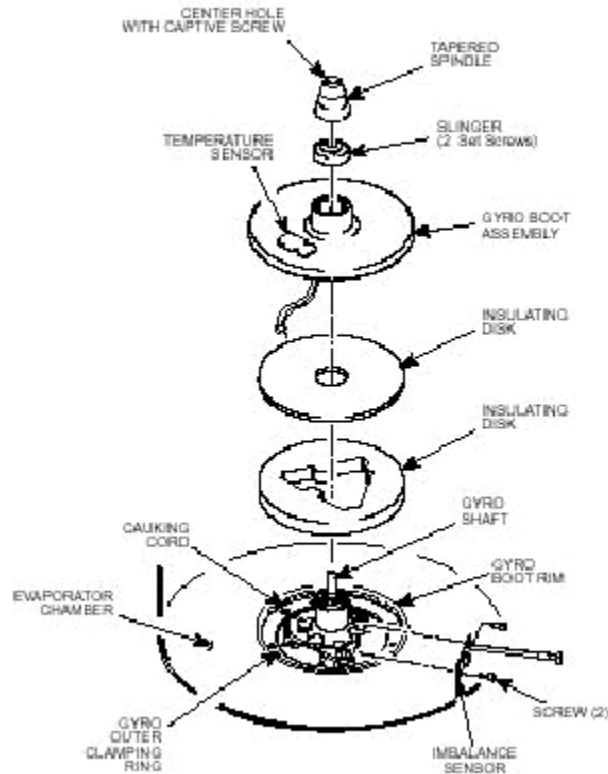


Figure 2

Note:

On centrifuges with serial numbers 10300736 and above skip step 9-a.

9. Working down underneath in front, disconnect all wires coming from the motor shroud:
 - a. Unplug the motor cable from the drive box and from the Ke P.C. board, and disconnect the ground wires from the frame using a 3 mm Allen wrench.
 - b. Unplug the commutation wires from the drive box.
 - c. Unplug the auxiliary tachometer wires from the drive interface P.C. board.
10. Using a 10 mm box wrench, remove the four nuts that are located up under the evaporator baseplate near the top of the motor shroud.

INSTRUCTIONS

for the
Evolution RC Condenser Assembly Kit
(Kit Catalog No. 73326)

11. From below, feed all motor cables and connectors (disconnected in step 9) into the motor shroud so that they will lay loose inside the shroud on top of the motor fan.

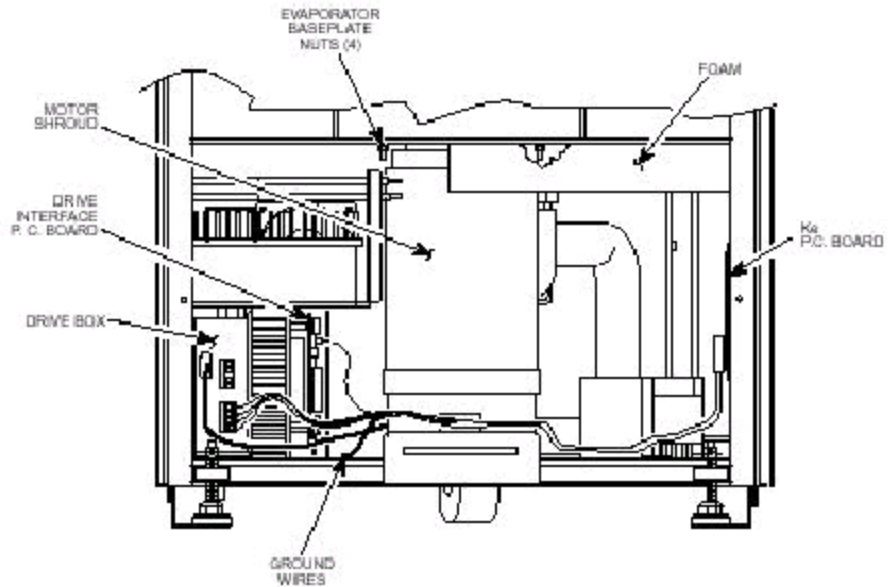


Figure 3

12. From above, using the tapered spindle as a handle, lift the motor/gyro assembly up and, being careful not to crush sensor cables, temporarily set it in the evaporator chamber.
13. Pull the motor cables up into the evaporator chamber, then lift the motor/gyro assembly from the centrifuge.

C. Removing the Condenser Assembly and Suction Line

1. From below, unplug the two wires from the motor fan, then using a 4 mm Allen wrench, remove the two screws securing the motor fan mounting brackets to the centrifuge frame baseplate. Remove the motor fan/shroud assembly.

INSTRUCTIONS

for the Evolution RC Condenser Assembly Kit (Kit Catalog No. 73326)

2. Remove insulating tape as required to access the two refrigeration system service valves (see illustration for valve locations), then connect refrigeration equipment and recover the refrigerant (Suva® HP62 [R404A]).
3. Remove insulating tape from the two evaporator fittings. Using three SAE open-end wrenches (top to bottom, 1, 1-1/4, and 7/8 inch) so that the two stationary fittings and connected tubing will not be twisted as the Rotalock® nut turns, disconnect the evaporator supply line from the evaporator fitting (see figure 4). Plug the end of both the supply line and the evaporator intake to seal them (to minimize moisture contamination).
4. Using three larger SAE open-end wrenches (top to bottom, 1-1/4, 1-3/8, and 1-1/8 inch), disconnect the suction line, then plug both the end of the evaporator output and the end of the suction line.

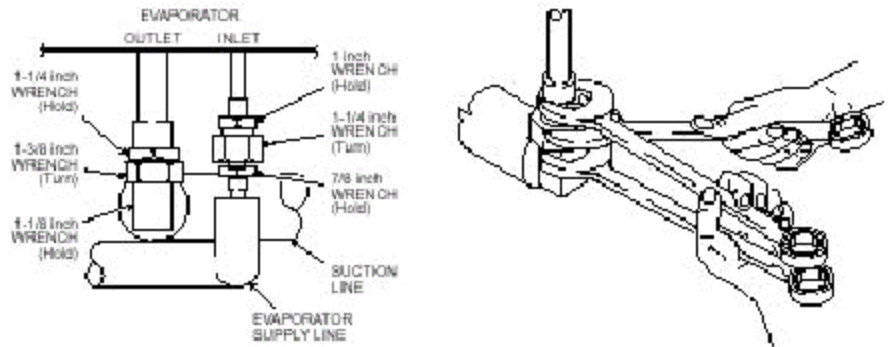


Figure 4

5. Using a 4 mm Allen wrench, remove the screw securing the inside edge of the condenser assembly baseplate (the corner of the baseplate directly below the evaporator fittings).
6. Disconnect the two power wires (nos. 16 & 17) from the compressor relay (solid state relay is located on the rear wall behind the evaporator chamber, to the right as you face the rear).
7. Working behind the centrifuge, disconnect all wires/cables that connect to the condenser assembly: unplug the fan harness connector, the hot gas solenoid (two wires, located above the condenser near the high side service valve), and the cables running to the refrigeration P.C. board.

INSTRUCTIONS

for the
Evolution RC Condenser Assembly Kit
(Kit Catalog No. 73326)

8. Using a 4 mm Allen wrench, remove the two screws securing the back corners of the condenser assembly baseplate (one from each corner).
9. Carefully (the assembly is heavy) remove the condenser assembly with the suction line attached from the centrifuge. Remove the round rubber cushioning pads that were positioned underneath the condenser assembly baseplate.
10. Remove any remaining insulating tape from the Rotalock ® fitting where the suction line connects to the compressor (at the low side service valve), then on the horizontal section of suction line below the fitting, cut and peel back the insulation where the expansion valve bulb sensor is attached.
11. Note the position of the expansion valve bulb sensor on the suction line (for installation of the new bulb sensor), then remove the bulb sensor from the suction line (leave the thermocouple sensor attached to the suction line).
12. Note the position of the suction line on the old condenser assembly (for installation on the new condenser assembly), then using the three larger SAE open-end wrenches, remove the suction line from the compressor.
13. On the new condenser assembly (supplied), affix the DANGER label, WARNING label, HP62 refrigerant labels, and plastic cable clips (catalog nos. 59846, 68868, 91909, and 69621, supplied) to the new condenser assembly, matching the locations of those affixed to the old condenser assembly.
14. Transfer components that are not supplied in the kit from the old condenser assembly to the new condenser assembly: On the condenser shroud, transfer the two condenser fans with wiring, the line filter (if any), and the refrigeration P.C. board.

INSTRUCTIONS

for the
Evolution RC Condenser Assembly Kit
(Kit Catalog No. 73326)

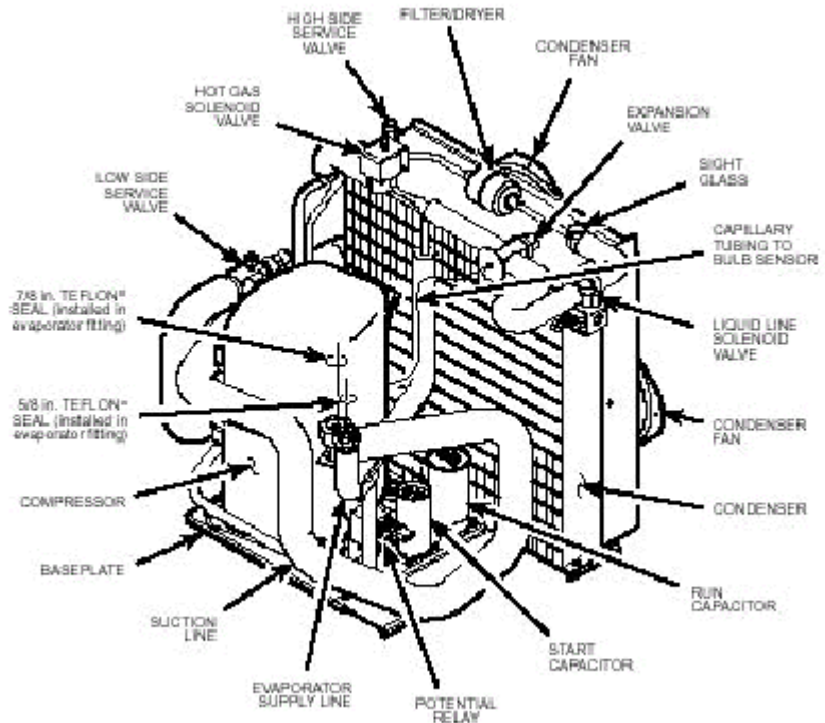


Figure 5

D. Installing the New Condenser Assembly:

1. Remove the plug from the suction line fitting on the new compressor. Install a new 7/8-inch seal (catalog no. 61768, supplied) into the end of the compressor fitting, then apply Leak Lock ® sealant to the fitting.
2. Position the suction line (removed in step C12) on the new condenser assembly, then thread the suction line Rotalock ® nut onto the compressor fitting. Again using three wrenches to avoid damage (1-1/4, 1-3/8, and 1-1/8 inch), but this time with the middle wrench being a torque wrench with an open-end adapter, tighten the Rotalock ® nut to 68 to 81 N · m (50 to 60 ft-lb).
3. Install the new expansion valve bulb on the suction line. Use insulating tape (supplied) to seal the insulation where the expansion valve capillary tubing and the thermocouple sensor wires exit the suction line insulation.

INSTRUCTIONS

for the
Evolution RC Condenser Assembly Kit
(Kit Catalog No. 73326)

4. Working inside the centrifuge underneath the center plate, remove and discard the Teflon® seal from the mating edge of both evaporator fittings. Insert a new Teflon® seal (catalog nos. 61768 and 66952, supplied) into the end of each evaporator fitting, then apply Leak Lock sealant.
5. Slide the new condenser assembly into position inside the centrifuge frame, installing the round rubber cushioning pads (removed in step C9) underneath the assembly baseplate. Using a 4 mm Allen wrench, secure the condenser assembly in place using hardware removed in steps C5 and C8.
6. Being careful not to dislodge the Teflon® seals, remove the plugs from the two evaporator fittings.
7. Remove the plug from the end of the suction line, then thread the Rotalock® nut onto the larger evaporator fitting. Using the same three wrenches used in step D2 earlier, tighten the suction line Rotalock® nut to 68 to 81 N . m (50 to 60 ft- lb).
8. Remove the plug from the end of the evaporator supply line, then thread the Rotalock® nut onto the smaller evaporator fitting. Using three smaller wrenches (again with the middle being a torque wrench, top to bottom, 1, 1-1/4, and 7/8 inch), tighten the evaporator supply line Rotalock® nut to 68 to 81 Nm (50 to 60 ft-lb).
9. Using helium, pressurize the refrigeration system through both service valves, then check for leaks by applying liquid soap at each of the five fittings and watching for bubbles. If a leak is detected, using appropriate wrenches to avoid damage, tighten the fitting enough to seal.
10. If no leaks are detected, configure refrigeration equipment for evacuation, then release the helium and evacuate the system. Continue with the procedure while the system is being evacuated, checking the vacuum level from time to time. Once the vacuum reading gets to 29 inches Hg (1.2 kPa) or greater, note the time – then continue to evacuate the system for a minimum of one hour from that point.
11. Wipe the liquid soap from the filter/dryer fittings and refrigeration lines, as well as from the top of the condenser (if any dripped).

INSTRUCTIONS

for the
Evolution RC Condenser Assembly Kit
(Kit Catalog No. 73326)

12. Wipe the liquid soap from the two evaporator fittings and refrigeration lines, from the connection at other end of the suction line, as well as from the frame baseplate. Insulate the three fittings using the tape supplied (apply the cork tape first, then use the foam tape to cover it).
13. Reconnect the two power wires (nos. 16 & 17, disconnected in step C6) to the compressor relay, then behind the centrifuge, reconnect all condenser assembly wires/cables (disconnected in step C7).
14. Reinstall the motor fan/shroud assembly (removed in step C1) and secure it in place using a 4 mm Allen wrench. Reconnect the motor fan wires.

E. Installing the Motor/Gyro Assembly:

1. Remove any RTV sealant remaining on the rim of the opening in the bottom of the evaporator.
2. Apply a drop of Loctite ® 222 to each of the four studs on the bottom of the mounting ring, then transport the motor/gyro assembly to the centrifuge and, being careful not to crush sensor cables, temporarily set it down inside the evaporator chamber.
3. Tape the auxiliary tachometer cable to the commutation cable (tape is temporary, to aid routing), then feed the motor cables down through the motor shroud; route the motor drive cable out the hole in the front, and route commutation and auxiliary tachometer cables out the hole on the left side.

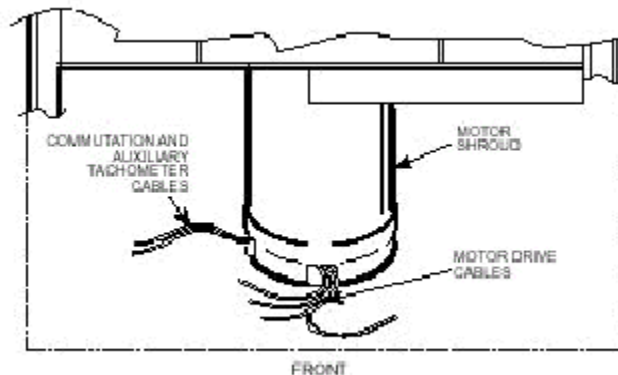


Figure 6

INSTRUCTIONS

for the
Evolution RC Condenser Assembly Kit
(Kit Catalog No. 73326)

4. Using the tapered spindle as a handle, orient the motor/gyro assembly so that the two notches in the outside edge of the gyro assembly face toward the front of the centrifuge. Lower the motor/gyro assembly into its correct position (being careful not to pinch the sensor wires) so that the four studs in the mounting ring engage the four holes in the evaporator baseplate (see figure 7).
5. Working down underneath in front, thread the four nuts (removed in step B10) onto the four mounting ring studs (located up on the evaporator baseplate near the top of the motor shroud), and tighten each nut securely using a 10 mm box wrench.
6. Connect all wires coming from the motor shroud:
 - a. Separate the auxiliary tachometer cable from the commutation cable by removing the tape applied in step E3, then connect the auxiliary tachometer wires to the drive interface P.C. board.
 - b. Connect the commutation wires to the drive box.
 - c. Connect the motor cable to the drive box and to the Ke P.C. board, and reconnect the ground wires to the frame using the hardware removed in step B9 and tighten using a 3 mm Allen wrench.
7. Working inside the evaporator chamber, use a 4 mm Allen wrench to remove the tapered spindle from the gyro shaft.
8. Using the length of new caulking cord supplied, seal around the gyro's outer clamp ring.
9. Apply a drop of Loctite ® 222 to each of the two screws that were used to secure the imbalance sensor (removed in step B7), then using a 3 mm Allen wrench, secure the imbalance sensor to the gyro.
10. Orient the lower insulating disk (with triangular cutout) so that the flat side of the cutout aligns with the imbalance sensor. When installed, the imbalance sensor cable should be completely underneath the disk, and the disk should be fully seated on the gyro.
11. Orient the thin upper insulating disk smooth side up, then install the disk on the gyro so that it seats flush against the lower disk.

INSTRUCTIONS

for the
Evolution RC Condenser Assembly Kit
(Kit Catalog No. 73326)

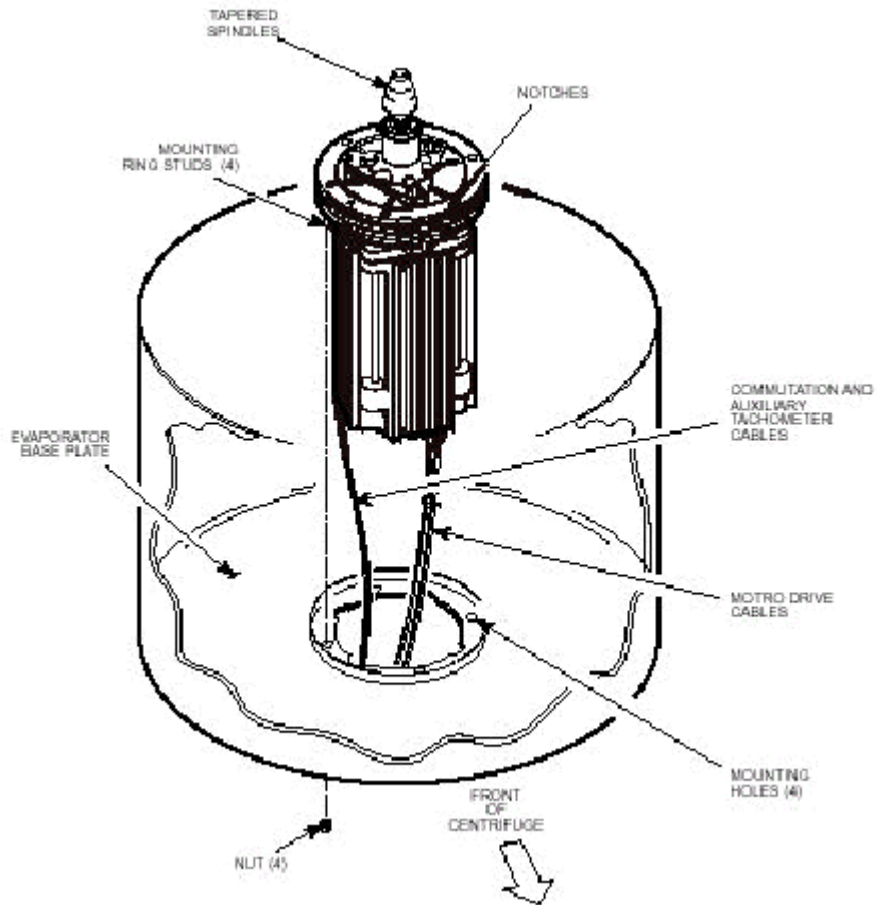


Figure 7

12. Apply a continuous bead of RTV adhesive around the underside of the gyro boot, in the outer groove that runs just inside the lip of the large disk portion.
13. Orient the gyro boot above the gyro so that the temperature sensor cable is not twisted and so that the sensor is aligned with where the sensor cable feeds down past the gyro. Slide the gyro boot onto the gyro until the mouth of the boot is below the rib that runs around the top of the gyro housing.
14. Bundle and tuck the temperature sensor cable in under the gyro boot, then work the lip of the boot onto the rim of the evaporator chamber. Make sure the evaporator rim is fully engaged all the way around the boot to ensure that the RTV adhesive will create a proper seal.

INSTRUCTIONS

for the Evolution RC Condenser Assembly Kit (Kit Catalog No. 73326)

15. Grasp the neck of the gyro boot and push it downward to fully expose the rib that runs around the top of the gyro housing. Apply a continuous bead of RTV adhesive around the gyro housing, just below the rib, then work the mouth of the boot back upward until its annular groove (just inside the mouth of the boot) fully engages the rib on the gyro housing to create a proper seal. Wipe any excess adhesive from the boot and gyro housing, making sure that none gets on the gyro shaft.
16. Slide the slinger (removed in step B2) down onto the gyro shaft until it seats, then slide it back upward just a small amount to ensure that it isn't touching the gyro boot. Using a 2 mm Allen wrench, tighten both screws to secure the slinger to the gyro shaft.
17. Apply a drop of Loctite ® 222 to the tapered spindle screw, then using a 4mm Allen wrench, reinstall and securely tighten the tapered spindle on the gyro shaft.
18. Insert the top of the front panel underneath the top deck and set it in position on the two pins on the front of the centrifuge. Reinstall the two screws with washers (removed in step A3) and, using a 4 mm Allen wrench, tighten the two screws to secure the panel.

F. Charging the Refrigeration System:

1. After the refrigeration system vacuum level has been at 29 inches Hg (1.2 kPa) or greater for at least one hour, charge the refrigeration system. Refrigeration charging specifications for the Evolution™ RC are supplied below.

Evolution™ RC Refrigeration Charging Specifications	
Refrigerant Type	Suva® HP62 (R404A) HFC
Initial Refrigerant Charge Weight	3.00 lbs. (1360 grams)
(during Superheat/Cond. T.D. optimization, additional liquid refrigerant will be added through low-side throttling valve)	
Specified Heat Load Rotor	SS-34
Operating Superheat Value	19°F (10.6°C)
Maximum Condenser T.D. Value	25°F (13.9°C)

Figure 8

INSTRUCTIONS

for the
Evolution RC Condenser Assembly Kit
(Kit Catalog No. 73326)

2. After optimizing the refrigerant charge based on condenser T.D. and superheat, perform a test run to check centrifuge performance and temperature control (if the centrifuge was moved, be sure to use the front locking stabilizers to level the centrifuge before operation).
3. Make sure the two service valve ports are closed securely, then remove the refrigeration equipment, reinstall all service valve caps, and apply insulation tape to the low-side service valve.
4. Position the drip tray between the door rails, reinstall the two screws (removed in step A7) and, using a 3 mm Allen wrench, tighten the two screws to secure the drip tray.
5. Position the rear panel on the rear of the centrifuge frame, and using a 3 mm Allen wrench, secure the panel in place using the six screws (removed in step A6).
6. Position the top rear deck on the frame, then using a 5 mm Allen wrench, reinstall the single screw in the center of the control console bracket. Using a 6 mm Allen wrench, reinstall the two screws that secure the back of the top rear deck.
7. If the centrifuge was moved, return it to its original operating location and level it using the front locking stabilizers.

Note:

Calibrate the centrifuge imbalance following the procedure outlined in the Calibration & Software section of the Evolution RC Service Manual.

INSTRUCTIONS

for the
Evolution RC Display Board Kits
(Kit Catalog No. 73337 & 73338)



Warning

Because of the presence of high voltage, untrained personnel must not attempt to test, repair, or modify any electrical circuits or systems in this centrifuge.

Caution

The printed circuit boards contained in the control console assembly are static sensitive and must be handled with the appropriate static control procedures. Always use an anti static wrist-strap and workstation (Kendro part #73369).

Parts Included Knob Display Board Kit

Quan	Part Number	Description
1	-----	Button Display Board
1	73347	Installation Instructions
1	72982	Gasket

Parts Included Knob Display Board Kit

Quan	Part Number	Description
1	-----	Knob Display Board
1	73347	Installation Instructions
1	72982	Gasket

Instructions

1. Turn off the centrifuge power and disconnect the instrument power cord from the mains supply.
2. Disconnect the power supply cable and the IIC cable from the rear of the control console.
3. Using a 3mm Allen wrench remove the (4) socket head screws from the rear of the console assembly (1 in each corner). Remove the trim ring from the front of the control console and set aside.
4. Using a 3mm Allen wrench, remove the (4) socket head screws that secure the control panel from the console assembly. Remove the control panel and place on a stable workbench insuring that an anti-static workstation (73369) is used.
5. Unplug the following connectors from the PC-104 processor.

Battery backup cable (73300)
Hard drive interface cable (73826)
J-10 on the display board

INSTRUCTIONS

for the Evolution RC Display Board Kits (Kit Catalog No. 73337 & 73338)

- Using a 2.5mm Allen wrench, remove the (3) socket head screws that secure the PC-104 processor to the display board assembly. Using a 5.5mm wrench (nut driver) remove the remaining nut used to secure the PC-104 processor to the display board assembly.



Figure 1

Note:

Some centrifuges may contain a hard disk assembly instead of the compact flash memory. This assembly is to be treated the same as if working with the compact flash memory.

- Remove the PC-104 processor from the existing control panel assembly and install it on the new assembly.
- Using a 5.5mm wrench (nut driver) remove the (4) nuts that secure the compact flash memory assembly to the control console assembly. Remove the compact flash assembly and set aside.
- Using a 5.5mm wrench (nut driver), remove the (4) standoffs that secure the compact flash assembly to the control console assembly (Standoffs with nylock nuts under). Install the standoffs onto the new console assembly.
- When replacing the Display Board on Knob style centrifuges use a 2.5 mm Allen wrench to remove the 4 knobs (Rotors, Speed, Temperature, & Time).
- Using a 5.5 mm nut driver or wrench, remove the (11) nylock nuts from the console that secure the display board. Using a flat blade screwdriver, remove the (3) pan head screws located under the gasket (around the interface connectors).

INSTRUCTIONS

for the
Evolution RC Display Board Kits
(Kit Catalog No. 73337 & 73338)

12. Remove the remaining standoffs from the old display board and install them on the new board.
13. Discard the old display board
14. Install the new display board onto the console assembly and secure the (11) nylock nuts removed previously. Install the (3) pan head screws around the interface connectors. Install the gasket that is supplied in the kit around the interface connectors.
15. Install the Ampro Processor onto the standoffs and secure with the (3) socket head screws and (1) hex nut removed previously.
16. Install the 4 standoffs that are used to secure the Hard Disk assembly to the display board.
17. Install the compact flash memory assembly onto the new control console assembly and secure it with the (4) 5.5mm hex nuts that were removed in step #8.
18. Install the following connectors onto the PC-104 processor / display board.
J-10 on the display board

compact flash interface cable (73826)
Battery backup (73300)
19. Install the control panel assembly into the console using the (4) 3mm socket head screws that were removed in step #4.
20. Connect the power supply cable and the IIC cable into the rear of the control console assembly.
21. Connect the centrifuge line cord to the mains supply.
22. Locate the serial interface ribbon cable hanging just above the control console. Connect a null serial modem cable between the interface cable and the serial port on the laptop computer (null modem cable Kendro #73827).

INSTRUCTIONS

for the Evolution RC Display Board Kits (Kit Catalog No. 73337 & 73338)

23. On centrifuges that have the Advanced Features Option (LCD Touch Screen) connect the Null Modem Interface cable (73889) (located inside the console assembly) to the pigtail cable that is attached to the PC-104 Processor. (This will cause the LCD Touch Screen to be inactive.)
24. Open the Hyperterminal program that is found in Windows 95, 98, 2000, & NT set for a baud rate of 9600. If there is a copy of the Evolution software updatedisk available the "Evolution Diagnostic" icon can be moved to the computer desktop and utilized.
25. Turn the centrifuge instrument power "ON". As the Evolution RC instrument boots interrupt the boot process by depressing "CONTROL C" on the computer just after the "EVOL" program starts to run. See Figure #1.

Note:

On centrifuges with software revision #41 (or higher) skip steps 25 - 30. Resume at step #31.

```
HOT cable detected, Serial Loader starting.  
Press ESC to abort Hard disk boot  
Booting Hard Drive  
Loading...  
  
DR DOS Release 5.0  
Copyright (c) 1976,1982,1988,1990 Digital Research Inc. All rights reserved.  
Ampro Computers, Inc.  
  
C>ECHO ON  
  
C>evol
```

Figure 2

26. When the message displays "Halt the Batch Process" answer by typing "Y".
27. Rename the Autoexec.bat file so that the instrument cannot be booted. (Rename the file something that will not be forgotten). In this case the Autoexec was renamed "steve".

```
C>rename autoexec.bat steve
```

28. Re-boot the Evolution RC instrument by cycling the power "OFF" then back "ON".

INSTRUCTIONS

for the
Evolution RC Display Board Kits
(Kit Catalog No. 73337 & 73338)

29. The instrument will re-boot then ask for the date and the time. Enter the date and current time.

```
HOT cable detected, Serial Loader starting.  
Press ESC to abort Hard disk boot  
Booting Hard Drive  
Loading...  
  
DR DOS Release 5.0  
Copyright (c) 1976,1982,1988,1990 Digital Research Inc. All rights reserved.  
Ampro Computers, Inc.  
  
Date: Sat 3-17-2001  
Enter date (mm-dd-yy):  
  
Time: 4:00:54.87  
Enter time:  
  
C>
```

Figure 3

30. At the “C>” start the Evolution Diagnostics by typing “**evol d**”. This will start the diagnostics program for the centrifuge and will display the menu depicted in figure #4.

31. On centrifuges with software revision #41 (or higher) turn the centrifuge power “**ON**” and allow the centrifuge to boot normally. To enter the centrifuge diagnostics type the letter “**d**”. The centrifuge display will display “**PLEASE WAIT**” and the diagnostics menu will appear on the PC screen.

Note:

On centrifuges with the Advanced Features Module installed (LCD Touch Screen) the LCD screen and all of it's options will become inactive when the Null Modem Cable is installed on the centrifuge.

```
C>evol d  
MAIN MENU  
-----  
c) configuration  
d) diagnostic tests  
s) Service Menu(s)  
a) exit menus (start application)  
e) exit application  
-----  
your choice: c
```

Figure 4

INSTRUCTIONS

for the Evolution RC Display Board Kits (Kit Catalog No. 73337 & 73338)

32. Select “**configuration**” by typing “**c**”. The display shown in figure #5 will show the configuration menu.

```
SYSTEM CONFIGURATION MENU
-----
p) panel
m) miscellaneous configuration
b) back to main menu
-----
your choice: p
```

Figure 5

33. Select “**panel**” by typing “**p**”. The current panel configuration will be displayed. The configuration of the panel will be displayed on the first line. In the case of the instrument depicted in figure #6 the panel was set up for knobs (NVRAM knobs = 1). If the diagnostic screen indicates “buttons = 1” the configuration must be changed by typing “K”. This will change the configuration from “buttons” to “knobs”.

```
-----
CURRENT PANEL CONFIGURATION
-----
current state: NVRAM: knobs = 1
NVRAM: LM76 = 1
NVRAM: LCD = 0
NVRAM: KeValue = 9.210
NVRAM: KeGain = 1.240
NVRAM: Machine gain = 0.000 machine offset = 0.000
NVRAM: Sensor Slope = 0.0000000 Sensor offset = 0.0000000
knob panel

k) knob panel
b) button panel
5) using LM75
6) using LM76
l) LCD present
n) LCD NOT present
e) exit panel configuration
-----
your choice:
```

Figure 6

INSTRUCTIONS

for the
Evolution RC Display Board Kits
(Kit Catalog No. 73337 & 73338)

34. Return to the configuration menu by typing “e”.

SYSTEM CONFIGURATION MENU

p) panel
m) miscellaneous configuration
b) back to main menu

your choice:

Figure 7

35. Return to the main menu by typing “b”.

MAIN MENU

c) configuration
d) diagnostic tests
s) Service Menu(s)
a) exit menus (start application)
e) exit application

your choice:

Figure 8

36. Select the service menu by typing “s”.

k) Read and Store Ke Value
r) Read and Store Ke Adjustment Ratio
m) Machine Temp Gain and Offset
s) Sensor Slope & Offset
a) Accelerometer menu
b) back to Main

your choice:

Figure 9

INSTRUCTIONS

for the Evolution RC Display Board Kits (Kit Catalog No. 73337 & 73338)

37. Select “Read and Store Ke Value” by typing “k”. The current Ke value will be displayed on the screen. Check the instrument Ke value that can be located on the motor power cable at the drive control module. Enter the motor Ke value that was read on the motor tag. After entering the motor Ke value the screen will indicate that the value was “Completed”. The display will return to the service menu.

```
your choice: k
read and store ke value
KE value read is 9.210
Enter new value 9.210
Completed
-----
k) Read and Store Ke Value
r) Read and Store Ke Adjustment Ratio
m) Machine Temp Gain and Offset
s) Sensor Slope & Offset
a) Accelerometer menu
b) back to Main
-----
your choice:
```

Figure 10

38. Select “Read and Store Ke Adjustment Ratio” by typing “r”. The display will show the Ke Adjustment Ratio that is currently in the memory. Enter the new Ke Adjustment Ratio (1.325 for software revision 37 or 1.250 for software revisions for revision 38 or above).

```
your choice: r
read and store Adjustment Ratio value
KE Adjustment Ratio value read is 1.325
Enter new value
b) back to menu
1.325
Completed
-----
k) Read and Store Ke Value
r) Read and Store Ke Adjustment Ratio
m) Machine Temp Gain and Offset
s) Sensor Slope & Offset
a) Accelerometer menu
c) Compressor Selection
b) back to Main
-----
```

Figure 11

INSTRUCTIONS

for the
Evolution RC Display Board Kits
(Kit Catalog No. 73337 & 73338)

39. Select “**Machine Temp Gain and Offset**” by typing “**m**”. Enter the gain and offset (both must always be 0.000).

```
your choice: m
Read and store Machine gain and offset values
Machine gain is 0.000 Machine offset is 0.000
Enter new gain
o) offset
b) back to menu
0.000
Enter new offset
b) back to menu
0.000
Completed

_____

k) Read and Store Ke Value
r) Read and Store Ke Adjustment Ratio
m) Machine Temp Gain and Offset
s) Sensor Slope & Offset
a) Accelerometer menu
c) Compressor Selection
b) back to Main

_____

your choice:
```

Figure 12

40. Select “**Back to Main Menu**” by typing “**b**”.

```
your choice: b
MAIN MENU

_____

c) configuration
d) diagnostic tests
s) Service Menu(s)
a) exit menus (start application)
e) exit application

_____

your choice: e
```

Figure 13

INSTRUCTIONS

for the
Evolution RC Display Board Kits
(Kit Catalog No. 73337 & 73338)

41. Exit the service diagnostics by selecting exit application “e”

43. Calibrate the centrifuge imbalance following the procedure that is outlined in the Calibration & Software section of the Evolution RC Service Manual.

Installation Instructions

Door Repair Kit P/N 73870

Parts Included

Quantity	Part Number	Description
1ea	73866	Door Spacer Bar
4ea		Door Roller Assemblies
1ea	73863	Door Rail, Left
1 ea	73862	Door Rail, Right
1ea	72879	Door Stop Bracket, Front
1ea	72943	Door Ramp
2ea	73872	Door Handle Spacers
1ea	90383	Bottom Tap, M8x0.8
1ea	65779	Loctite #242
2ea	90382	Flat Washer, M6
2ea	92559	Socket Head Screw, M8x16mm
2ea	92552	Socket Head Screw, M6x16mm
4ea	91500	Socket Head Screw, M6x20mm
2ea	69328	Hex Nut, M6
2ea	90381	Shoulder Screw
2ea	73861	Rubber Door Stop
2ea	73864	Rubber Bushing, Bumper
2ea	93017	Socket Head Screw, M6x10mm

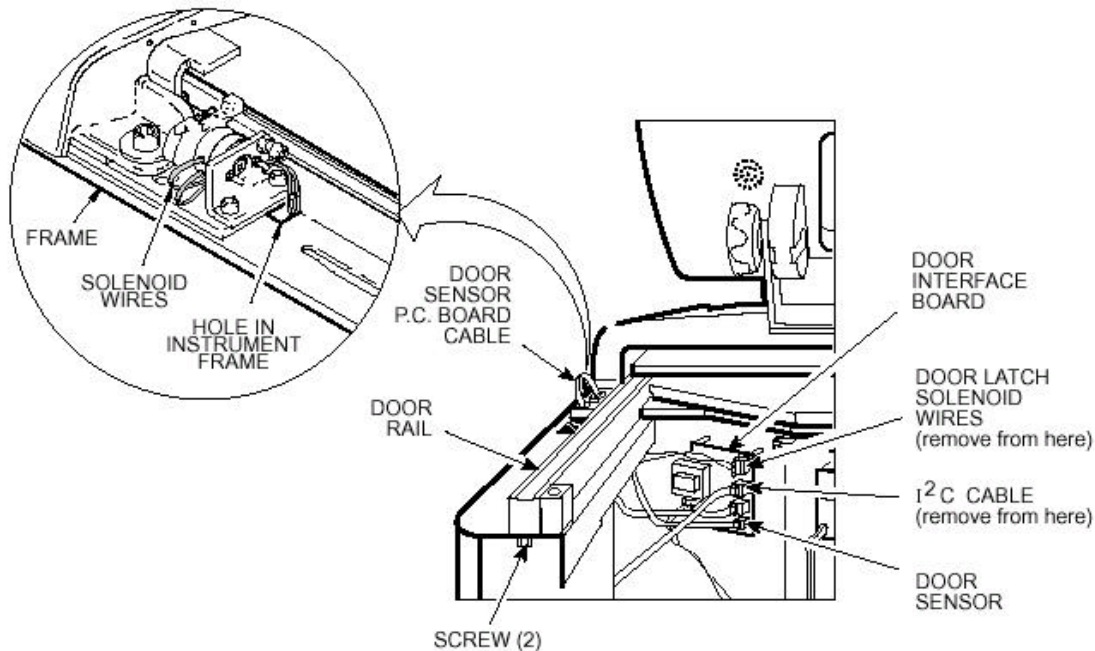
1. Open the chamber door, then turn the main power switch OFF, unplug the centrifuge, and wait four minutes before proceeding.

WARNING

Hazardous voltages may exist whenever power is connected and circuits are energized. To eliminate potential for serious electrical shock or component damage, turn the main power switch OFF, unplug the centrifuge, then wait four minutes before proceeding.

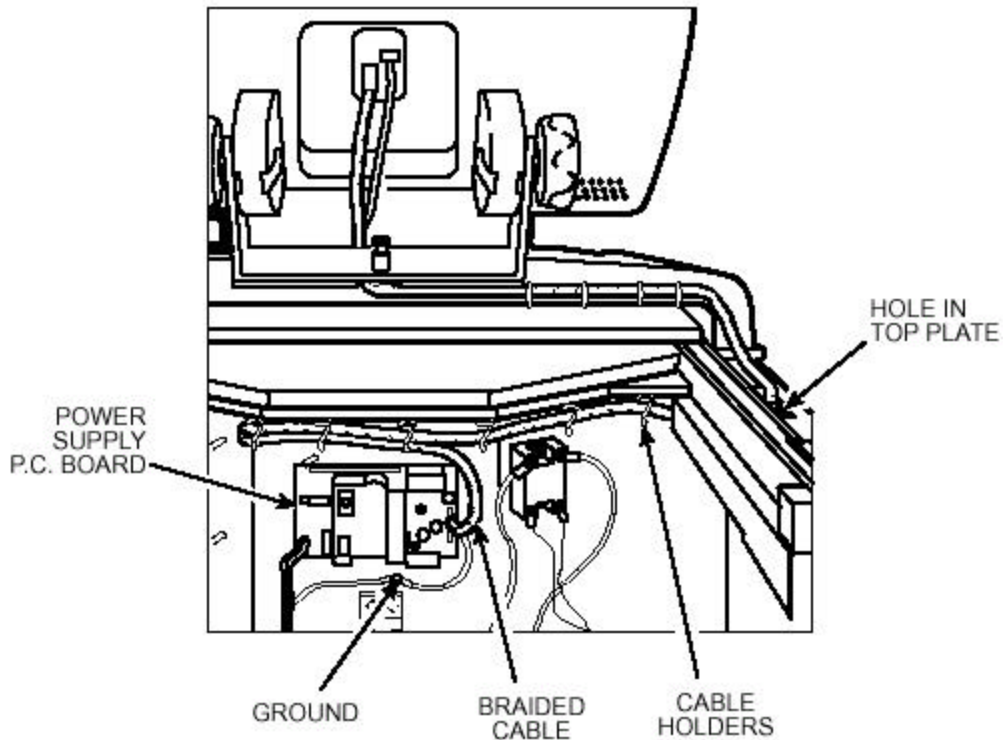
2. If the centrifuge is located so that there is no room to work behind or in front of the centrifuge, raise the front locking stabilizers and roll the centrifuge to a suitable working location.
3. Using a 4 mm Allen wrench, remove the two screws with washers from the louver area of the front panel, then remove the front panel.

4. Using a 6mm Allen wrench, remove the two screws that secure the back of the top rear deck.
5. Using a 5 mm Allen wrench, remove the single screw from the center of the control console bracket, then remove the top rear deck.
6. Using a 4 mm Allen wrench, remove the six screws securing the rear panel, and remove the panel.
7. Using a 3 mm Allen wrench, remove the two screws that secure the drip tray between the door rails, then remove the drip tray.
8. From the door interface P.C. board, disconnect the door latch solenoid wires and the I2C cable (two plugs toward the top). Feed both up through the holes in the frame/top plate.



9. Using a 5mm Allen wrench, remove the 2 screws that secure the door latch to the centrifuge frame. Remove the door latch assembly and place aside.
10. Using a 2.5mm Allen wrench, remove the 2 screws that secure the door sensor board to the right door rail. Remove the door sensor board and place aside. Insure that the proper ESD precautions are followed when handling all printed circuit boards.
11. From the power supply P.C. board, disconnect the cable with the braided shield (use a 3 mm Allen wrench to disconnect ground).

- 12 Remove the braided cable from the cable holders along the back of the top plate, then feed the braided cable and plug up through the holes in the frame and top plate.



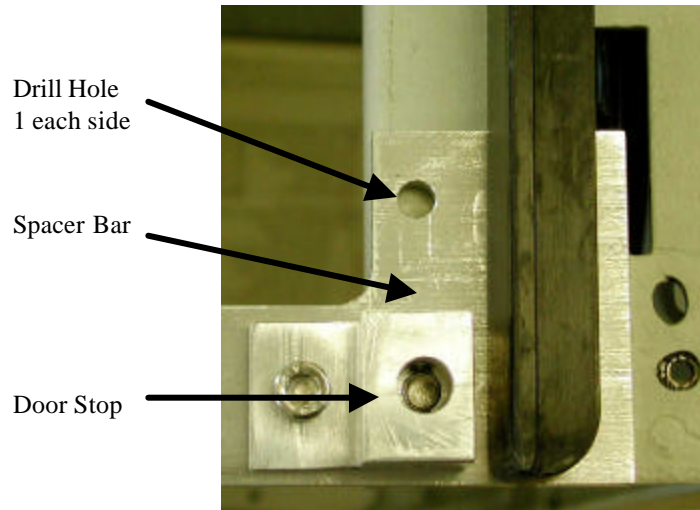
- 13 Using an 8 mm Allen wrench, remove the two screws with washers securing the rear tabs of the top front deck.
- 14 From underneath the top front deck, using a 5 mm Allen wrench, remove the four screws that secure the top front deck to the top plate, then remove the top front deck with control console by lifting it up and off of the frame/top plate.
- 15 Using an 8 mm Allen wrench, remove the six screws with washers securing the two Z-brackets (3 screws per bracket), then remove the brackets.
- 16 Holding the door retractor cable so that it cannot retract, using a 3 mm Allen wrench, remove the shoulder screw that attaches the cable to the left side of the door. Allow the cable to slowly retract until the cable end is positioned securely between the idler pulley and pulley bracket.
- 17 Using a 3mm Allen wrench, remove the shoulder screw that secures the idler pulley to the pulley bracket (use care as the cable should have tension from the spring loaded

retractor reel). Feed the cable through the centrifuge frame. Discard the idler pulley and shoulder screw.

- 18 Remove the cotter pin that secures the retractor reel to the centrifuge frame and remove and discard the retractor reel. Using a 4mm Allen wrench remove and discard the idler pulley bracket.
- 19 Remove the door by lifting it up and off of the door rails.
- 20 Using a 5 mm Allen wrench, remove the two screws securing the back end of the two door rails (one each, from underneath).
- 21 Using a 5mm Allen wrench remove the 4 remaining screws that secure the door rails from the centrifuge frame (2 on each rail). Remove and discard the door rails.
- 22 Using a 8mm Allen wrench, remove and discard the 2 door stops located at the rear of the centrifuge (1 at each side).
- 23 Using a 10mm wrench remove the 2 bolts that secure the door striker plate at the front of the centrifuge (save the bolts for use later). Remove and discard the striker plate
- 24 Working on a flat workbench place the 2 new door rails on the bench upside down with the right side rail on the left and the left side rail on the right.
- 25 Place the supplied spacer bar assembly at the rear of the door rails and attach using the (2) M5x16mm socket head screws (92476) supplied in the kit.

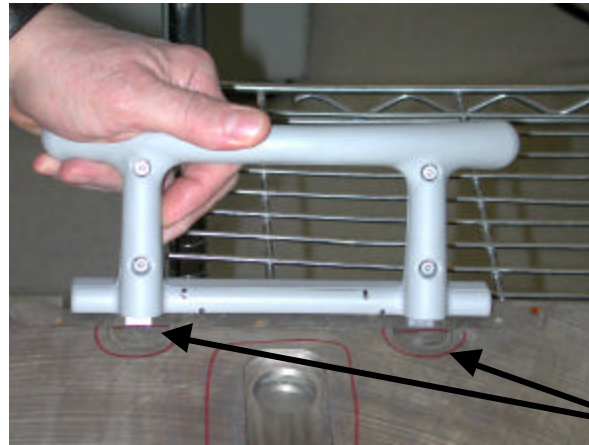


- 26 Carefully turn the assembly over and place onto the centrifuge frame. Attach the door rail assembly to the centrifuge frame using 4 of the screws that were removed in step #21.
- 27 Using a ¼” drill bit drill 2 holes in the centrifuge frame (1) at each side of the new spacer bar (use the spacer bar as a template).



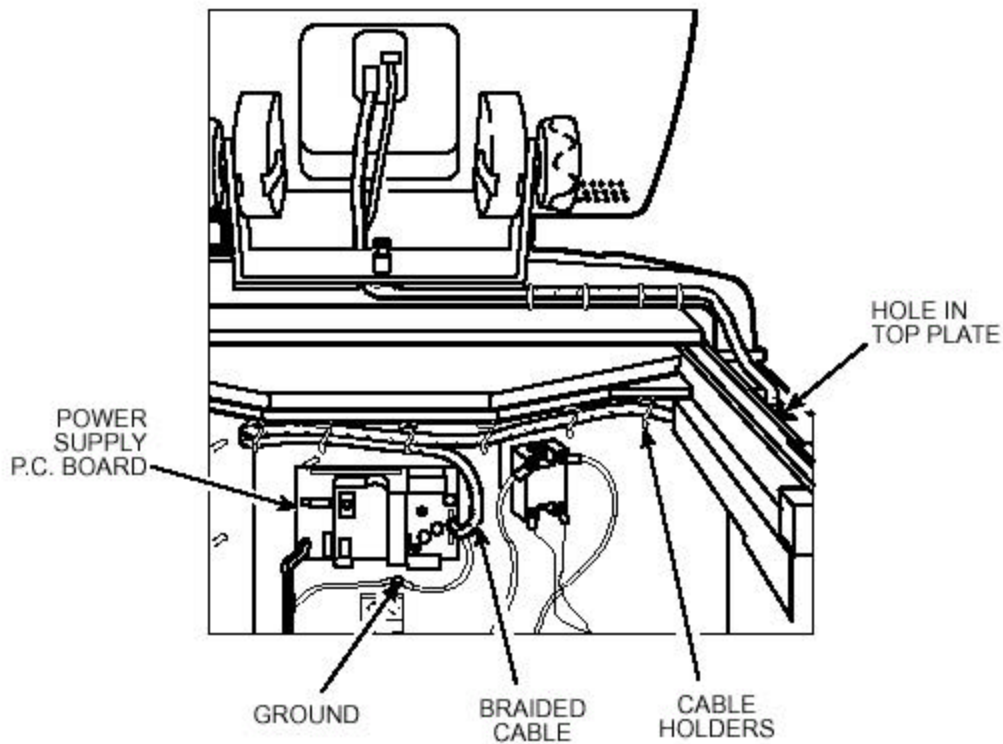
- 28 Secure the spacer bar to the centrifuge frame using (2) M6x16 socket head screws (92552) and (2) M6 hex nuts (69328) one at each side of the spacer bar into the holes drilled in step #27.
- 29 Using the supplied shoulder screws (90381) and flat washers (90382), attach the new rubber door stops (73861) to the door stop brackets located on the spacer bar that was installed earlier.
- 30 Secure the Door Stop bracket to the top of the spacer bar using (1) 93017 M6x10mm Socket Head screw and (1) 92559 M8x16mm Socket Head Screw (attached from under the rail). Insert (1) 73864 Rubber Bumper in each door stop bracket.
- 31 Install the supplied door striker plate onto the centrifuge. Adjust the striker by pushing it against the plastic deck assembly. Tighten the plate using the bolts removed in step #23.
- 32 Using a 3mm Allen wrench remove the door top skin.
- 33 Using a 3mm Allen wrench remove and discard the 4 door roller assemblies.
- 34 Using a 3mm Allen wrench remove the door ramp located at the right rear of the door assembly. One screw is located at the rear and one is located on the side of the ramp. Use the supplied Loctite #242 on hardware used on the door ramp.
- 35 Using the supplied M5x0.8 bottom tap re-tap the threads for the door roller holes to clean any debris from the holes.
- 36 Using a 4mm Allen wrench install the new door roller assemblies. Each roller assembly is marked as to whether it is installed in the front or rear of the door assembly. (the roller assemblies are marked "F" or "R" on the end of the mounting screw). Use the supplied Loctite #242 when installing the door roller assemblies.

- 37 Insert the 2 door handle spacers (73872) on the door plate as indicated securing the spacers using super glue. One under each side of the door handle.



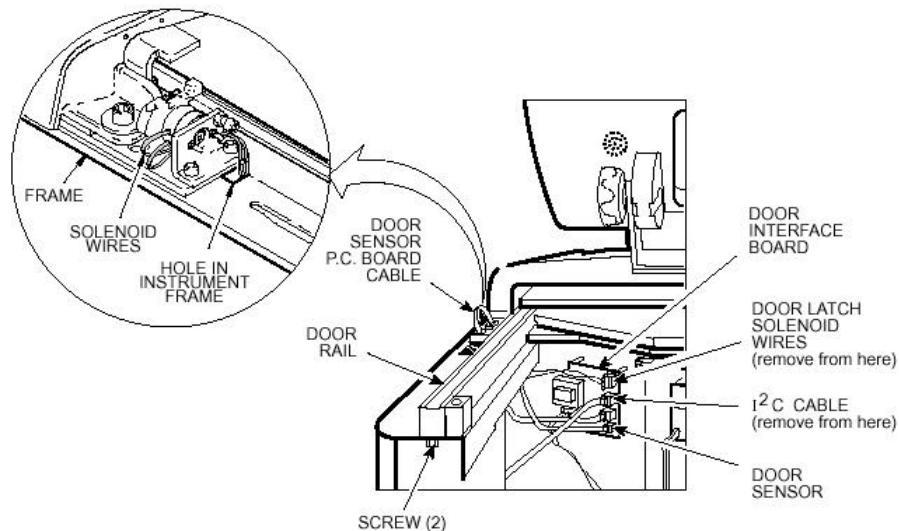
Insert door
handle spacers

- 38 Install the door sensor board into the right door rail securing it using a 3mm Allen wrench. Feed the door sensor cable back up through the hole in the top plate and reconnect it to the door sensor P.C. board.
- 39 Place the door assembly on the two door rails, making sure the rollers roll smoothly on the rails.
- 40 Position the two Z-brackets on the top plate. Using an 8 mm Allen wrench, reinstall the six screws with washers (3 screws per bracket) securing the two Z-brackets.
- 41 Being careful not to pinch the I 2 C cable or the braided cable, position the top front deck on the centrifuge top plate. Using an 8 mm Allen wrench, thread the two large screws and washers (removed earlier) through the tabs at the rear of the deck into the top deck/frame, but do not tighten yet.
- 42 From underneath the front, using a 5 mm Allen wrench, reinstall the four screws that secure the top front deck to the top plate, then tighten the two large screws that were previously left loose at the rear of the top front deck.
- 43 Extending from the control console and routed across the rear of the top front deck, feed the braided cable and plug down through the hole in the top deck/frame, then route/insert the cable in the cable holders along the back of the top plate. Connect the plug to the power supply P.C. board and using a 3 mm Allen wrench, attach the braided shield to the frame (using the hardware removed earlier).



44 Also extending from the control console, but routed across the rear of the top front deck to the other side, feed the I 2 C cable and plug down through the hole in the top deck/frame, then connect the plug to the door interface P.C. board.

45 Install the door latch onto the centrifuge frame. Feed the door latch solenoid plug and wires down through the hole in the frame that is immediately behind the top plate and reconnect it to the door interface P.C. board.



- 46 Position the drip tray between the door rails, reinstall the two screws (removed earlier) and, using a 3 mm Allen wrench, tighten the two screws to secure the drip tray.
- 47 Position the top rear deck on the frame, then using a 5 mm Allen wrench, reinstall the single screw in the center of the control console bracket. Using a 6 mm Allen wrench, reinstall the two screws that secure the back of the top rear deck.
- 48 Position the rear panel on the rear of the centrifuge frame, and using a 4 mm Allen wrench, secure the panel in place using the six screws (removed earlier).
- 49 Insert the top of the front panel underneath the top deck and set it in position on the two pins on the front of the centrifuge, then reinstall the two screws with washers (removed earlier) and, using a 4mm Allen wrench, tighten the two screws to secure the panel.
- 50 If the centrifuge was moved, return it to its original operating location and level it using the front locking stabilizers.

INSTRUCTIONS

for the
Evolution RC Door Roller Replacement Kit
(Catalog No. 73869)

Parts Included

Quantity	Part #	Description
4 ea		Door Roller Assemblies
1 ea	65799	Loctite #242
1 ea	90383	Bottom Tap M8x0.8mm
1 ea	73886	Installation Instructions

Instructions

WARNING

Hazardous voltages may exist whenever power is connected and circuits are energized. To eliminate potential for serious electrical shock or component damage, turn the main power switch OFF, unplug the centrifuge, then wait four minutes before proceeding.

1. Open the chamber door, then turn the main power switch OFF, unplug the centrifuge, and wait four minutes before proceeding.
2. If the centrifuge is located so that there is no room to work behind or in front of the centrifuge, raise the front locking stabilizers and roll the centrifuge to a suitable working location.
3. Using a 4 mm Allen wrench, remove the two screws with washers from the louver area of the front panel, then remove the front panel.
4. Using a 6mm Allen wrench, remove the two screws that secure the back of the top rear deck.
5. Using a 5 mm Allen wrench, remove the single screw from the center of the control console bracket, then remove the top rear deck.
6. Using a 4 mm Allen wrench, remove the six screws securing the rear panel, and remove the panel.
7. Using a 3 mm Allen wrench, remove the two screws that secure the drip tray between the door rails, then remove the drip tray.
8. From the door interface P.C. board, disconnect the I2C cable, feed the cable up through the hole in the frame/top plate.

INSTRUCTIONS

for the Evolution RC Door Roller Replacement Kit (Catalog No. 73869)

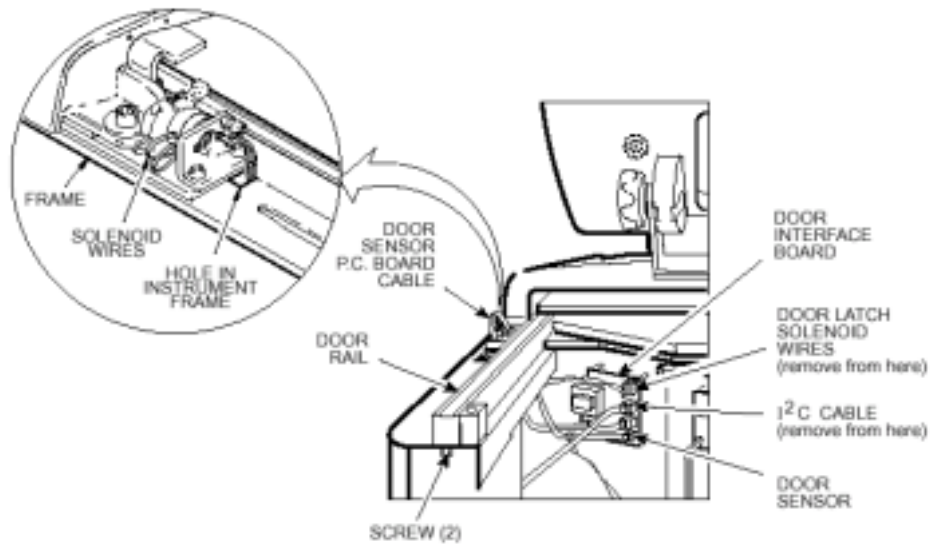


Figure #1

9. From the power supply P.C. board, disconnect the cable with the braided shield (use a 3 mm Allen wrench to disconnect ground).
10. Remove the braided cable from the cable holders along the back of the top plate, then feed the braided cable and plug up through the holes in the frame and top plate.

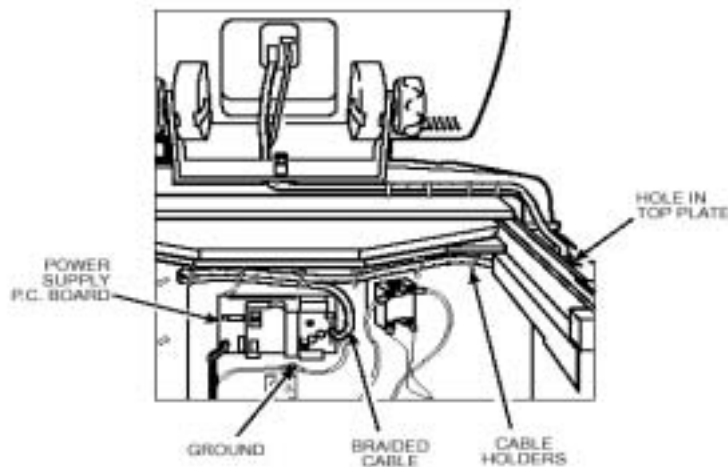


Figure #2

INSTRUCTIONS

for the
Evolution RC Door Roller Replacement Kit
(Catalog No. 73869)

11. Using an 8 mm Allen wrench, remove the two screws with washers securing the rear tabs of the top front deck.
12. From underneath the top front deck, using a 5 mm Allen wrench, remove the four screws that secure the top front deck to the top plate, then remove the top front deck with control console by lifting it up and off of the frame/top plate.
13. Using an 8 mm Allen wrench, remove the six screws with washers securing the two Z-brackets (3 screws per bracket), then remove the brackets.
14. Remove the door by lifting it up and off of the door rails.
15. Using a 3mm Allen wrench, remove the door top skin.
16. Using a 3mm Allen wrench remove the door ramp located at the right rear of the door assembly. One screw is located at the rear and one is located on the side of the ramp.
17. Using a 4mm Allen wrench, remove and discard the 4 door roller assemblies.
18. Using the supplied M5x0.8 bottom tap re-tap the threads for the door roller holes to clean any debris from the holes.
19. Using a 4mm Allen wrench install the new door roller assemblies. Each roller assembly is marked as to whether it is installed in the front or rear of the door assembly. (the roller assemblies are marked "F" or "R" on the end of the mounting screw). Use the supplied Loctite #242 when installing the door roller assemblies.
20. Using a 3mm Allen wrench re-install the door ramp located at the right rear of the door assembly. One screw is located at the rear and one is located on the side of the ramp. Use the supplied Loctite #242 when installing the door ramp.
21. Place the door assembly on the two door rails, making sure the rollers roll smoothly on the rails.
22. Position the two Z-brackets on the top plate. Using an 8 mm Allen wrench, reinstall the six screws with washers (3 screws per bracket) securing the two Z-brackets.

INSTRUCTIONS

for the Evolution RC Door Roller Replacement Kit (Catalog No. 73869)

23. Being careful not to pinch the I 2 C cable or the braided cable, position the top front deck on the centrifuge top plate. Using an 8 mm Allen wrench, thread the two large screws and washers (removed earlier) through the tabs at the rear of the deck into the top deck/frame, but do not tighten yet.
24. From underneath the front, using a 5 mm Allen wrench, reinstall the four screws that secure the top front deck to the top plate, then tighten the two large screws that were previously left loose at the rear of the top front deck.
25. Extending from the control console and routed across the rear of the top front deck, feed the braided cable and plug down through the hole in the top deck/frame, then route/insert the cable in the cable holders along the back of the top plate. Connect the plug to the power supply P.C. board and using a 3 mm Allen wrench, attach the braided shield to the frame (using the hardware removed earlier).

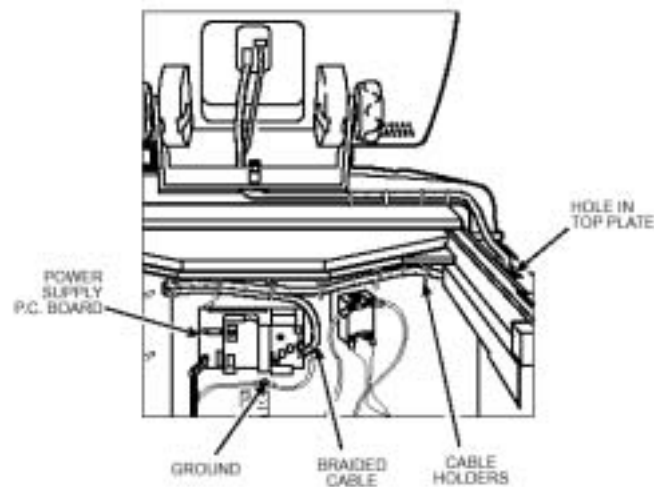


Figure #3

26. Also extending from the control console, but routed across the rear of the top front deck to the other side, feed the I 2 C cable and plug down through the hole in the top deck/frame, then connect the plug to the doodoor interface P.C. board.

INSTRUCTIONS

for the Evolution RC Door Roller Replacement Kit (Catalog No. 73869)

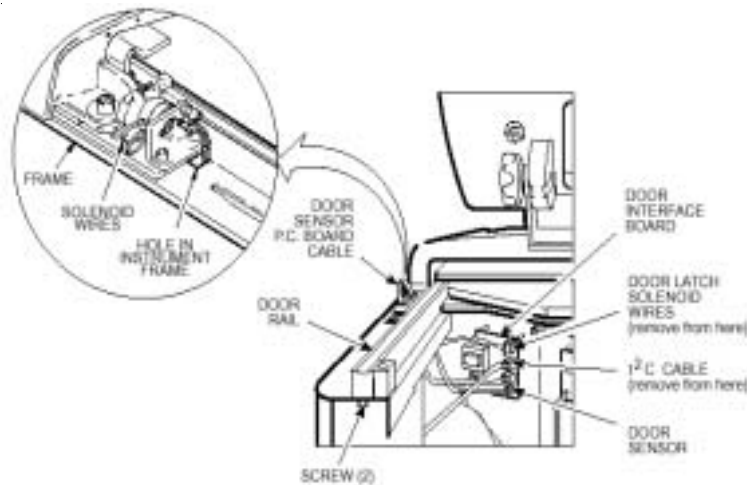


Figure #4

27. Position the drip tray between the door rails, reinstall the two screws (removed earlier) and, using a 3 mm Allen wrench, tighten the two screws to secure the drip tray.
28. Position the top rear deck on the frame, then using a 5 mm Allen wrench, reinstall the single screw in the center of the control console bracket. Using a 6 mm Allen wrench, reinstall the two screws that secure the back of the top rear deck.
29. Position the rear panel on the rear of the centrifuge frame, and using a 4 mm Allen wrench, secure the panel in place using the six screws (removed earlier).
30. Insert the top of the front panel underneath the top deck and set it in position on the two pins on the front of the centrifuge, then reinstall the two screws with washers (removed earlier) and, using a 4mm Allen wrench, tighten the two screws to secure the panel.
31. If the centrifuge was moved, return it to its original operating location and level it using the front locking stabilizers.

INSTRUCTIONS

for the
Evolution RC Motor Coupling Replacement Kit
(Kit Catalog No. 73450)

Parts Supplied:

Quan	Part #	Description
1	-----	Motor Coupling
2 ft	60255	Mortite caulking cord
12	68629	Screw, Socket Head, M5x12mm
1	90702	Loctite sealant #222
4	69180	Screw, Socket Head, M6x16mm
3	61141	Hex nut, ¼ - 20
1	65664	Adhesive sealant, RTV silicone, black
1	73492	Evolution RC Gap Gauge
1	73451	Installation instructions



Warning:

Because of the presence of high voltage, untrained personnel must not attempt to test, repair, or modify any electrical circuits or systems in this unit.



Warning:

Because of the characteristics of the samples likely to be processed in this centrifuge, biological or radioactive contamination may occur. Always be aware of this possibility, and take normal precautions. The Kendro Service Decontamination Policy states that a completed Decontamination Information Certificate is required before servicing.

Instructions

a. Removing the Motor/Gyro Assembly

1. Open the chamber door, then turn the main power switch OFF, unplug the centrifuge, and wait four minutes before proceeding.
2. Using a 4 mm Allen wrench, remove the two screws with washers from the louver area of the front panel, then remove the front panel.
3. Working inside the evaporator chamber, using a 4 mm Allen wrench through the center hole in the tapered spindle, unscrew the captive screw, then pull the tapered spindle up and off of the gyro shaft.

INSTRUCTIONS

for the
Evolution RC Motor Coupling Replacement Kit
(Kit Catalog No. 73450)

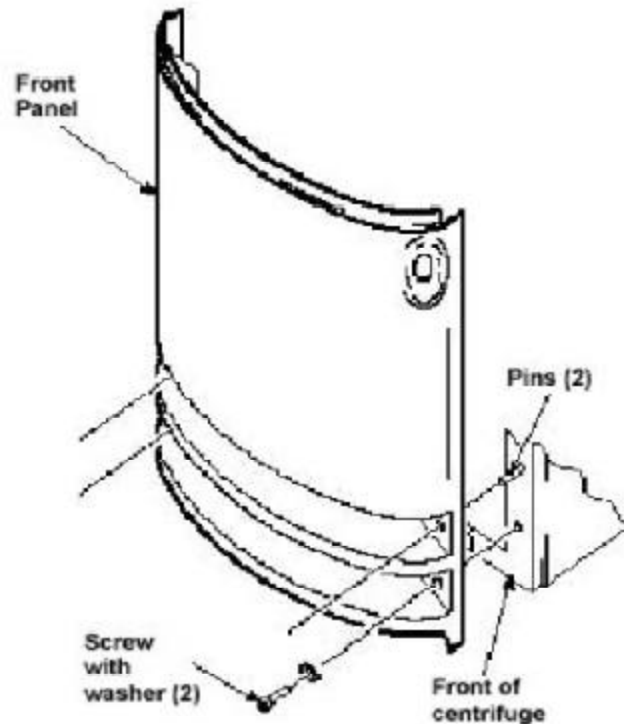


Figure 1

4. Using a 2 mm Allen wrench, loosen the two set screws that secure the slinger to the gyro shaft, then slide the slinger up and off of the gyro shaft.
5. Remove the gyro boot (affixed with RTV adhesive): First work the circumference off of the evaporator rim, then, being careful not to stress the temperature sensor cable, pull the boot (with temperature sensor attached) straight up and off of the gyro housing.
6. Carefully, so as not to damage the gyro boot or temperature sensor cable, work to remove and discard the old RTV sealant remaining from the underside of the boot (do not remove sealant from where the sensor cable feeds through the boot), then set the boot/sensor assembly aside on the evaporator floor.

INSTRUCTIONS

for the Evolution RC Motor Coupling Replacement Kit (Kit Catalog No. 73450)

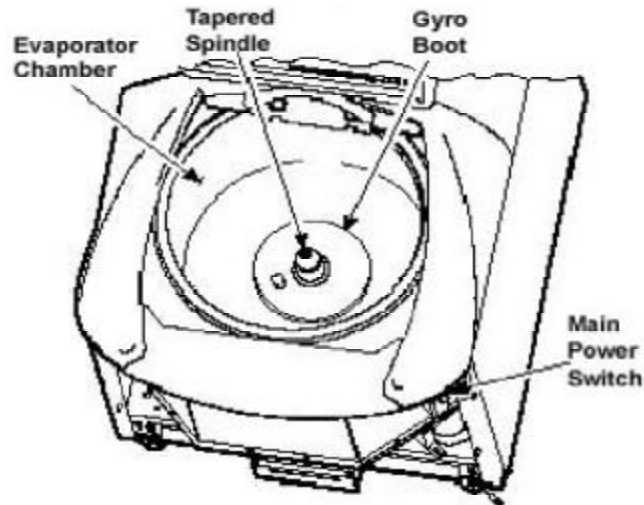


Figure 2

7. One at a time, pull the two insulating disks off of the gyro and place them aside on the evaporator floor, near the boot/sensor assembly.
8. Remove the caulk from around the gyro's outer clamp ring. Discard the caulk.
9. Using a 3 mm Allen wrench, remove the two screws that secure the imbalance sensor to the gyro. Draw the cables from the imbalance and temperature sensors straight up, bend them toward the front of the centrifuge, and hook the cables over the evaporator rim (so that the sensors can stay in the bottom of the chamber and the two cables will be out of the way).
10. Using a 4 mm Allen wrench, reinstall the tapered spindle on the gyro shaft.

Note:

The tapered spindle will be used as a handle when lifting the motor from the centrifuge.

INSTRUCTIONS

for the Evolution RC Motor Coupling Replacement Kit (Kit Catalog No. 73450)

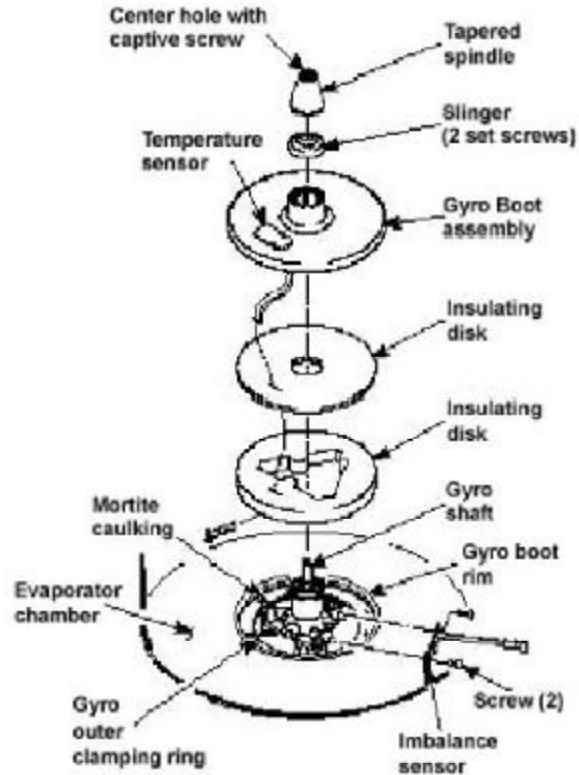


Figure 3

11. Working down underneath in front, disconnect all wires coming from the motor shroud:
 - a. Unplug the motor cable from the drive box and from the Ke P.C. board (if present), and disconnect the ground wires from the frame using a 3 mm Allen wrench.
 - b. Unplug the commutation wires from the drive box.
 - c. Unplug the auxiliary tachometer wires from the drive interface P.C. board.
 - d. Disconnect the motor temperature sensor wires from the lower rear corner of the drive interface board (if present).
12. Using a 10 mm box wrench, remove the four nuts that are located up under the evaporator baseplate near the top of the motor shroud.
13. From above, using the tapered spindle as a handle, lift the motor/gyro assembly up and, being careful not to crush sensor cables, temporarily set it in the evaporator chamber.

Note:

Removing the calrod brake resistor from the top of the drive box assembly will allow easier access to the motor mounting nuts referenced in step 12.

P/N: 73451-1

SORVALL[™]

 **Kendro**

INSTRUCTIONS

for the Evolution RC Motor Coupling Replacement Kit (Kit Catalog No. 73450)

- From below, feed all motor cables and connectors (disconnected in step a-11) into the motor shroud so that they will lay loose inside the shroud on top of the motor fan.

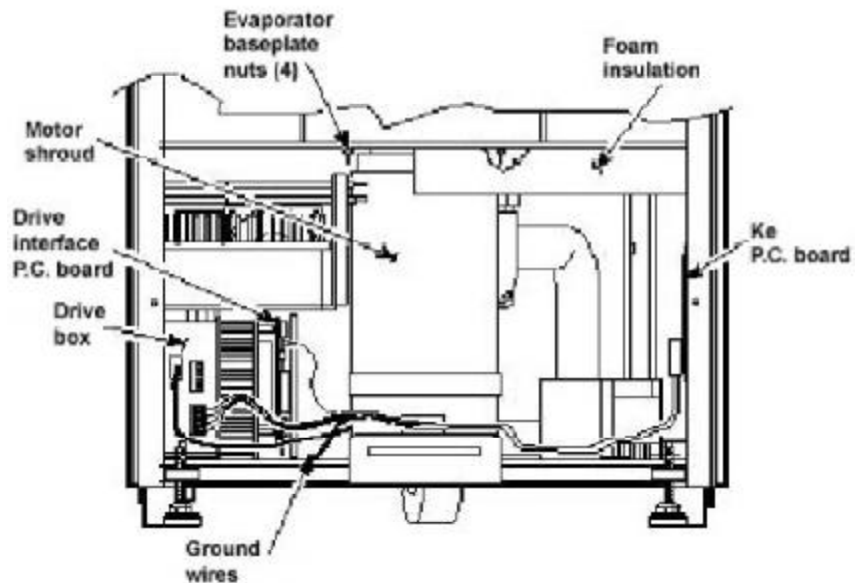


Figure 4

- From above, pull the motor cables up into the evaporator chamber, then lift the motor/gyro assembly from the centrifuge.

b. Removing the Drive Coupling from the Motor

- Lay the motor/gyro assembly on a clean work surface so that the motor is fully and squarely on the surface and the larger round portions of the gyro assembly extend off the edge.
- Turn the motor/gyro so that the drive coupling access slot in the gyro faces up.
- Rotate the tapered spindle/drive shaft until a coupling clamping screw is visible through the access slot. While holding the spindle so that it does not rotate, use a 2.5 mm Allen wrench to loosen the screw. Then rotate the tapered spindle/drive shaft one-half rotation (180°) until the other coupling clamping screw is visible through the access slot, and loosen the second screw.

INSTRUCTIONS

for the Evolution RC Motor Coupling Replacement Kit (Kit Catalog No. 73450)

4. Turn the motor/gyro so that the coupling access slot in the gyro faces down (motor cables up).

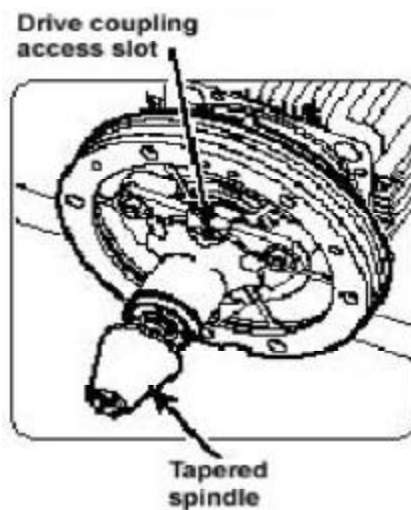


Figure 5

5. Using a 4 mm Allen wrench, remove the tapered spindle from gyro shaft.
6. Using a 4 mm Allen wrench, remove the six screws that secure the outer clamping ring to the backing plate and remove the outer ring. Discard the six screws.
7. Using a 7/16 inch wrench, remove and discard the three nuts that secure the gyro to the three shock mounts on the backing plate, then remove the gyro/spring assembly. Inspect the three shock mounts; if worn or in poor condition, replace them (order three of catalog no. 92786).
8. Using a 4 mm Allen wrench, remove the six screws that secure the backing plate to the motor mount end plate. Carefully pry at different points around the periphery to separate the plate from the mounting ring/motor assembly. Discard the six screws.
9. Pull the mounting ring/damping ring assembly off of the motor mount end plate. Inspect the rubber damping ring; if worn or in poor condition, replace it (order catalog no. 72839).
10. Using a 5 mm Allen wrench, remove the four screws that secure the motor mount end plate to the motor. Being careful not to damage the surface of the motor mount end plate, separate and remove the end plate from the motor. Discard the four screws.

Note:

On centrifuges with serial numbers 10300736 and newer (silver cylindrical motors) the motor mount end plate is part of the motor assembly. Skip step #10.

P/N: 73451-1

SORVALL[™]

INSTRUCTIONS

for the Evolution RC Motor Coupling Replacement Kit (Kit Catalog No. 73450)

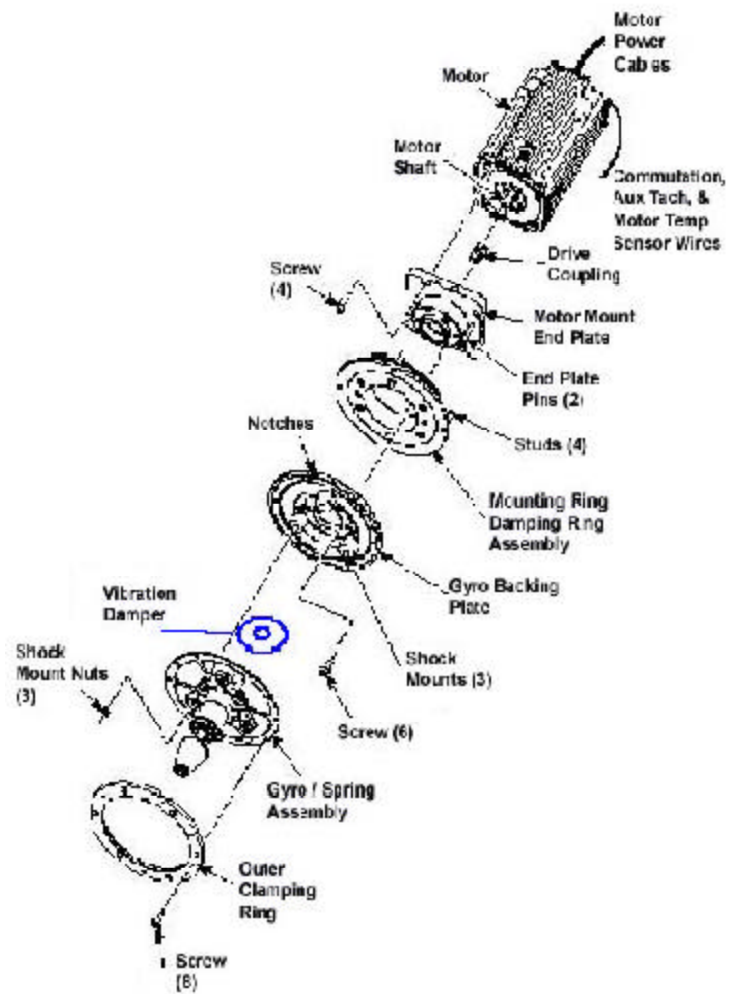


Figure 6

- Using a 2.5 mm Allen wrench, loosen the two coupling clamping screws and remove the drive coupling from the motor shaft. Discard the coupling.

INSTRUCTIONS

for the Evolution RC Motor Coupling Replacement Kit (Kit Catalog No. 73450)

Note:

On centrifuges that use motors that are manufactured by Servo Magnetics (cylindrical motor housing) there is no need to use the gap gauge mentioned in step #1. On these motors the coupling rests on a shoulder on the motor shaft.

c. Assembling the Coupling on the Motor:

1. Position the motor coupling/door latch gap gauge (catalog no. 73492) on the motor, so that it sits widthwise and is against the motor shaft, lengthwise it spans across the flat surface of the motor end bell. Slide the new drive coupling (supplied) onto the motor shaft until it is against the gap gauge tool and, using a small torque wrench with a 2.5 mm Allen bit, tighten one of the coupling clamping screws (on the end closest to the motor) to 2.37 N . m (21 inch-lbs). Then rotate the coupling/drive shaft one-half rotation (180°), and tighten the second screw to the same torque. Remove the gauge tool.

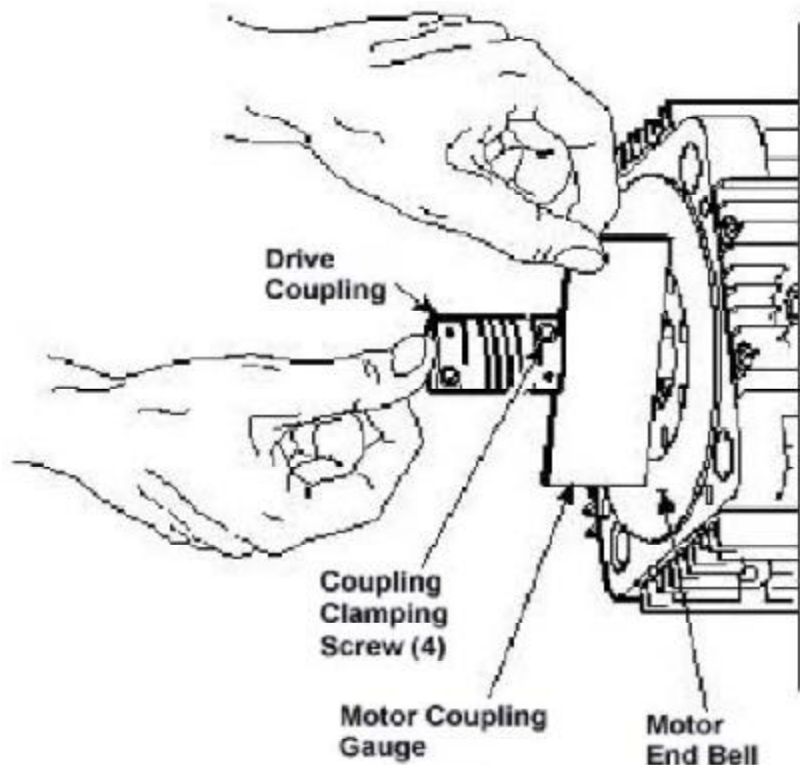


Figure 7

Note:

On centrifuges that use the Servo Magnetics (cylindrical motor housing) the motor mount end plate is part of the motor end plate and step #2 can be skipped.

2. Apply a drop of Loctite ® 222 (catalog no. 90702, supplied) to each of the four M6 x 16 mm screws (catalog no. 69180, supplied). Orient the motor mount end plate so that the two pins align horizontally, and using a 5 mm Allen wrench, secure the plate to the motor.

INSTRUCTIONS

for the Evolution RC Motor Coupling Replacement Kit (Kit Catalog No. 73450)

3. Apply a thin film of vacuum grease to the inside of the damping ring. Orient the mounting ring/damping ring assembly so that the two notches in the outer edge of the mounting ring are facing upward and the holes in the damping ring align with the two pins. Slide the assembly onto the motor mount end plate until the damping ring is fully seated.
4. Apply a drop of Loctite ® 222 to each of two M5 x 12 mm screws (catalog no. 68629, supplied), then orient the backing plate so that the two notches in the outer edge align with those in the mounting ring (facing upward). Insert the two screws into opposing positions around the center hole, and using a 4 mm Allen wrench, alternately tighten the two screws into the motor mount end plate until the backing plate is fully seated on the end plate.
5. Apply a drop of Loctite ® 222 to each of four more of the M5 x 12 mm screws (supplied), then insert them into the remaining backing plate positions, and using a 4 mm Allen wrench, securely tighten the four screws and double-check tightness on the other two.

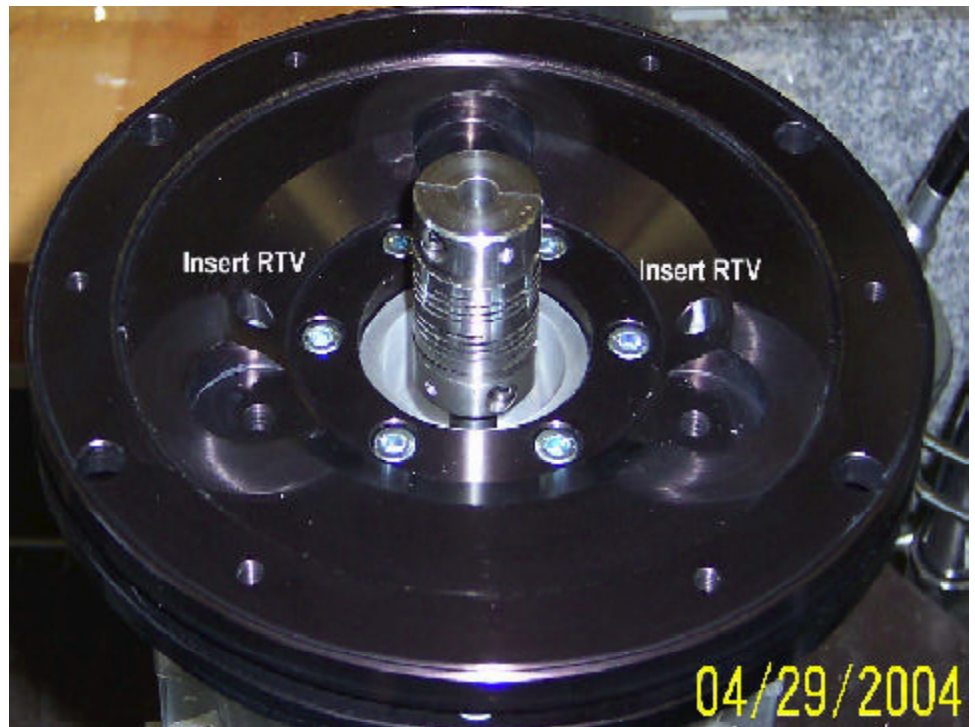


Figure 8

INSTRUCTIONS

for the Evolution RC Motor Coupling Replacement Kit (Kit Catalog No. 73450)

6. Using RTV sealant, seal the (2) holes for the gyro backing plate guide pins to prevent moisture from entering the drive motor.
7. Place the gyro damping ring under the inner clamping ring prior to assembling the gyro assembly to the motor.
8. Apply a drop of Loctite ® 222 to each of the three shock mount studs (on the backing plate). Orient the gyro/spring assembly so that the drive coupling access slot in the gyro faces downward, then position the assembly on the shock mounts and hold it in position by threading the three new 1/4-20 nuts (catalog no. 61141, supplied) onto the shock mount studs (leave finger-tight).
9. Apply a drop of Loctite ® 222 to each of six remaining M5 x 12 mm screws (supplied), orient the outer clamping ring so that the counter-bore side faces out and the two notches in the outer edge align with those in the mounting ring and backing plate (facing upward). Using a 4 mm Allen wrench, insert the screws through the outer ring and spring into the backing plate and tighten.
10. Loosen all three 1/4-20 nuts from the shock mount studs, then using a 7/16 inch wrench, tighten all three securely.
11. Using a 4 mm Allen wrench, install the tapered spindle on the gyro shaft.
12. Turn the motor/gyro assembly so that the drive coupling access slot in the gyro faces upward and rotate the tapered spindle until a coupling clamping screw is visible. Using a torque wrench with a 2.5 mm Allen bit while holding the spindle so that it does not rotate, tighten the coupling clamping screw to 2.37 N/m (21 inch- lbs). Rotate the tapered spindle/drive shaft one-half rotation (180°) until the other clamping screw is visible through the access slot, and tighten the second screw to the same torque.

INSTRUCTIONS

for the Evolution RC Motor Coupling Replacement Kit (Kit Catalog No. 73450)

d. Installing the Motor/Gyro Assembly

1. Work to remove and discard any RTV sealant remaining on the rim around the opening in the bottom of the evaporator.
2. Apply a drop of Loctite ® 222 to each of the four studs on the bottom of the mounting ring, then transport the motor/gyro assembly to the centrifuge and, being careful not to crush sensor cables, temporarily set it down inside the evaporator chamber.
3. Feed the motor cables down into the motor shroud; route the motor drive cable out the hole in the front, and route commutation and auxiliary tachometer cables out the hole on the left side.

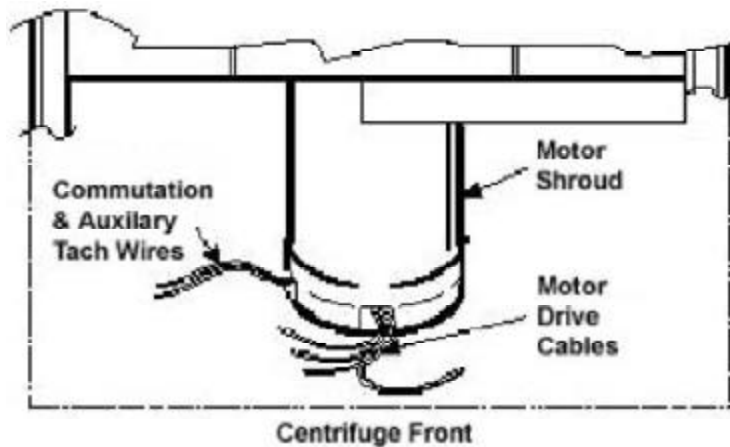


Figure 9

4. Using the tapered spindle as a handle, orient the motor/gyro assembly so that the two notches in the outside edge of the gyro assembly face toward the front of the centrifuge. Lower the motor/gyro assembly into its correct position (being careful not to pinch the sensor wires) so that the four studs in the mounting ring engage the four holes in the evaporator baseplate.
5. Working down underneath in front, thread the four nuts (removed in step A12) onto the four mounting ring studs (located up on the evaporator baseplate near the top of the motor shroud), and tighten each nut securely using a 10 mm box wrench.

INSTRUCTIONS

for the Evolution RC Motor Coupling Replacement Kit (Kit Catalog No. 73450)

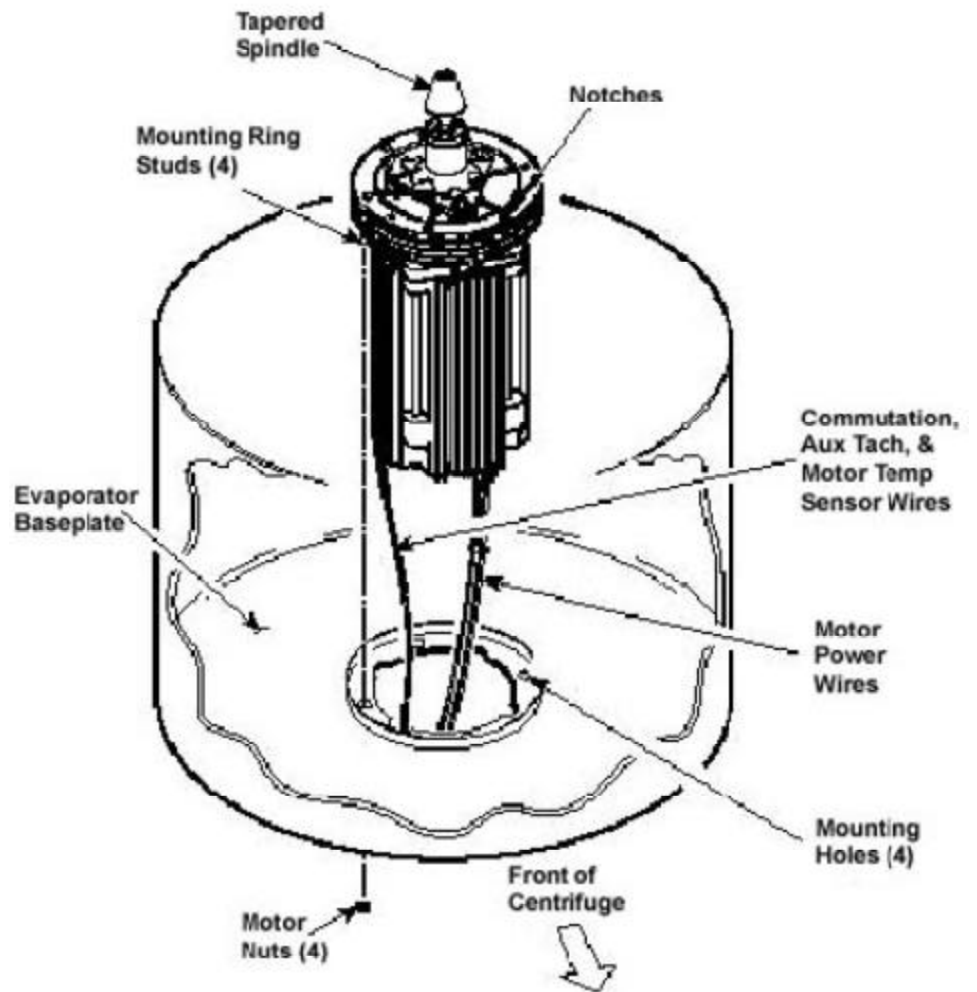


Figure 10

6. Connect all wires coming from the motor shroud:
 - a. Connect the auxiliary tachometer wires to the drive interface P.C. board.
 - b. Connect the commutation wires to the drive box.
 - c. Connect the motor cable to the drive box and to the Ke P.C. board (if present), and reconnect the ground wires to the frame using the hardware removed in step A11 and tighten using a 3 mm Allen wrench.
 - d. Connect the motor temperature sensor wires (if present) to the drive interface board (lower rear corner).

INSTRUCTIONS

for the Evolution RC Motor Coupling Replacement Kit (Kit Catalog No. 73450)

7. Working inside the evaporator chamber, use a 4 mm Allen wrench to remove the tapered spindle from the gyro shaft.
8. Using the length of new Mortite caulking cord supplied, seal around the gyro's outer clamp ring.
9. Apply a drop of Loctite ® 222 to each of the two screws that were used to secure the imbalance sensor (removed in step A8), then using a 3 mm Allen wrench, secure the imbalance sensor to the gyro.
10. Orient the lower insulating disk (triangular cutout) so that the flat side of the cutout aligns with the imbalance sensor (the slit with the temperature sensor cable positioned clockwise from the flat side). When installed, the imbalance sensor cable should be completely underneath the disk, and the disk should be fully seated on the gyro.
11. Orient the thin upper insulating disk, smooth side up, then install the disk on the gyro while drawing the cable up through the slit. Properly installed, the upper insulating disk will be tight against the lower disk with slits aligned.

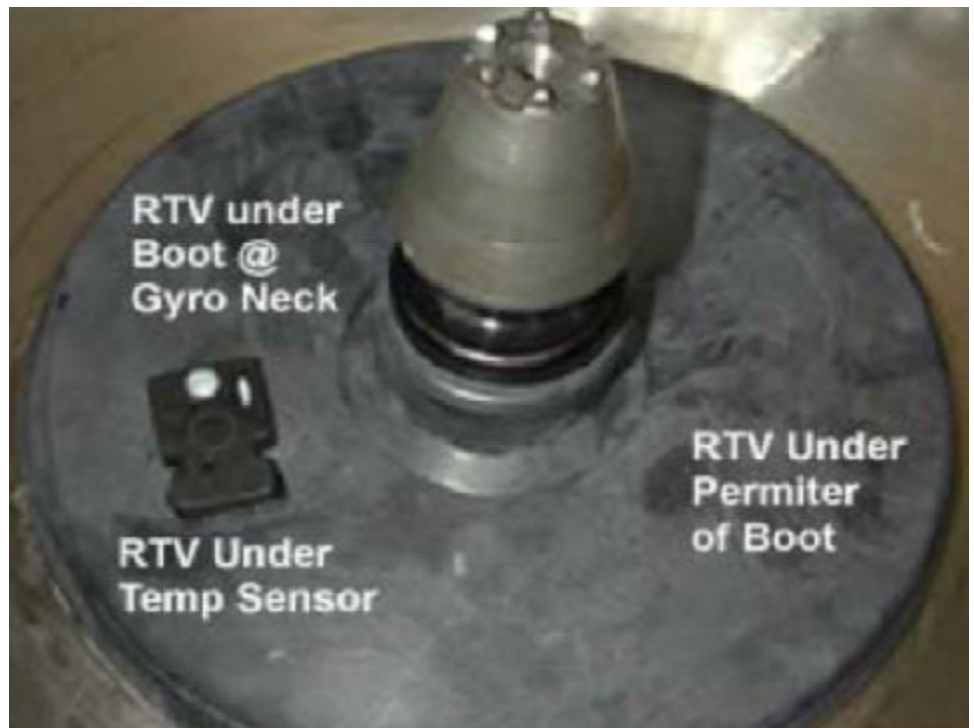


Figure 11

INSTRUCTIONS

for the
Evolution RC Motor Coupling Replacement Kit
(Kit Catalog No. 73450)

12. To the underside of the gyro boot, in the outer groove that runs inside the lip of the large disk portion, apply a continuous bead of RTV adhesive (catalog no. 65664, supplied).
13. Place RTV adhesive under the temperature sensor sealing where the cable passes through the boot.
14. Aligning the temperature sensor with the slots in the insulation, slide the gyro boot onto the gyro until the mouth of the boot is below the rib that runs around the top of the gyro housing.
15. Tuck the temperature sensor cable in under the gyro boot, then work the lip of the boot onto the rim of the evaporator chamber. Make sure the evaporator rim is fully engaged all the way around the boot to ensure that the RTV adhesive will create a proper seal.
16. Grasp the neck of the gyro boot and push it downward to fully expose the rib that runs around the top of the gyro housing. Apply a continuous bead of the RTV adhesive around the gyro housing, just below the rib, then work the mouth of the boot back upward until its annular groove (just inside the mouth of the boot) fully engages the rib on the gyro housing to create a proper seal. Wipe any excess adhesive from the boot and gyro housing, making sure that none gets on the gyro shaft.
17. Slide the slinger (removed in step C6) onto the gyro shaft so that it seats on the shoulder on the shaft, then using a 2 mm Allen wrench, tighten both screws to secure the slinger to the gyro shaft.
18. Apply a drop of Loctite ® 222 to the tapered spindle screw, then using a 4 mm Allen wrench, reinstall and securely tighten the tapered spindle on the gyro shaft.
19. Insert the top of the front panel underneath the top deck and set it in position on the two pins on the front of the centrifuge. Reinstall the two screws with washers (removed in step A2) and, using a 4 mm Allen wrench, tighten the two screws to secure the panel.

INSTRUCTIONS

for the
Evolution RC Motor Coupling Replacement Kit
(Kit Catalog No. 73450)

e. Checking Performance

1. Reconnect power, then turn the main power switch ON.
2. Install a rotor and perform a test run to confirm proper performance and calibrate imbalance per the instructions outlined in the Evolution RC Service Manual..

INSTRUCTIONS

for the
Evaporator Replacement Kit (Catalog No. 73461)
for the
SORVALL® Evolution™ RC Centrifuge

This kit contains items necessary for replacement of the refrigeration system evaporator (rotor chamber) in a SORVALL® Evolution™ RC centrifuge. Check the two lists that follow to be sure you have received all parts and have all necessary tools before beginning this procedure.



CAUTION

This procedure should only be attempted by a qualified technician who has been trained in the proper servicing of SORVALL® Evolution™ RC centrifuges and SORVALL® centrifuge refrigeration systems. These instructions assume that the repairer has such expertise.

Parts Supplied

Quantity	Catalog Number	Description
1	–	Evaporator Assembly
1	–	Cork Tape, 3000 mm (10 ft)
1	–	Foam Tape, 3000 mm (10 ft)
1	–	Caulking Cord, 600 mm (2 ft)
1	61768	Seal, Teflon®, 7/8 inch i.d.
1	66952	Seal, Teflon®, 5/8 inch i.d.
4	20094	Foam Strip, adhesive backed
1	–	Filter/Dryer Assembly
1	90702	Loctite® 222, 2 ml tube
1	65664	RTV Adhesive Sealant, Silicone Rubber, 82.8 ml tube

Tools and Other Items Required

Allen Wrenches, Metric: 2, 3, 4, 5, and 6 mm

Box Wrench, Metric, 10 mm

Open-end Wrenches, SAE: 7/8, 1, 1-1/8, 1-1/4 and 1-3/8 inch

Torque Wrench, 68–81 N·m (50–60 ft·lb), with SAE Open-End Wrench Ends: 1-1/4 and 1-3/8 inch

Flare Nut Wrenches, SAE: 5/8 and 11/16 inch

(continued)

Leak-lock® Fitting Sealant
Tubing Cutter, Mini (for 3/8-inch [9.5 mm] copper tubing)
Swagelok® Gap Inspection Gauge (Kendro Catalog No. 90401)
Helium Test Kit (Kendro Service-Issue)
SORVALL® Centrifuge Refrigeration Service Guide (Kendro Service-Issue)
Refrigeration Recovery/Charging Equipment
Suva® HP62 (R404A) HFC Refrigerant
Laptop Computer with serial port, running MSWindows 95® or later
Null Modem Cable, DB9 F to DB9 F (Kendro Catalog No. 73827)

Evaporator Replacement Procedure



W A R N I N G

Because of the characteristics of the samples likely to be processed in this centrifuge, biological or radioactive contamination may occur. Always be aware of this possibility, and take normal precautions. The Kendro Service Decontamination Policy states that a completed Decontamination Information Certificate is required before servicing.

Replace the evaporator as follows (save all parts for reassembly unless directed otherwise):

A. Removing the Cabinet Panels

1. Open the chamber door, then turn the main power switch OFF, unplug the centrifuge, and wait four minutes before proceeding.



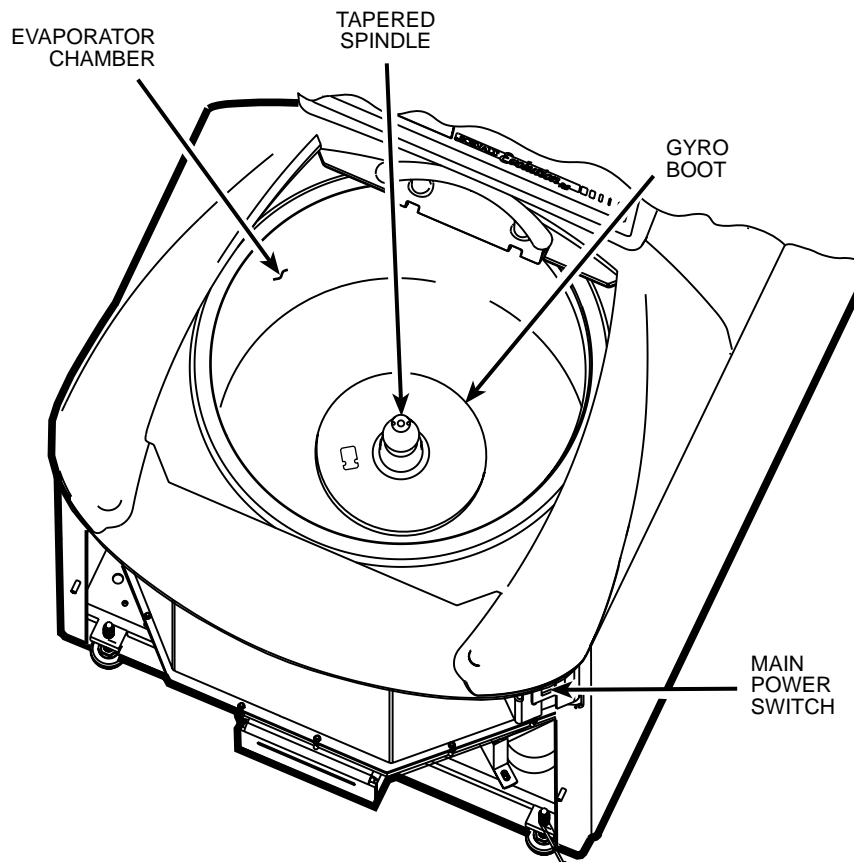
W A R N I N G

Hazardous voltages may exist whenever power is connected and circuits are energized. To eliminate potential for serious electrical shock or component damage, turn the main power switch OFF, unplug the centrifuge, then wait four minutes before proceeding.

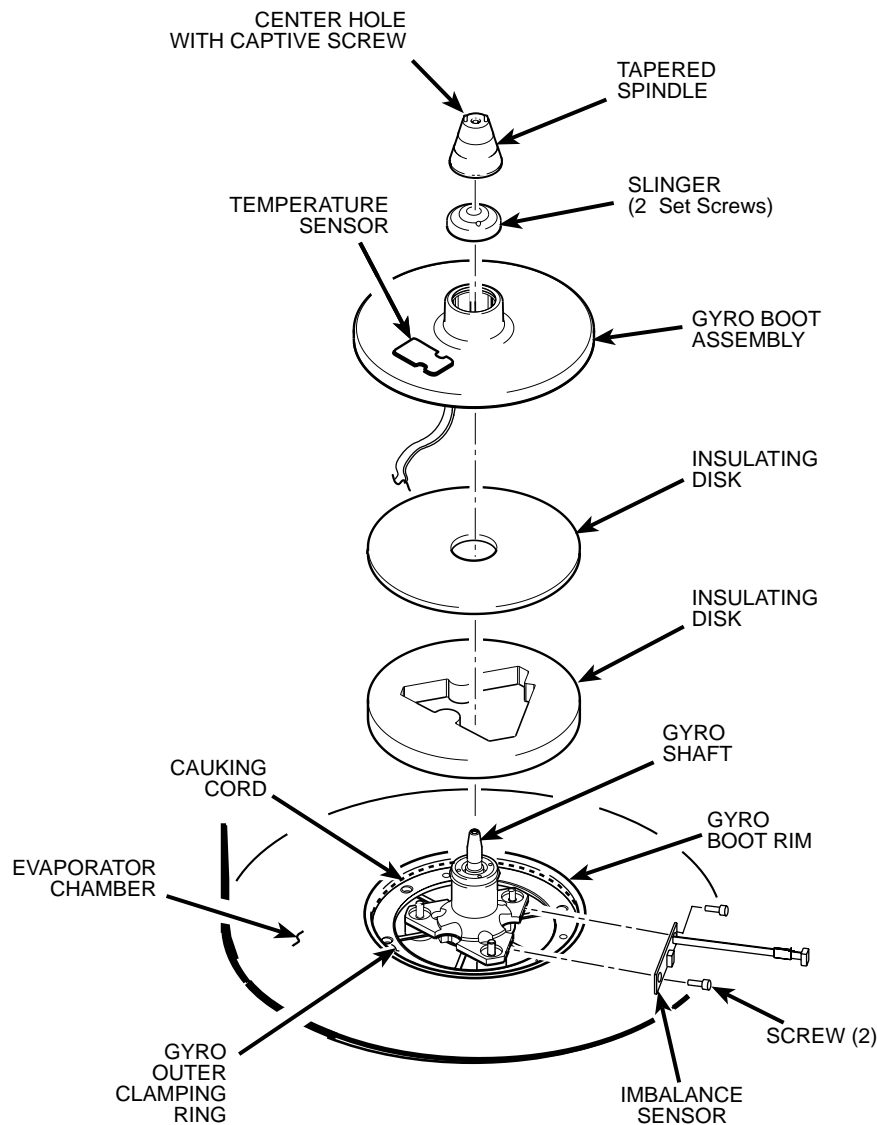
2. If the centrifuge is located so that there is no room to work behind or in front of the centrifuge, raise the front locking stabilizers and roll the centrifuge to a suitable working location.
3. Using a 4 mm Allen wrench, remove the two screws with washers from the louver area of the front panel, then remove the front panel.
4. Using a 6 mm Allen wrench, remove the two screws that secure the back of the top rear deck.
5. Using a 5 mm Allen wrench, remove the single screw from the center of the control console bracket, then remove the top rear deck.
6. Using a 3 mm Allen wrench, remove the six screws securing the rear panel, and remove the panel.
7. Using a 3 mm Allen wrench, remove the two screws that secure the drip tray between the door rails, then remove the drip tray.

B. Removing the Motor/Gyro Assembly

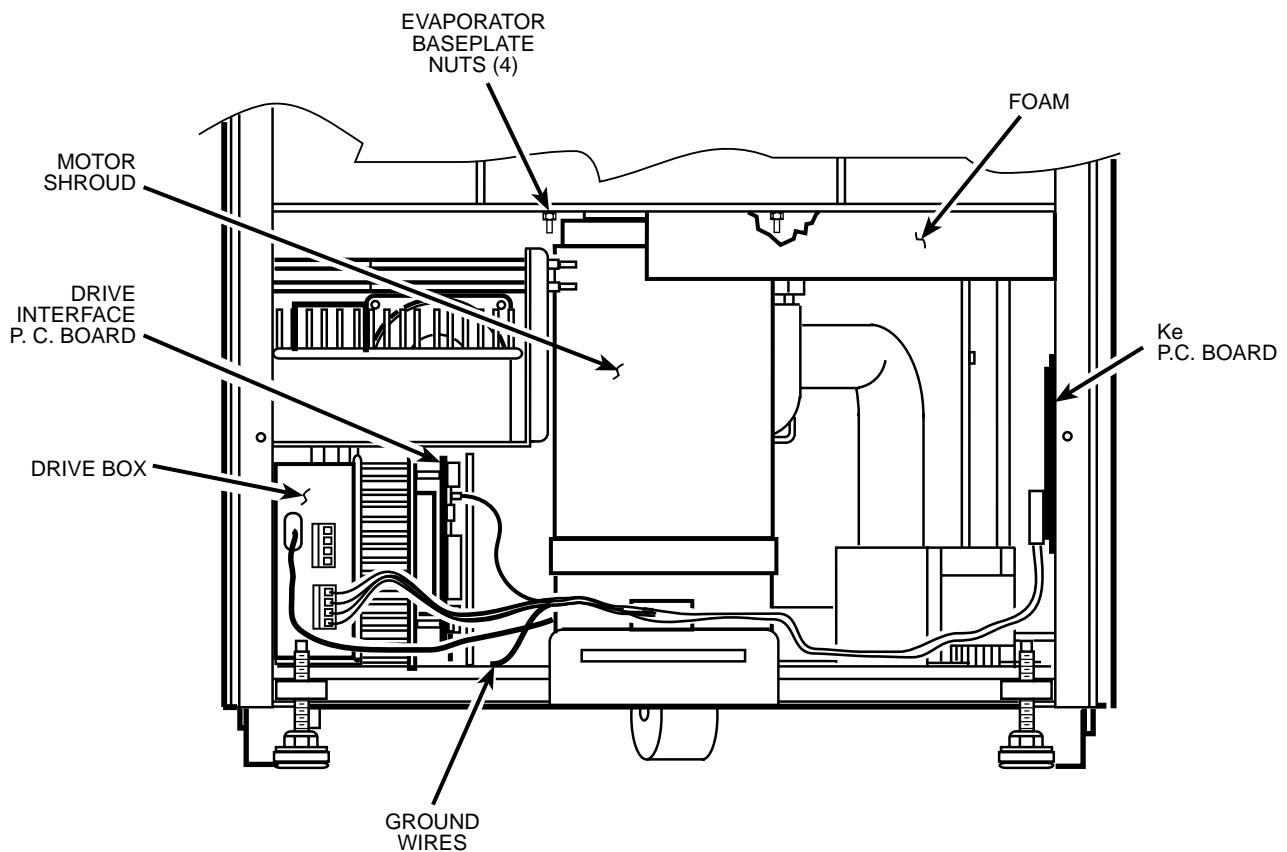
1. Working inside the evaporator chamber, using a 4 mm Allen wrench through the center hole in the tapered spindle, unscrew the captive screw, then pull the tapered spindle up and off of the gyro shaft.



2. Using a 2 mm Allen wrench, loosen the two set screws that secure the slinger to the gyro shaft, then slide the slinger up and off of the gyro shaft.
3. Remove the gyro boot (affixed with RTV adhesive): First work the circumference off of the evaporator rim, then, being careful not to stress the temperature sensor cable, pull the boot (with temperature sensor attached) straight up and off of the gyro housing.
4. Carefully, so as not to damage the gyro boot or temperature sensor cable, work to remove and discard the old RTV sealant remaining from the underside of the boot (do not remove sealant from where the sensor cable feeds through the boot), then set the boot / sensor assembly aside on the evaporator floor.
5. One at a time, pull the two insulating disks off of the gyro.
6. Remove the caulk from around the gyro's outer clamp ring. Discard the caulk.
7. Using a 3 mm Allen wrench, remove the two screws that secure the imbalance sensor to the gyro. Draw the cables from the imbalance and temperature sensors straight up, bend them toward the front of the centrifuge, and hook the cables over the evaporator rim (so that the sensors can stay in the bottom of the chamber and the two cables will be out of the way).
8. Using a 4 mm Allen wrench, reinstall the tapered spindle on the gyro shaft.



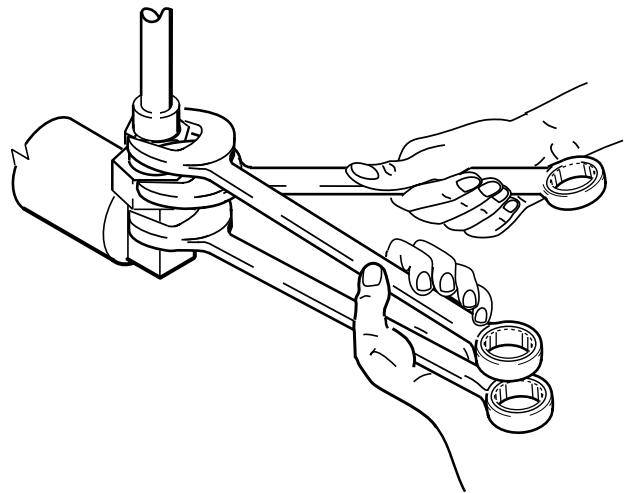
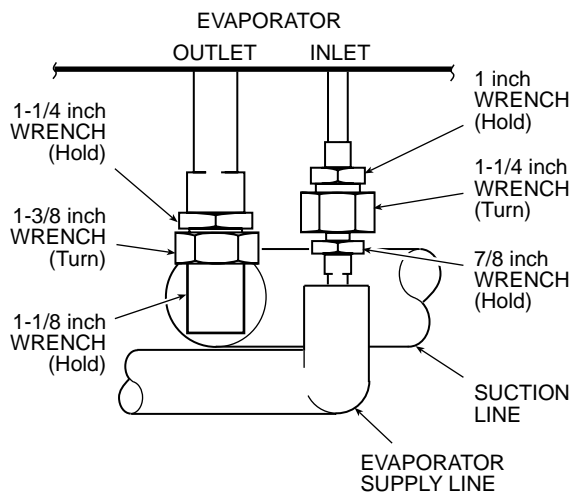
9. Working down underneath in front, disconnect all wires coming from the motor shroud:
 - a. Unplug the motor cable from the drive box and from the Ke P.C. board, and disconnect the ground wires from the frame using a 3 mm Allen wrench.
 - b. Unplug the commutation wires from the drive box.
 - c. Unplug the auxiliary tachometer wires from the drive interface P.C. board.
10. Using a 10 mm box wrench, remove the four nuts that are located up under the evaporator baseplate near the top of the motor shroud.
11. From below, feed all motor cables and connectors (disconnected in step B9 above) into the motor shroud so that they will lay loose inside the shroud on top of the motor fan.
12. From above, using the tapered spindle as a handle, lift the motor / gyro assembly up and, being careful not to crush sensor cables, temporarily set it in the evaporator chamber.



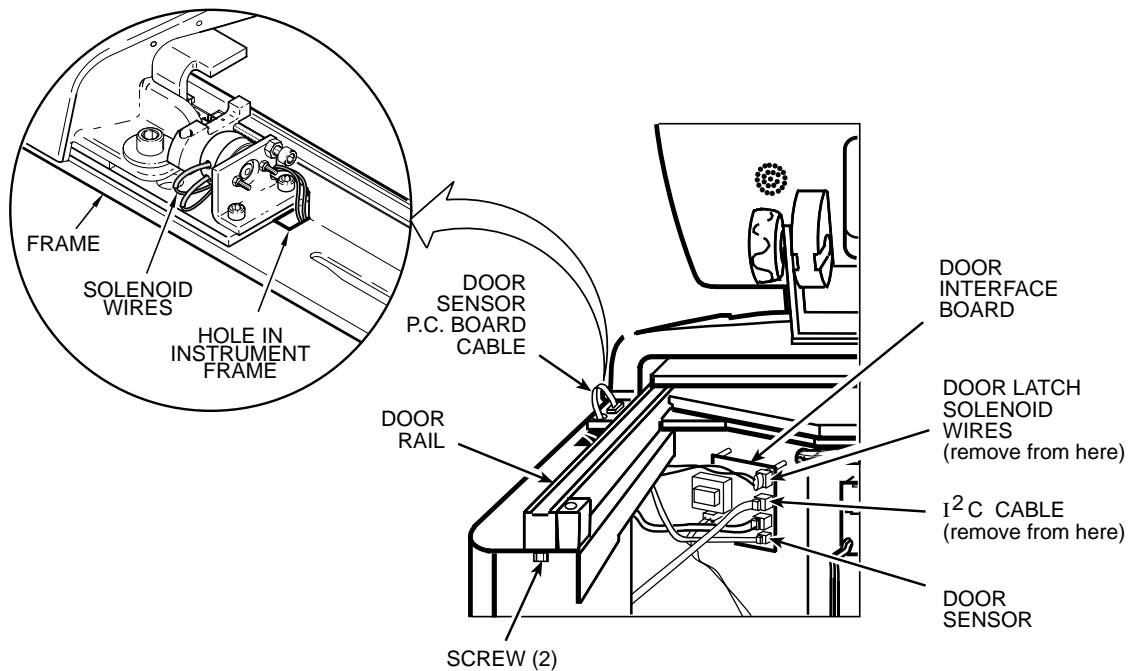
13. Pull the motor cables up into the evaporator chamber, then lift the motor/gyro assembly from the centrifuge.

C. Removing the Evaporator

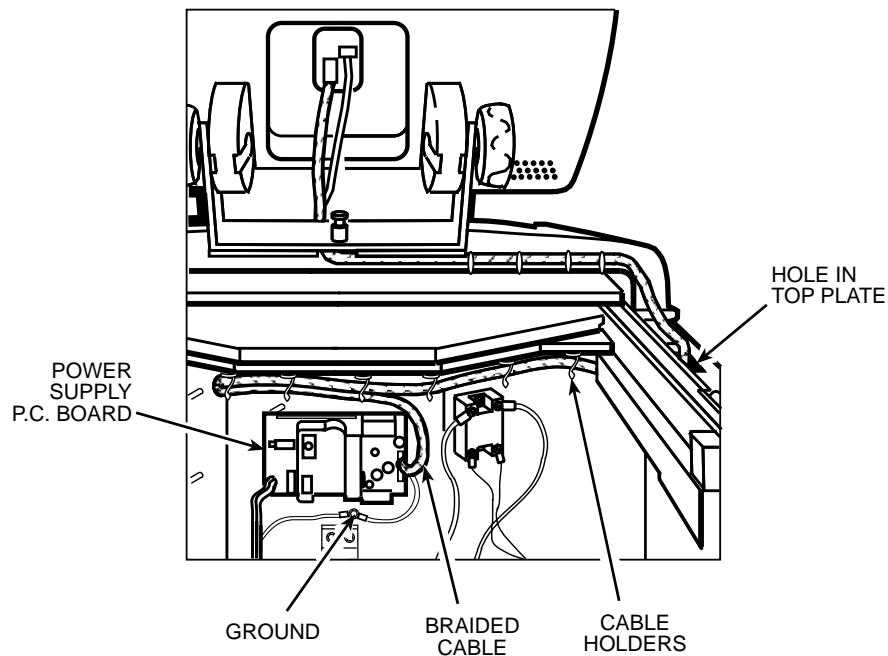
1. From below, unplug the two wires from the motor fan, then using a 4 mm Allen wrench, remove the two screws securing the motor fan mounting brackets to the centrifuge frame baseplate. Remove the motor fan/shroud assembly.
2. Remove insulating tape as required to access the two refrigeration system service valves (see illustration on page 7 for valve locations), then connect refrigeration equipment and recover the refrigerant (Suva® HP62 [R404A]).
3. Remove insulating tape from the two evaporator fittings. Using three SAE open-end wrenches (top to bottom, 1, 1-1/4, and 7/8 inch) so that the two stationary fittings and connected tubing will not be twisted as the Rotalock® nut turns, disconnect the evaporator supply line from the evaporator fitting (see illustration on next page). Plug the end of the supply line to seal off the condenser assembly (to minimize moisture contamination).
4. Using three larger SAE open-end wrenches (top to bottom, 1-1/4, 1-3/8, and 1-1/8 inch), disconnect the suction line, then plug the end of the suction line.



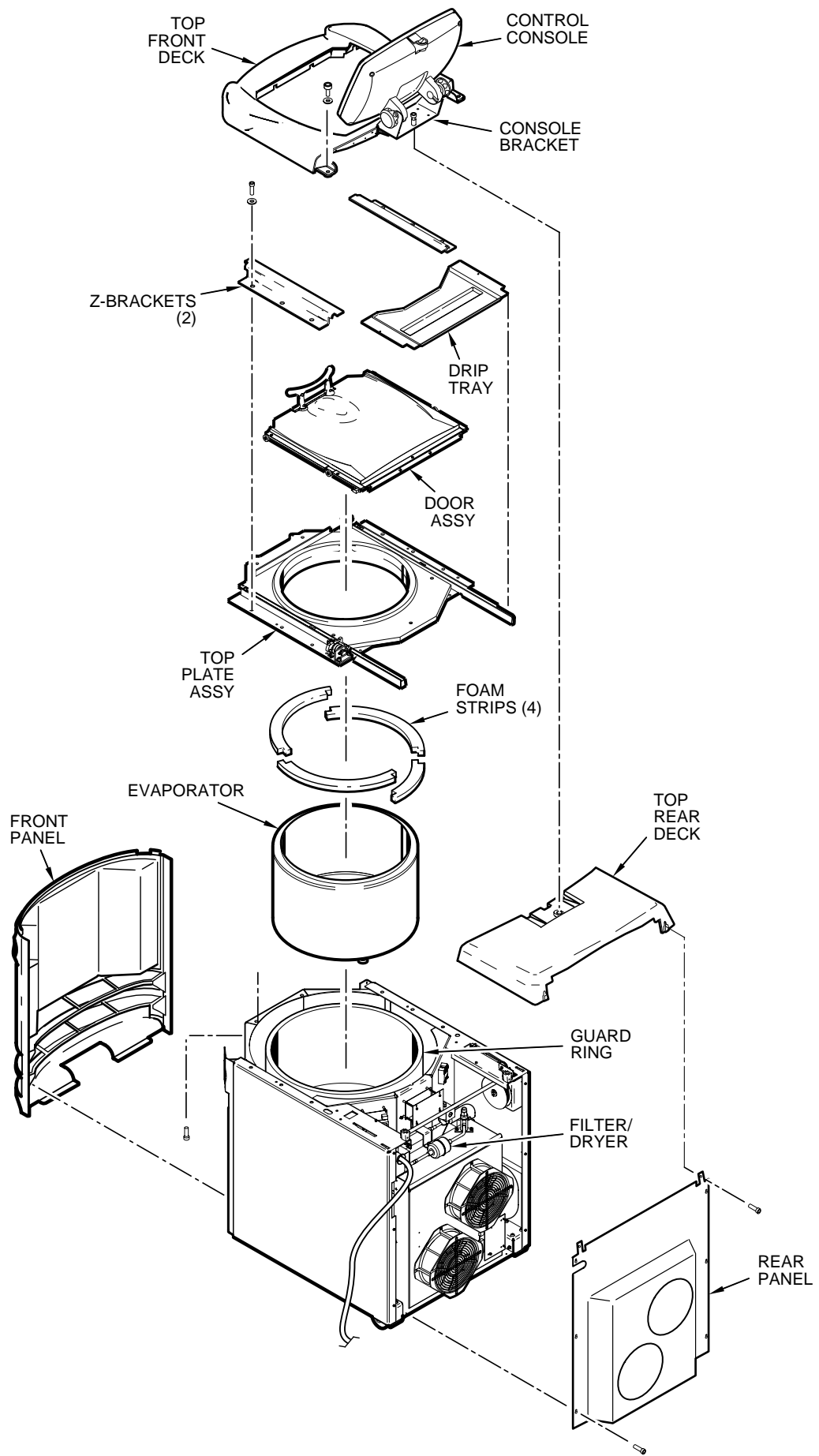
5. **IMPORTANT:** If the evaporator is only *suspected* of leaking and physical damage is not apparent, check the evaporator for leaks using helium *before proceeding with this procedure*. If the helium test proves that the evaporator is bad, continue with the next step. If, however, the helium test proves that a questionable evaporator is good, do not replace it. Reassemble by performing steps D2 through D10, then complete the procedure beginning with E1.
6. From the door interface P.C. board, disconnect the door latch solenoid wires and the I²C cable (two plugs toward the top). Feed both up through the holes in the frame/top plate.



7. From the power supply P.C. board, disconnect the cable with the braided shield (use a 3 mm Allen wrench to disconnect ground).
8. Remove the braided cable from the cable holders along the back of the top plate, then feed the braided cable and plug up through the holes in the frame and top plate.
9. Using an 8 mm Allen wrench, remove the two screws with washers securing the rear tabs of the top front deck.



10. From underneath the top front deck, using a 5 mm Allen wrench, remove the four screws that secure the top front deck to the top plate, then remove the top front deck with control console by lifting it up and off of the frame / top plate.
11. Using an 8 mm Allen wrench, remove the six screws with washers securing the two Z-brackets (3 screws per bracket), then remove the brackets.
12. Holding the door retractor cable so that it cannot retract, using a 3 mm Allen wrench, remove the shoulder screw that attaches the cable to the left side of the door. Allow the cable to slowly retract until the cable end is positioned securely between the idler pulley and pulley bracket.
13. Remove the door by lifting it up and off of the door rails.
14. Unplug the cable from the door sensor P.C. board, and feed it down through the hole in the top plate.
15. Using a 5 mm Allen wrench, remove the two screws securing the back end of the two door rails (one each, from underneath).
16. Using an 8 mm Allen wrench, remove the two front screws with washers securing the top plate to the frame, then work around the bottom of the door seal to separate any adhesion to the evaporator walls, and remove the top plate assembly (with door seal and door rails intact) by lifting it straight up to disengage the evaporator.
17. Peel the foam from around the top of the evaporator lockfoam and guard ring.
18. Remove insulating tape from the two evaporator fittings.
19. From inside the evaporator, feed the imbalance sensor and cable down through the motor hole. Do the same with the gyro boot / temperature sensor and cable.
20. Lift the evaporator straight up and out of the guard ring.



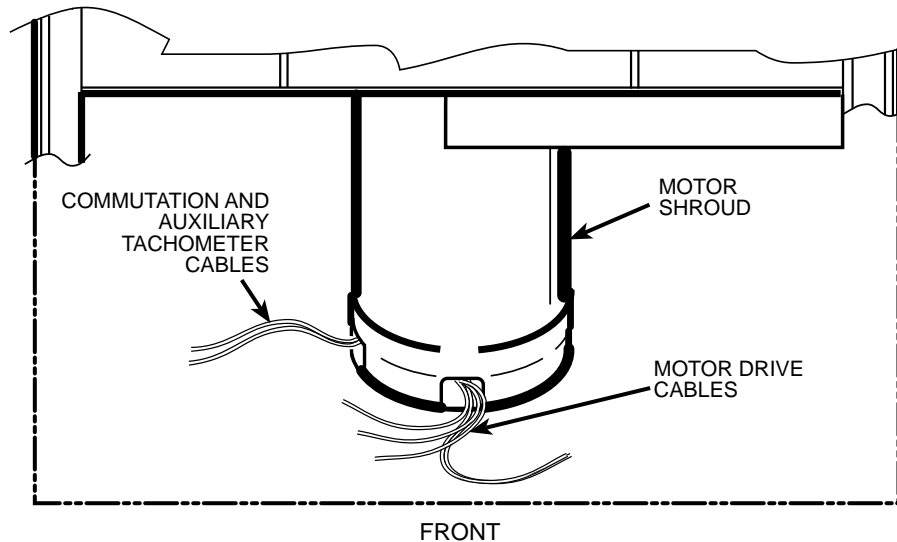
D. *Installing the New Evaporator*

1. Orient the new evaporator so that the two refrigeration fittings on the bottom align with the feedthrough hole in the baseplate, then lower the evaporator into the guard ring until it is fully seated on the baseplate.
2. Working underneath, insert a new Teflon® seal (catalog nos. 61768 and 66952, supplied) into the end of each evaporator fitting, then remove the two plugs from the evaporator, and apply Leak Lock® sealant to both fittings.
3. Remove the plug from the suction line, then again using three wrenches but with the middle wrench being a torque wrench with open-end adapter (top to bottom, 1-1/4, 1-3/8, and 1-1/8 inch), connect the evaporator supply line and tighten the Rotalock® nut to 68 to 81 N·m (50 to 60 ft-lb).
4. Remove the plug from the evaporator supply line, then using three smaller wrenches (again with the middle being a torque wrench, top to bottom, 1, 1-1/4, and 7/8 inch), connect the evaporator supply line and tighten the Rotalock® nut to 68 to 81 N·m (50 to 60 ft-lb).
5. Working behind the centrifuge, remove and discard the original filter/dryer. If Swagelok® fittings are not on either side of the original filter/dryer, use a mini tubing cutter to cleanly cut the filter/dryer from the system: Cut the tubing at 82.5 mm (3.25 inches) from the center of the filter/dryer (the filter/dryer housing has a center rib; distance from the center of the filter/dryer applies in either direction, for both cuts).
6. Install the new filter/dryer assembly (supplied), making sure that the flow arrows on the filter/dryer housing point toward the sight glass. Using flare nut wrenches and a Swagelok® gap inspection gauge, follow standard procedures for Swagelok® fittings to ensure proper sealing.
7. Using helium, pressurize the refrigeration system through both service valves, then check for leaks by applying liquid soap at each of the five fittings and watching for bubbles. If a leak is detected, using appropriate wrenches to avoid damage, tighten the fitting enough to seal.
8. If no leaks are detected, configure refrigeration equipment for evacuation, then release the helium and evacuate the system. Continue with the procedure while the system is being evacuated, checking the vacuum level from time to time. Once the vacuum reading gets to 29 inches Hg (1.2 kPa) or greater, note the time – then continue to evacuate the system for a minimum of one hour from that point.
9. Wipe the liquid soap from the filter/dryer fittings and refrigeration lines, as well as from the top of the condenser (if any dripped).
10. Wipe the liquid soap from the two evaporator fittings and refrigeration lines, as well as from the frame baseplate, then insulate the two lines/fittings using the tape supplied (apply the cork tape first, then use the foam tape to cover it).
11. Reinstall the motor fan/shroud assembly (removed in step C1) and secure it in place using a 4 mm Allen wrench. Reconnect the motor fan wires.
12. One at a time, apply three of the four adhesive-backed foam strips (catalog no. 20094, supplied) around the top of the evaporator, affixing them to the top of the evaporator lockfoam and guard ring, leaving approximately a 5 mm (3/16 inch) gap between the evaporator wall and each foam strip, interlocking the ends. When finished, it should be as if a continuous foam strip is affixed around the top of the evaporator lockfoam

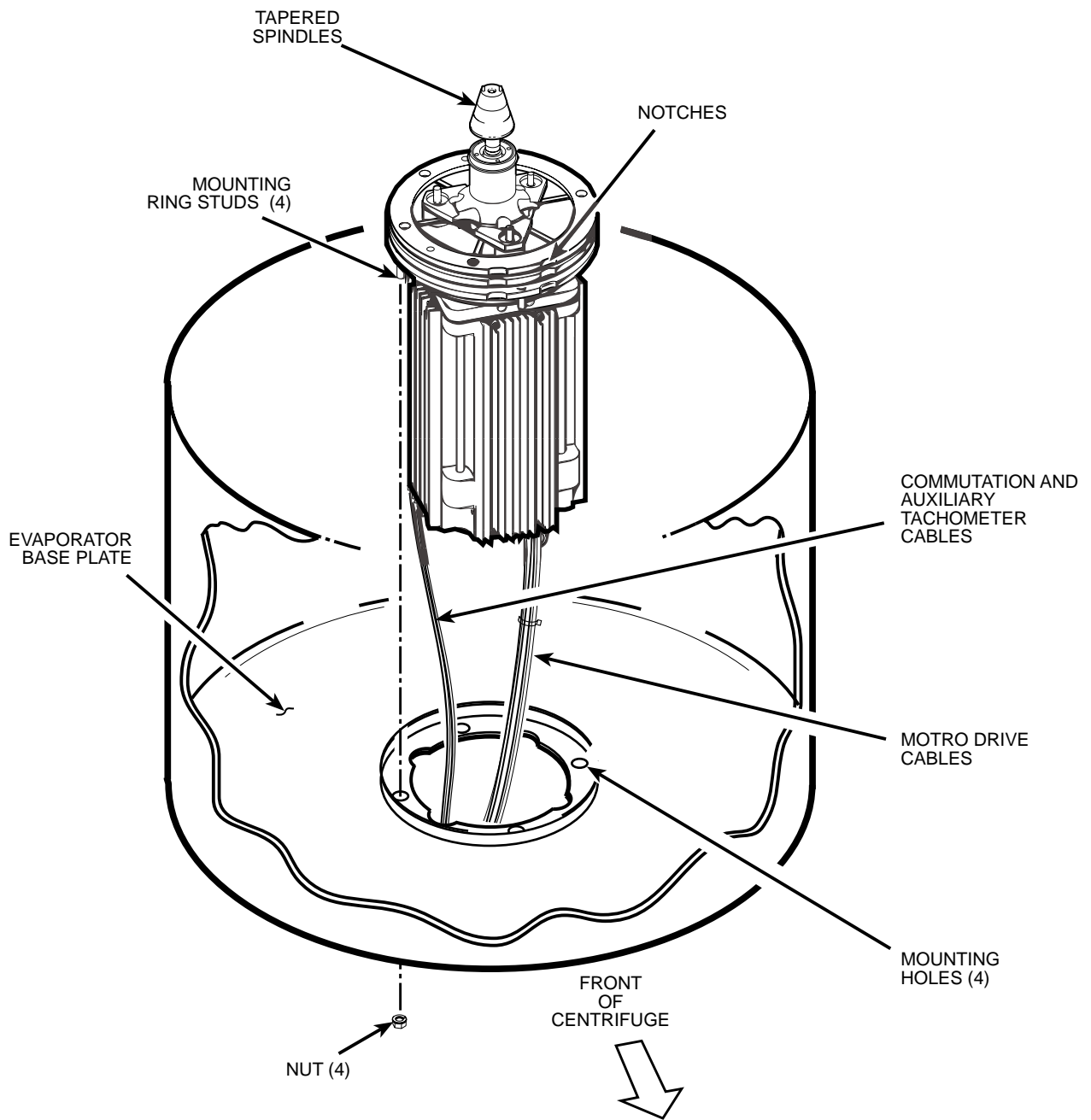
13. Rough-position the fourth adhesive-backed strip in the remaining space, then mark and cut it so that it is the right length and will interlock both ends. Affix that piece in the remaining gap.
14. Reinstall the top plate assembly: Align the door seal with the evaporator chamber, then lower the top plate assembly onto the evaporator, being careful not to pinch the door latch solenoid wires. Work around the door seal so that it becomes fully engaged and seats properly on the top edge of the evaporator wall while the top plate seats on the centrifuge frame with mounting holes aligned.
15. Systematically working around the door seal, carefully lift the seal (so as not to disengage the seal from the evaporator), apply a bead of RTV sealant underneath, and press/smooth the seal against the evaporator wall. Wipe up any excess sealant that is squeezed out from under the edge of the door seal.
16. Using a 5 mm Allen wrench, reinstall the two screws (removed in step B14) securing the back end of the two door rails (one each, from underneath).
17. Using an 8 mm Allen wrench, reinstall the two front screws with washers (removed in step B15) to secure the front of the top plate to the frame.
18. Feed the door sensor cable back up through the hole in the top plate and reconnect it to the door sensor P.C. board.
19. Feed the door latch solenoid plug and wires down through the hole in the frame that is immediately behind the top plate and reconnect it to the door interface P.C. board.
20. Place the door assembly on the two door rails, making sure the rollers roll correctly on the rails.
21. Roll the door all the way back on the door rails. Draw the door retractor cable forward (keeping the idler pulley engaged), and using a 3 mm Allen wrench, reinstall the shoulder screw (removed in step B11) to attach the retractor cable to the door.
22. Position the two Z-brackets on the top plate. Using an 8 mm Allen wrench, reinstall the six screws with washers (3 screws per bracket, removed in step B10) securing the two Z-brackets.
23. Being careful not to pinch the I²C cable or the braided cable, position the top front deck on the top plate. Using an 8 mm Allen wrench, thread the two large screws and washers (removed in step B8) through the tabs at the rear of the deck into the top deck/frame, but do not tighten yet.
24. From underneath the front, using a 5 mm Allen wrench, reinstall the four screws (removed in step B9) that secure the top front deck to the top plate, then tighten the two large screws that were previously left loose at the rear of the top front deck.
25. Extending from the control console and routed across the rear of the top front deck, feed the braided cable and plug down through the hole in the top deck/frame, then route/insert the cable in the cable holders along the back of the top plate. Connect the plug to the power supply P.C. board and using a 3 mm Allen wrench, attach the braided shield to the frame (using the hardware removed in step B6).
26. Also extending from the control console, but routed across the rear of the top front deck to the other side, feed the I²C cable and plug down through the hole in the top deck/frame, then connect the plug to the door interface P.C. board.

E. Installing the Motor/Gyro Assembly

1. Apply a drop of Loctite® 222 to each of the four studs on the bottom of the mounting ring, then transport the motor/gyro assembly to the centrifuge and, being careful not to crush sensor cables, temporarily set it down inside the evaporator chamber.
2. Tape the auxiliary tachometer cable to the commutation cable (tape is temporary, to aid routing), then feed the motor cables down through the motor shroud; route the motor drive cable out the hole in the front, and route commutation and auxiliary tachometer cables out the hole on the left side.



3. Using the tapered spindle as a handle, orient the motor/gyro assembly so that the two notches in the outside edge of the gyro assembly face toward the front of the centrifuge, then lower the motor/gyro assembly into its correct position (being careful not to pinch the sensor wires) so that the four studs in the mounting ring engage the four holes in the evaporator baseplate (see illustration on next page).
4. Working down underneath in front, thread the four nuts (removed in step B10) onto the four mounting ring studs (located up on the evaporator baseplate near the top of the motor shroud), and tighten each nut securely using a 10 mm box wrench.
5. Connect all wires coming from the motor shroud:
 - a. Separate the auxiliary tachometer cable from the commutation cable by removing the tape applied in step E2, then connect the auxiliary tachometer wires to the drive interface P.C. board.
 - b. Connect the commutation wires to the drive box.
 - c. Connect the motor cable to the drive box and to the Ke P.C. board, and reconnect the ground wires to the frame using the hardware removed in step B9 and tighten using a 3 mm Allen wrench.
6. Working inside the evaporator chamber, use a 4 mm Allen wrench to remove the tapered spindle from the gyro shaft.
7. Using the length of new caulking cord supplied, seal around the gyro's outer clamp ring.



8. Apply a drop of Loctite® 222 to each of the two screws that were used to secure the imbalance sensor (removed in step B7), then using a 3 mm Allen wrench, secure the imbalance sensor to the gyro.
9. Orient the lower insulating disk (with triangular cutout) so that the flat side of the cutout aligns with the imbalance sensor. When installed, the imbalance sensor cable should be completely underneath the disk, and the disk should be fully seated on the gyro.
10. Orient the thin upper insulating disk smooth side up, then install the disk on the gyro so that it seats flush against the lower disk.
11. Apply a continuous bead of RTV adhesive around the underside of the gyro boot, in the outer groove that runs just inside the lip of the large disk portion.

12. Orient the gyro boot above the gyro so that the temperature sensor cable is not twisted and so that the sensor is aligned with where the sensor cable feeds down past the gyro, then slide the gyro boot onto the gyro until the mouth of the boot is below the rib that runs around the top of the gyro housing.
13. Bundle and tuck the temperature sensor cable in under the gyro boot, then work the lip of the boot onto the rim of the evaporator chamber. Make sure the evaporator rim is fully engaged all the way around the boot to ensure that the RTV adhesive will create a proper seal.
14. Grasp the neck of the gyro boot and push it downward to fully expose the rib that runs around the top of the gyro housing. Apply a continuous bead of RTV adhesive around the gyro housing, just below the rib, then work the mouth of the boot back upward until its annular groove (just inside the mouth of the boot) fully engages the rib on the gyro housing to create a proper seal. Wipe any excess adhesive from the boot and gyro housing, making sure that none gets on the gyro shaft.
15. Slide the slinger (removed in step B2) down onto the gyro shaft until it seats, then slide it back upward just a small amount to ensure that it isn't touching the gyro boot. Using a 2 mm Allen wrench, tighten both screws to secure the slinger to the gyro shaft.
16. Apply a drop of Loctite® 222 to the tapered spindle screw, then using a 4 mm Allen wrench, reinstall and securely tighten the tapered spindle on the gyro shaft.
17. Insert the top of the front panel underneath the top deck and set it in position on the two pins on the front of the centrifuge, then reinstall the two screws with washers (removed in step A3) and, using a 4 mm Allen wrench, tighten the two screws to secure the panel.

F. Charging the Refrigeration System and Checking Performance

1. After the refrigeration system vacuum level has been at 29 inches Hg (1.2 kPa) or greater for at least one hour, charge the refrigeration system. Refrigeration charging specifications for the Evolution™ RC are supplied on the next page.

Evolution™ RC Refrigeration Charging Specifications

Refrigerant Type	Suva® HP62 (R404A) HFC
<i>Initial</i> Refrigerant Charge Weight (during Superheat/Cond.T.D. optimization, additional liquid refrigerant will be added through low-side throttling valve)	3.00 lbs. (1360 grams)
Specified Heat Load Rotor	SS-34
Operating Superheat Value	19°F (10.6°C)
Maximum Condenser T.D. Value	25°F (13.9°C)

2. After optimizing the refrigerant charge based on condenser T.D. and superheat, perform a test run to check centrifuge performance and temperature control (if the centrifuge was moved, be sure to use the front locking stabilizers to level the centrifuge before operation).
3. Make sure the two service valve ports are closed securely, then remove the refrigeration equipment, reinstall all service valve caps, and apply insulation tape to the low-side service valve.

4. Position the drip tray between the door rails, reinstall the two screws (removed in step A7) and, using a 3 mm Allen wrench, tighten the two screws to secure the drip tray.
5. Position the rear panel on the rear of the centrifuge frame, and using a 3 mm Allen wrench, secure the panel in place using the six screws (removed in step A6).
6. Position the top rear deck on the frame, then using a 5 mm Allen wrench, reinstall the single screw in the center of the control console bracket. Using a 6 mm Allen wrench, reinstall the two screws that secure the back of the top rear deck.
7. If the centrifuge was moved, return it to its original operating location and level it using the front locking stabilizers.

Calibrating Imbalance:

1. Calibrate the centrifuge imbalance following the procedure outlined in the Calibration & Software section of the Evolution RC Service Manual.

INSTRUCTIONS

for the
Expansion Valve/Liquid Line Replacement Kit
(Catalog No. 73458)
for the
SORVALL® Evolution™ RC Centrifuge

This kit contains items necessary for replacement of the refrigeration system expansion valve/liquid line (expansion valve with bulb sensor, liquid line control valve, sight glass, filter/dryer, and interconnecting tubing) in a SORVALL® Evolution™ RC centrifuge. Check the two lists that follow to be sure you have received all parts and have all necessary tools before beginning this procedure.



CAUTION

This procedure should only be attempted by a qualified technician who has been trained in the proper servicing of SORVALL® Evolution™ RC centrifuges and SORVALL® centrifuge refrigeration systems. These instructions assume that the repairer has such expertise.

Parts Supplied

Quantity	Catalog Number	Description
1	–	Expansion Valve/Liquid Line Assembly
1	–	Cork Tape, 3000 mm (10 ft)
1	–	Foam Tape, 3000 mm (10 ft)
1	–	Insulation, Pipe, 600 mm (2 ft)
1	–	Caulking Cord, 600 mm (2 ft)
1	61768	Seal, Teflon®, 7/8 inch i.d.
1	66952	Seal, Teflon®, 5/8 inch i.d.
1	90702	Loctite® 222, 2 ml tube
1	65664	RTV Adhesive Sealant, Silicone Rubber, 82.8 ml tube

Tools and Other Items Required

Allen Wrenches, Metric: 2, 3, 4, 5, and 6 mm

Box Wrench, Metric, 10 mm

Open-end Wrenches, SAE: 7/8, 1, 1-1/8, 1-1/4 and 1-3/8 inch

Torque Wrench, 68–81 N·m (50–60 ft·lb), with SAE Open-End Wrench Ends: 1-1/4 and 1-3/8 inch

Flare Nut Wrenches, SAE: 5/8, 11/16, 13/16, and 7/8 inch

(continued)

Tubing Cutter, Mini (for 3/8-inch [9.5 mm] and 1/2-inch [12.7 mm] copper tubing)
Swagelok® Gap Inspection Gauge (Kendro Catalog No. 90401)
Leak-lock® Fitting Sealant
Helium Test Kit (Kendro Service-Issue)
SORVALL® Centrifuge Refrigeration Service Guide (Kendro Service-Issue)
Refrigeration Recovery/Charging Equipment
Suva® HP62 (R404A) HFC Refrigerant
Laptop Computer with serial port, running MSWindows 95® or later
Null Modem Cable, DB9 F to DB9 F (Kendro Catalog No. 73827)

Expansion Valve/Liquid Line Replacement Procedure



W A R N I N G

Because of the characteristics of the samples likely to be processed in this centrifuge, biological or radioactive contamination may occur. Always be aware of this possibility, and take normal precautions. The Kendro Service Decontamination Policy states that a completed Decontamination Information Certificate is required before servicing.

Replace the expansion valve/liquid line as follows (save all parts for reassembly unless directed otherwise):

A. Removing the Cabinet Panels

1. Open the chamber door, then turn the main power switch OFF, unplug the centrifuge, and wait four minutes before proceeding.



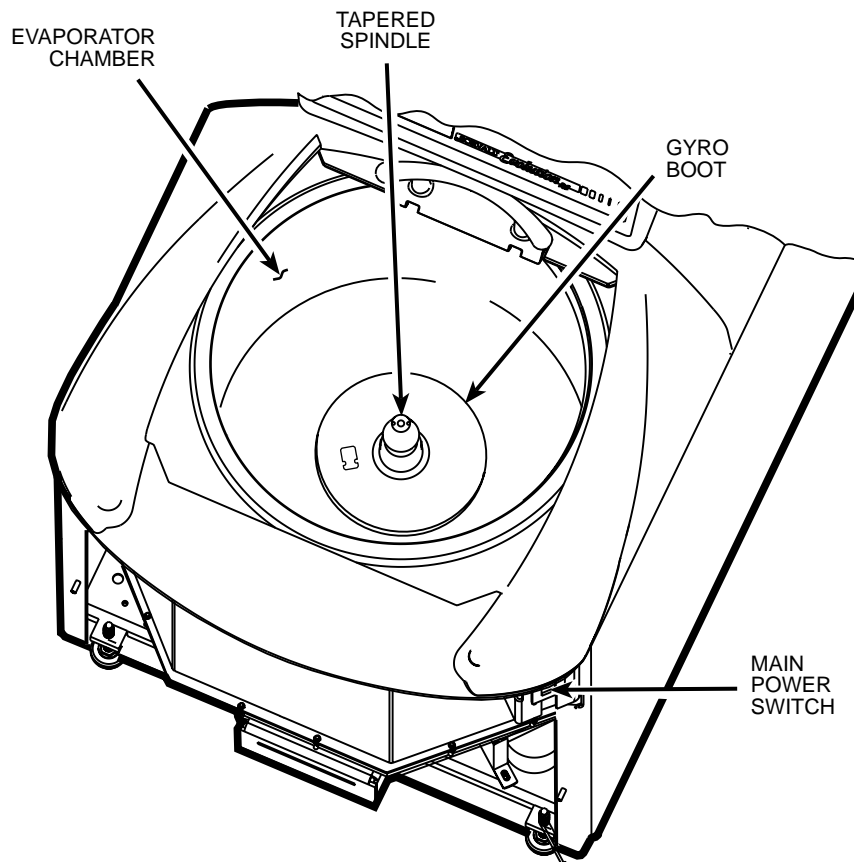
W A R N I N G

Hazardous voltages may exist whenever power is connected and circuits are energized. To eliminate potential for serious electrical shock or component damage, turn the main power switch OFF, unplug the centrifuge, then wait four minutes before proceeding.

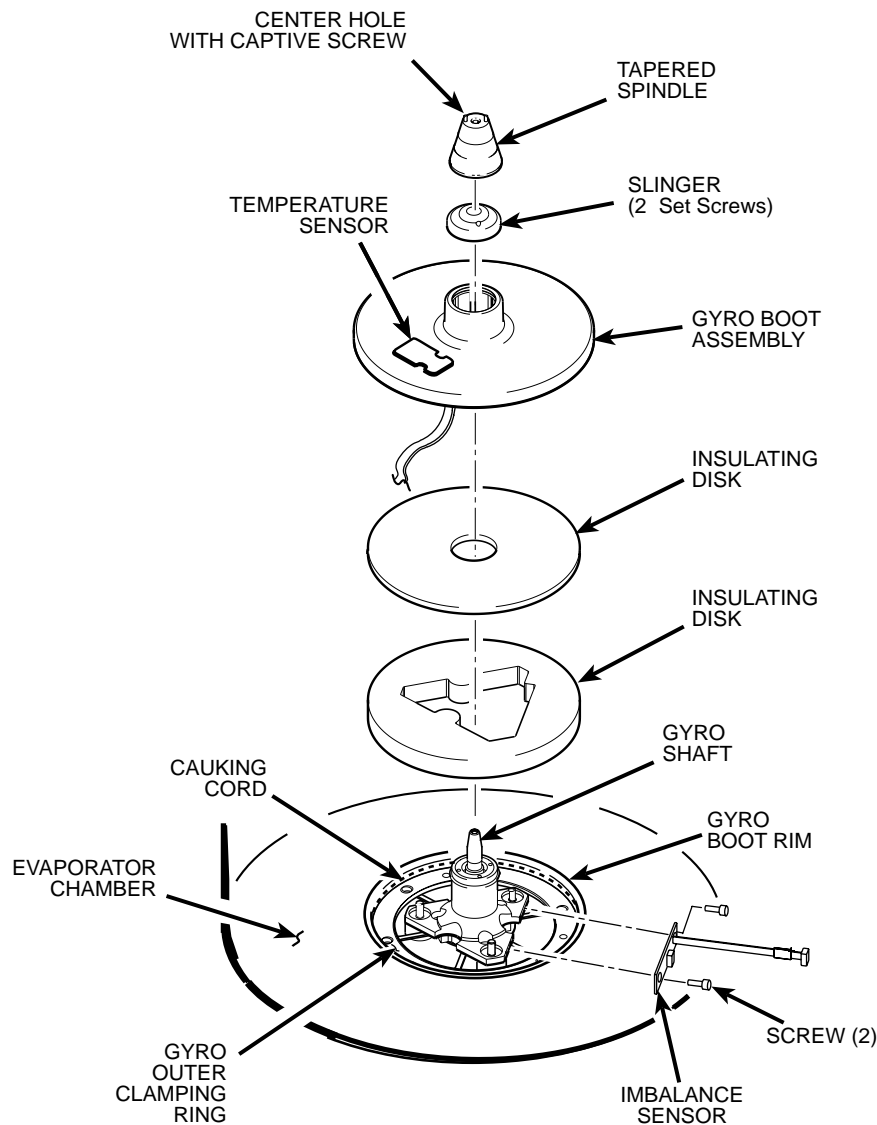
2. If the centrifuge is located so that there is no room to work behind or in front of the centrifuge, raise the front locking stabilizers and roll the centrifuge to a suitable working location.
3. Using a 4 mm Allen wrench, remove the two screws with washers from the louver area of the front panel, then remove the front panel.
4. Using a 6 mm Allen wrench, remove the two screws that secure the back of the top rear deck.
5. Using a 5 mm Allen wrench, remove the single screw from the center of the control console bracket, then remove the top rear deck.
6. Using a 3 mm Allen wrench, remove the six screws securing the rear panel, and remove the panel.
7. Using a 3 mm Allen wrench, remove the two screws that secure the drip tray between the door rails, then remove the drip tray.

B. Removing the Motor/Gyro Assembly

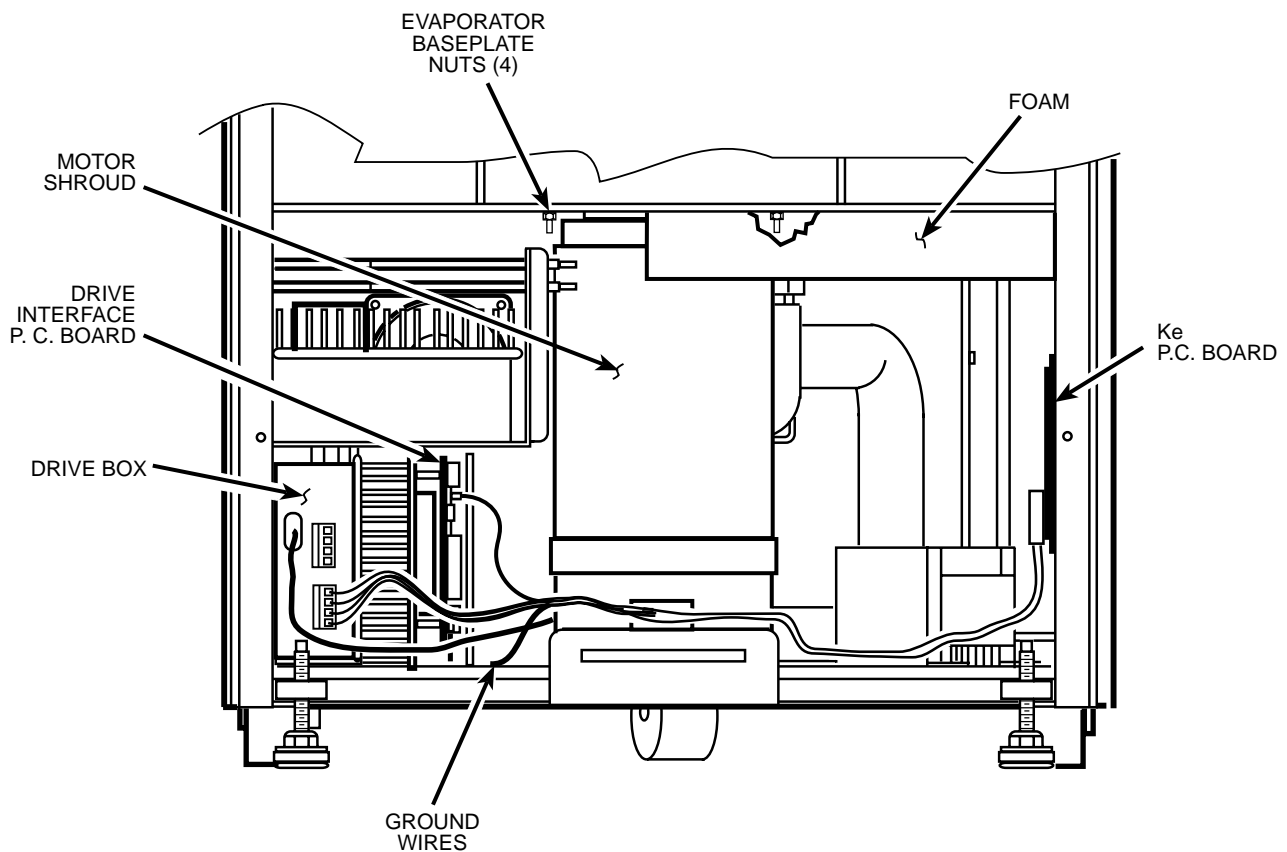
1. Working inside the evaporator chamber, using a 4 mm Allen wrench through the center hole in the tapered spindle, unscrew the captive screw, then pull the tapered spindle up and off of the gyro shaft.



2. Using a 2 mm Allen wrench, loosen the two set screws that secure the slinger to the gyro shaft, then slide the slinger up and off of the gyro shaft.
3. Remove the gyro boot (affixed with RTV adhesive): First work the circumference off of the evaporator rim, then, being careful not to stress the temperature sensor cable, pull the boot (with temperature sensor attached) straight up and off of the gyro housing.
4. Carefully, so as not to damage the gyro boot or temperature sensor cable, work to remove and discard the old RTV sealant remaining from the underside of the boot (do not remove sealant from where the sensor cable feeds through the boot), then set the boot / sensor assembly aside on the evaporator floor.
5. One at a time, pull the two insulating disks off of the gyro.
6. Remove the caulk from around the gyro's outer clamp ring. Discard the caulk.
7. Using a 3 mm Allen wrench, remove the two screws that secure the imbalance sensor to the gyro. Draw the cables from the imbalance and temperature sensors straight up, bend them toward the front of the centrifuge, and hook the cables over the evaporator rim (so that the sensors can stay in the bottom of the chamber and the two cables will be out of the way).
8. Using a 4 mm Allen wrench, reinstall the tapered spindle on the gyro shaft.



9. Working down underneath in front, disconnect all wires coming from the motor shroud:
 - a. Unplug the motor cable from the drive box and from the Ke P.C. board, and disconnect the ground wires from the frame using a 3 mm Allen wrench.
 - b. Unplug the commutation wires from the drive box.
 - c. Unplug the auxiliary tachometer wires from the drive interface P.C. board.
10. Using a 10 mm box wrench, remove the four nuts that are located up under the evaporator baseplate near the top of the motor shroud.
11. From below, feed all motor cables and connectors (disconnected in step B9 above) into the motor shroud so that they will lay loose inside the shroud on top of the motor fan.
12. From above, using the tapered spindle as a handle, lift the motor / gyro assembly up and, being careful not to crush sensor cables, temporarily set it in the evaporator chamber.

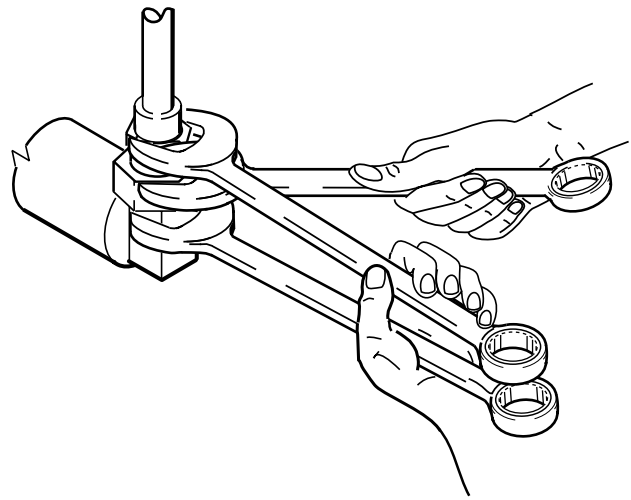
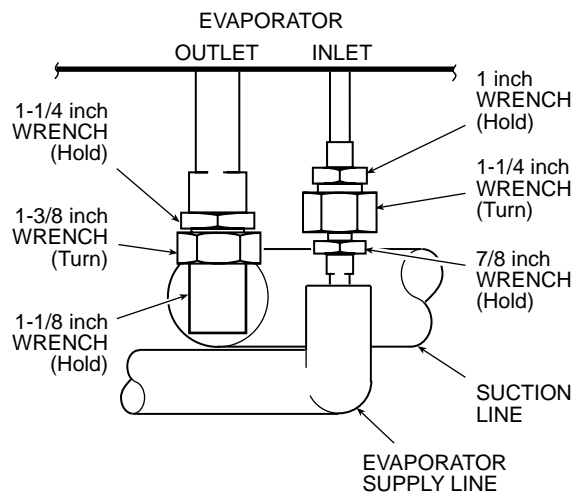


13. Pull the motor cables up into the evaporator chamber, then lift the motor/gyro assembly from the centrifuge.

C. Removing the Condenser Assembly and Suction Line

NOTE For the purposes of these instructions, "Condenser Assembly" refers to the main assembled refrigeration unit (condenser, condenser fans, compressor, interconnecting tubing with control valves and filter/dryer, capacitors, relay, refrigeration P.C. board, and baseplate). It does not refer to remaining refrigeration system components such as the suction line or evaporator.

1. From below, unplug the two wires from the motor fan, then using a 4 mm Allen wrench, remove the two screws securing the motor fan mounting brackets to the centrifuge frame baseplate. Remove the motor fan/shroud assembly.
2. Remove insulating tape as required to access the two refrigeration system service valves (see illustration on page 7 for valve locations), then connect refrigeration equipment and recover the refrigerant (Suva® HP62 [R404A]).
3. Remove insulating tape from the two evaporator fittings. Using three SAE open-end wrenches (top to bottom, 1, 1-1/4, and 7/8 inch) so that the two stationary fittings and connected tubing will not be twisted as the Rotalock® nut turns, disconnect the evaporator supply line from the evaporator fitting (see illustration on next page). Plug the end of both the supply line and the evaporator intake to seal them (to minimize moisture contamination).

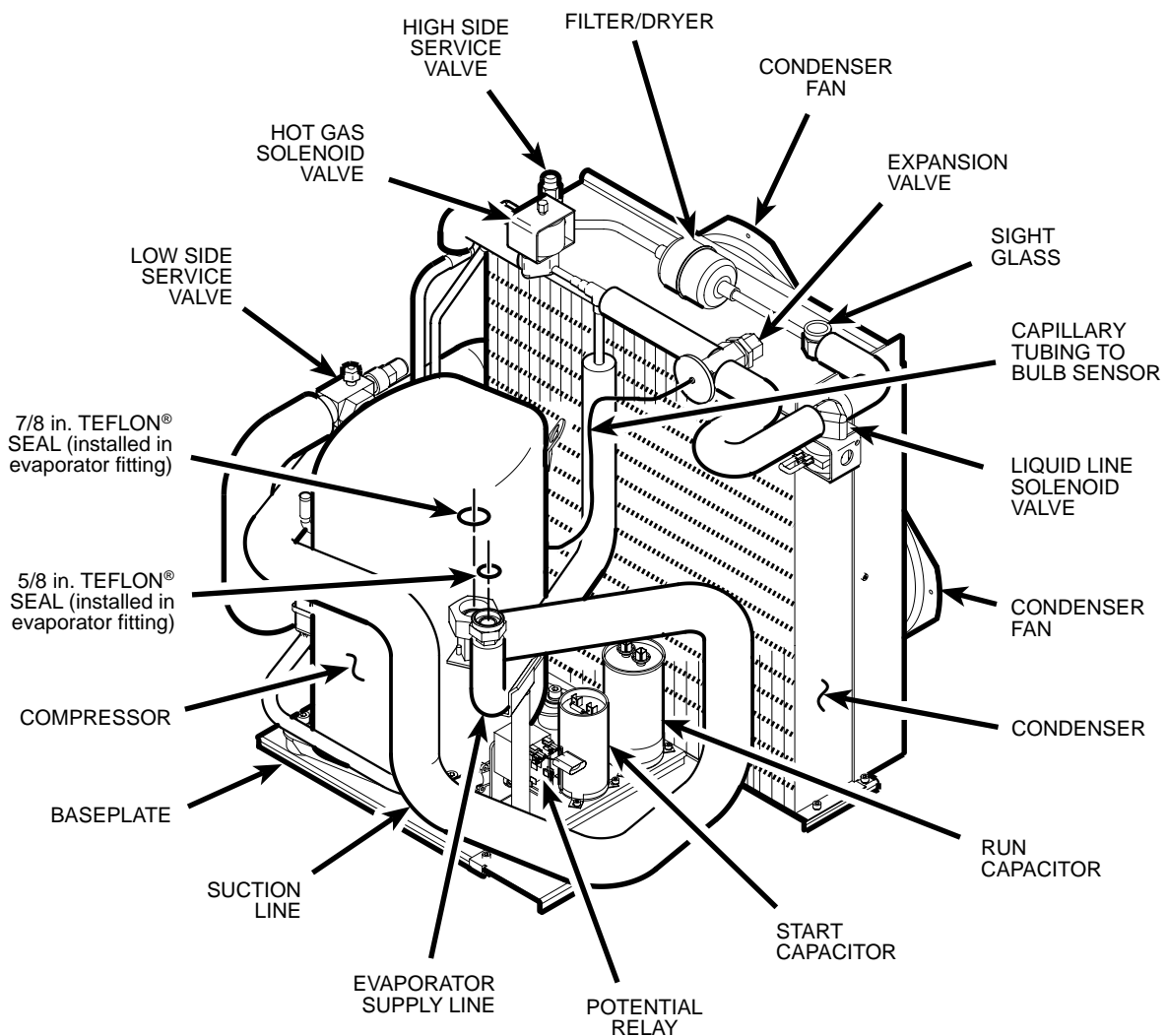


4. Using three larger SAE open-end wrenches (top to bottom, 1-1/4, 1-3/8, and 1-1/8 inch), disconnect the suction line, then plug both the end of the evaporator output and the end of the suction line.
5. Using a 4 mm Allen wrench, remove the screw securing the inside edge of the condenser assembly baseplate (the corner of the baseplate directly below the evaporator fittings).
6. Disconnect the two power wires (nos. 16 & 17) from the compressor relay (solid state relay is located on the rear wall behind the evaporator chamber, to the right as you face the rear).
7. Working behind the centrifuge, disconnect all wires/cables that connect to the condenser assembly: unplug the fan harness connector, the hot gas solenoid (two wires, located above the condenser near the high side service valve), and the cables running to the refrigeration P.C. board.
8. Using a 4 mm Allen wrench, remove the two screws securing the back corners of the condenser assembly baseplate (one from each corner).
9. Carefully (the assembly is heavy) remove the condenser assembly with the suction line attached from the centrifuge; also remove the round rubber cushioning pads that were positioned underneath the condenser assembly baseplate.

D. Installing the New Expansion Valve/Liquid Line Assembly

1. On the horizontal section of suction line below the low side service valve, cut and peel back the insulation where the expansion valve bulb sensor is attached.
2. Note the position of the expansion valve bulb sensor on the suction line (for reassembly), then remove the bulb sensor from the suction line (leave the thermocouple sensor attached to the suction line).
3. Remove the solenoid from the liquid line solenoid valve.
4. Remove and discard the original expansion valve/liquid line from the condenser assembly. If Swagelok® fittings are not on either side of the original expansion valve/liquid line (check between the high-side service valve and the filter/dryer, and between the expansion valve and the hot gas bypass "T" fitting), use a mini tubing cutter to cleanly cut the filter/dryer from the system:

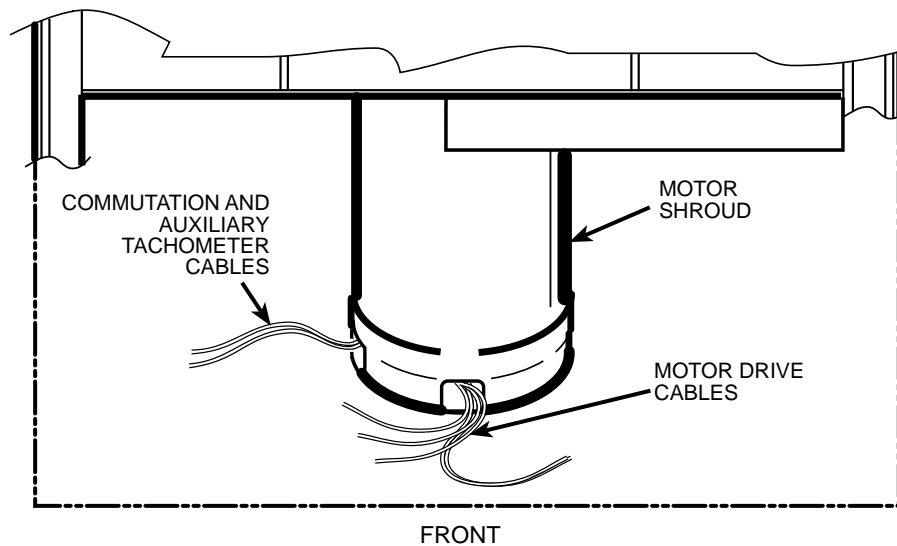
- a. On the straight section between the high-side service valve and the filter/dryer, cut the tubing 82.5 mm (3.25 inches) from the center of the filter/dryer (the filter/dryer housing has a center rib from which you can measure).
 - b. On the straight section between the expansion valve and the "T" fitting for the hot gas bypass, cut the tubing 108 mm (4.25 inches) from the center of the expansion valve body.
5. Install the new expansion valve/liquid line assembly (supplied). Using flare nut wrenches and a Swagelok® gap inspection gauge, follow standard procedures for Swagelok® fittings to ensure proper sealing.
 6. Install the new expansion valve bulb on the suction line. Use insulating tape (supplied) to seal the insulation where the expansion valve capillary tubing and the thermocouple sensor wires exit the suction line insulation.
 7. Install the solenoid (removed in step D3) onto the new liquid line solenoid valve.
 8. Working inside the centrifuge underneath the center plate, remove and discard the Teflon® seal from the mating edge of both evaporator fittings. Insert a new Teflon® seal (catalog nos. 61768 and 66952, supplied) into the end of each evaporator fitting, then apply Leak Lock® sealant to both fittings.



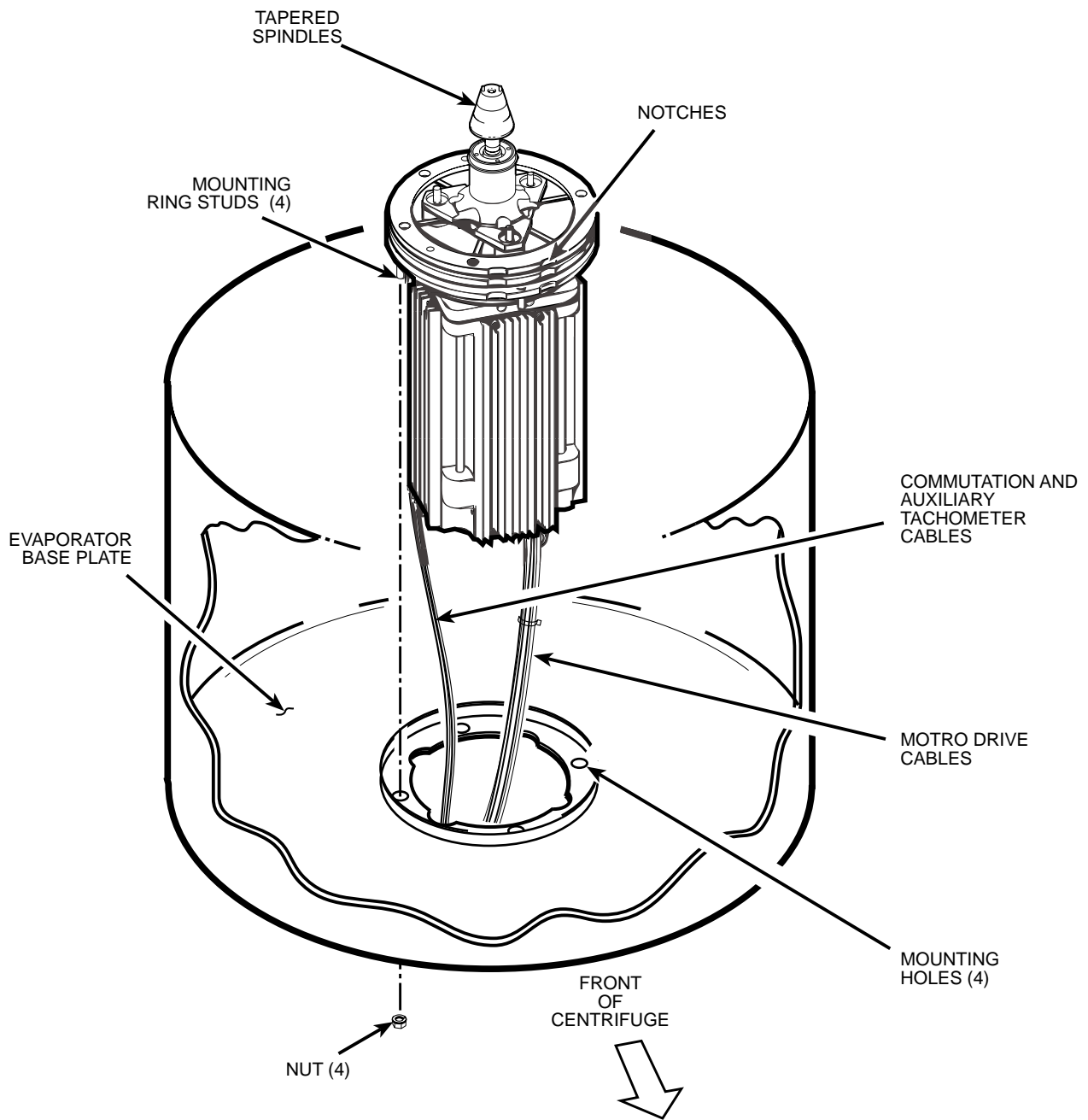
9. Slide the condenser assembly back into position inside the centrifuge frame, installing the round rubber cushioning pads (removed in step C9) underneath the assembly baseplate. Using a 4 mm Allen wrench, secure the condenser assembly in place using hardware removed in steps C5 and C8.
10. Being careful not to dislodge the Teflon® seals, remove the plugs from the two evaporator fittings.
11. Remove the plug from the end of the suction line, then thread the Rotalock® nut onto the larger evaporator fitting. Again using three wrenches to avoid damage (1-1/4, 1-3/8, and 1-1/8 inch), but this time with the middle wrench being a torque wrench with an open-end adapter, tighten the Rotalock® nut to 68 to 81 N·m (50 to 60 ft-lb).
12. Remove the plug from the end of the evaporator supply line, then thread the Rotalock® nut onto the smaller evaporator fitting. Using three smaller wrenches (again with the middle being a torque wrench, top to bottom, 1, 1-1/4, and 7/8 inch), tighten the evaporator supply line Rotalock® nut to 68 to 81 N·m (50 to 60 ft-lb).
13. Using helium, pressurize the refrigeration system through both service valves, then check for leaks by applying liquid soap at each of the four fittings and watching for bubbles. If a leak is detected, using appropriate wrenches to avoid damage, tighten the fitting enough to seal.
14. If no leaks are detected, configure refrigeration equipment for evacuation, then release the helium and evacuate the system. Continue with the procedure while the system is being evacuated, checking the vacuum level from time to time. Once the vacuum reading gets to 29 inches Hg (1.2 kPa) or greater, note the time – then continue to evacuate the system for a minimum of one hour from that point.
15. Wipe the liquid soap from the liquid line fittings and refrigeration lines, as well as from the top of the condenser (if any dripped).
16. Wipe the liquid soap from the two evaporator fittings and refrigeration lines, as well as from the frame baseplate, then insulate the two fittings using the tape supplied (apply the cork tape first, then use the foam tape to cover it).
17. Reconnect the two power wires (nos. 16 & 17, disconnected in step C6) to the compressor relay, then behind the centrifuge, reconnect all condenser assembly wires/cables (disconnected in step C7).
18. Reinstall the motor fan/shroud assembly (removed in step C1) and secure it in place using a 4 mm Allen wrench. Reconnect the motor fan wires.

E. Installing the Motor/Gyro Assembly

1. Remove any RTV sealant remaining on the rim of the opening in the bottom of the evaporator.
2. Apply a drop of Loctite® 222 to each of the four studs on the bottom of the mounting ring, then transport the motor/gyro assembly to the centrifuge and, being careful not to crush sensor cables, temporarily set it down inside the evaporator chamber.
3. Tape the auxiliary tachometer cable to the commutation cable (tape is temporary, to aid routing), then feed the motor cables down through the motor shroud; route the motor drive cable out the hole in the front, and route commutation and auxiliary tachometer cables out the hole on the left side.



4. Using the tapered spindle as a handle, orient the motor / gyro assembly so that the two notches in the outside edge of the gyro assembly face toward the front of the centrifuge, then lower the motor / gyro assembly into its correct position (being careful not to pinch the sensor wires) so that the four studs in the mounting ring engage the four holes in the evaporator baseplate (see illustration on next page).
5. Working down underneath in front, thread the four nuts (removed in step B10) onto the four mounting ring studs (located up on the evaporator baseplate near the top of the motor shroud), and tighten each nut securely using a 10 mm box wrench.
6. Connect all wires coming from the motor shroud:
 - a. Separate the auxiliary tachometer cable from the commutation cable by removing the tape applied in step E3, then connect the auxiliary tachometer wires to the drive interface P.C. board.
 - b. Connect the commutation wires to the drive box.
 - c. Connect the motor cable to the drive box and to the Ke P.C. board, and reconnect the ground wires to the frame using the hardware removed in step B9 and tighten using a 3 mm Allen wrench.
7. Working inside the evaporator chamber, use a 4 mm Allen wrench to remove the tapered spindle from the gyro shaft.
8. Using the length of new caulking cord supplied, seal around the gyro's outer clamp ring.
9. Apply a drop of Loctite® 222 to each of the two screws that were used to secure the imbalance sensor (removed in step B7), then using a 3 mm Allen wrench, secure the imbalance sensor to the gyro.
10. Orient the lower insulating disk (with triangular cutout) so that the flat side of the cutout aligns with the imbalance sensor. When installed, the imbalance sensor cable should be completely underneath the disk, and the disk should be fully seated on the gyro.
11. Orient the thin upper insulating disk smooth side up, then install the disk on the gyro so that it seats flush against the lower disk.



12. Apply a continuous bead of RTV adhesive around the underside of the gyro boot, in the outer groove that runs just inside the lip of the large disk portion.
13. Orient the gyro boot above the gyro so that the temperature sensor cable is not twisted and so that the sensor is aligned with where the sensor cable feeds down past the gyro, then slide the gyro boot onto the gyro until the mouth of the boot is below the rib that runs around the top of the gyro housing.
14. Bundle and tuck the temperature sensor cable in under the gyro boot, then work the lip of the boot onto the rim of the evaporator chamber. Make sure the evaporator rim is fully engaged all the way around the boot to ensure that the RTV adhesive will create a proper seal.

15. Grasp the neck of the gyro boot and push it downward to fully expose the rib that runs around the top of the gyro housing. Apply a continuous bead of RTV adhesive around the gyro housing, just below the rib, then work the mouth of the boot back upward until its annular groove (just inside the mouth of the boot) fully engages the rib on the gyro housing to create a proper seal. Wipe any excess adhesive from the boot and gyro housing, making sure that none gets on the gyro shaft.
16. Slide the slinger (removed in step B2) down onto the gyro shaft until it seats, then slide it back upward just a small amount to ensure that it isn't touching the gyro boot. Using a 2 mm Allen wrench, tighten both screws to secure the slinger to the gyro shaft.
17. Apply a drop of Loctite® 222 to the tapered spindle screw, then using a 4 mm Allen wrench, reinstall and securely tighten the tapered spindle on the gyro shaft.
18. Insert the top of the front panel underneath the top deck and set it in position on the two pins on the front of the centrifuge, then reinstall the two screws with washers (removed in step A3) and, using a 4 mm Allen wrench, tighten the two screws to secure the panel.

F. Charging the Refrigeration System and Checking Performance

1. After the refrigeration system vacuum level has been at 29 inches Hg (1.2 kPa) or greater for at least one hour, charge the refrigeration system. Refrigeration charging specifications for the Evolution™ RC are supplied below.

Evolution™ RC Refrigeration Charging Specifications

Refrigerant Type	Suva® HP62 (R404A) HFC
<i>Initial</i> Refrigerant Charge Weight	3.00 lbs. (1360 grams)
(during Superheat/Cond.T.D. optimization, additional liquid refrigerant will be added through low-side throttling valve)	
Specified Heat Load Rotor	SS-34
Operating Superheat Value	19°F (10.6°C)
Maximum Condenser T.D. Value	25°F (13.9°C)

2. After optimizing the refrigerant charge based on condenser T.D. and superheat, perform a test run to check centrifuge performance and temperature control (if the centrifuge was moved, be sure to use the front locking stabilizers to level the centrifuge before operation).
3. Make sure the two service valve ports are closed securely, then remove the refrigeration equipment, reinstall all service valve caps, and apply insulation tape to the low-side service valve.
4. Position the drip tray between the door rails, reinstall the two screws (removed in step A7) and, using a 3 mm Allen wrench, tighten the two screws to secure the drip tray.
5. Position the rear panel on the six screws on the rear of the frame (3 on either side), then using a 3 mm Allen wrench, tighten the six screws to secure the panel.

4. Position the drip tray between the door rails, reinstall the two screws (removed in step A7) and, using a 3 mm Allen wrench, tighten the two screws to secure the drip tray.
5. Position the rear panel on the rear of the centrifuge frame, and using a 3 mm Allen wrench, secure the panel in place using the six screws (removed in step A6).
6. Position the top rear deck on the frame, then using a 5 mm Allen wrench, reinstall the single screw in the center of the control console bracket. Using a 6 mm Allen wrench, reinstall the two screws that secure the back of the top rear deck.
7. If the centrifuge was moved, return it to its original operating location and level it using the front locking stabilizers.

Calibrating Imbalance:

1. Calibrate the centrifuge imbalance following the procedure outlined in the Calibration & Software section of the Evolution RC Service Manual.

INSTRUCTIONS

for the Filter/Dryer Replacement Kit (Catalog No. 73328) for the SORVALL® Evolution™ RC Centrifuge

This kit contains one filter/dryer assembly and instructions for replacement of the refrigeration system filter/dryer in a SORVALL® Evolution™ RC centrifuge. Check the two lists that follow to be sure you have received all parts and have all necessary tools before beginning this procedure.



CAUTION

This procedure should only be attempted by a qualified technician who has been trained in the proper servicing of SORVALL® Evolution™ RC centrifuges and SORVALL® centrifuge refrigeration systems. These instructions assume that the repairer has such expertise.

Tools and Other Items Required

Allen Wrenches, Metric: 3, 5, and 6 mm
 Flare Nut Wrenches, SAE: 5/8 and 11/16 inch
 Tubing Cutter, Mini (for 3/8-inch [9.5 mm] copper tubing)
 Swagelok® Gap Inspection Gauge (Kendro Catalog No. 90401)
 Helium Test Kit (Kendro Service-Issue)
 SORVALL® Centrifuge Refrigeration Service Guide (Kendro Service-Issue)
 Refrigeration Recovery/Charging Equipment
 Suva® HP62 (R404A) HFC Refrigerant
 Insulating Tape

Filter/Dryer Replacement Procedure



WARNING

Because of the characteristics of the samples likely to be processed in this centrifuge, biological or radioactive contamination may occur. Always be aware of this possibility, and take normal precautions. The Kendro Service Decontamination Policy states that a completed Decontamination Information Certificate is required before servicing.

Replace the filter/dryer as follows (save all parts for reassembly unless directed otherwise).

(continued)

A. Removing the Cabinet Panels

1. Open the chamber door, then turn the main power switch OFF, unplug the centrifuge, and wait four minutes before proceeding.



W A R N I N G

Hazardous voltages may exist whenever power is connected and circuits are energized. To eliminate potential for serious electrical shock or component damage, turn the main power switch OFF, unplug the centrifuge, then wait four minutes before proceeding.

2. If the centrifuge is located so that there is no room to work behind the centrifuge, raise the front locking stabilizers and roll the centrifuge to a suitable working location.
3. Using a 6 mm Allen wrench, remove the two screws that secure the back of the top rear deck.
4. Using a 5 mm Allen wrench, remove the single screw from the center of the control console bracket, then remove the top rear deck.
5. Using a 3 mm Allen wrench, remove the six screws securing the rear panel, and remove the panel.
6. Using a 3 mm Allen wrench, remove the two screws that secure the drip tray between the door rails, then remove the drip tray.

B. Replacing the Filter/Dryer

1. Remove insulating tape as required to access the two refrigeration system service valves (high side valve is on top of condenser, low side valve is down lower on the side, where the suction line connects to the compressor), then connect refrigeration equipment and recover the refrigerant (Suva® HP62 [R404A]).
2. Complete any required refrigeration system work. As a rule, replacing the filter/dryer should be the last thing done as the refrigeration system is closed, immediately before helium testing, evacuating, and charging the system.
3. Remove and discard the original filter/dryer. If Swagelok® fittings are not on either side of the original filter/dryer, use a mini tubing cutter to cleanly cut the filter/dryer from the system: Cut the tubing at 82.5 mm (3.25 inches) from the center of the filter/dryer (the filter/dryer housing has a center rib; distance from the center of the filter/dryer applies in either direction, for both cuts).
4. Install the new filter/dryer assembly (supplied), making sure that the flow arrows on the filter/dryer housing point toward the sight glass. Using flare nut wrenches and a Swagelok® gap inspection gauge, follow standard procedures for Swagelok® fittings to ensure proper sealing.
5. Using helium, pressurize the refrigeration system through both service valves, then check for leaks by applying liquid soap at each of the two fittings and watching for bubbles. If the system had previously been leaking or if it has been opened at other fittings, apply liquid soap at each fitting that should be tested, as well. If a leak is detected, using appropriate wrenches to avoid damage, tighten the fitting enough to seal.

6. If no leaks are detected, configure refrigeration equipment for evacuation, then release the helium and evacuate the system. Continue with the procedure while the system is being evacuated, checking the vacuum level from time to time. Once the vacuum reading gets to 29 inches Hg (1.2 kPa) or greater, note the time – then continue to evacuate the system for a minimum of one hour from that point.
7. Wipe the liquid soap from the filter/dryer fittings, as well as from the top of the condenser (if any dripped). Do the same cleanup at any other locations tested.

C. Charging the Refrigeration System and Checking Performance

1. After the refrigeration system vacuum level has been at 29 inches Hg (1.2 kPa) or greater for at least one hour, charge the refrigeration system. Refrigeration charging specifications for the Evolution™ RC are supplied below.

Evolution™ RC Refrigeration Charging Specifications

Refrigerant Type	Suva® HP62 (R404A) HFC
Initial Refrigerant Charge Weight	3.00 lbs. (1360 grams)
(during Superheat/Cond.T.D. optimization, additional liquid refrigerant will be added through low-side throttling valve)	
Specified Heat Load Rotor	SS-34
Operating Superheat Value	19°F (10.6°C)
Maximum Condenser T.D. Value	25°F (13.9°C)

2. After optimizing the refrigerant charge based on condenser T.D. and superheat, perform a test run to check centrifuge performance and temperature control (if the centrifuge was moved, be sure to use the front locking stabilizers to level the centrifuge before operation).
3. Make sure the two service valve ports are closed securely, then remove the refrigeration equipment, reinstall all service valve caps, and apply insulation tape to the low-side service valve.
4. Position the drip tray between the door rails, reinstall the two screws (removed in step A7) and, using a 3 mm Allen wrench, tighten the two screws to secure the drip tray.
5. Position the rear panel on the rear of the centrifuge frame, and using a 3 mm Allen wrench, secure the panel in place using the six screws (removed in step A6).
6. Position the top rear deck on the frame, then using a 5 mm Allen wrench, reinstall the single screw in the center of the control console bracket. Using a 6 mm Allen wrench, reinstall the two screws that secure the back of the top rear deck.
7. If the centrifuge was moved, return it to its original operating location and level it using the front locking stabilizers.

INSTRUCTIONS

for the
Evolution RC Gyro Replacement Kit
(Kit Catalog No. 73446)

Parts Supplied:

Quan	Part #	Description
1	-----	Gyro Assembly
2 ft	60255	Mortite caulking cord
12	68629	Screw, Socket Head, M5x12mm
1	90702	Loctite sealant #222
1	72931	Spring plate, 6 spoke
1	73854	Spring plate, 6 spoke
3	92786	Shock mount
3	61141	Hex nut, ¼ - 20
1	65664	Adhesive sealant, RTV silicone, black
1	73957	Coupling gap gauge
1	73447	Installation instructions



Warning:

Because of the presence of high voltage, untrained personnel must not attempt to test, repair, or modify any electrical circuits or systems in this unit.



Warning:

Because of the characteristics of the samples likely to be processed in this centrifuge, biological or radioactive contamination may occur. Always be aware of this possibility, and take normal precautions. The Kendro Service Decontamination Policy states that a completed Decontamination Information Certificate is required before servicing.

Instructions

a. Removing the Motor/Gyro Assembly

1. Open the chamber door, then turn the main power switch OFF, unplug the centrifuge, and wait four minutes before proceeding.
2. Using a 4 mm Allen wrench, remove the two screws with washers from the louver area of the front panel, then remove the front panel.
3. Working inside the evaporator chamber, using a 4 mm Allen wrench through the center hole in the tapered spindle, unscrew the captive screw, then pull the tapered spindle up and off of the gyro shaft.

INSTRUCTIONS

for the Evolution RC Gyro Replacement Kit (Kit Catalog No. 73446)

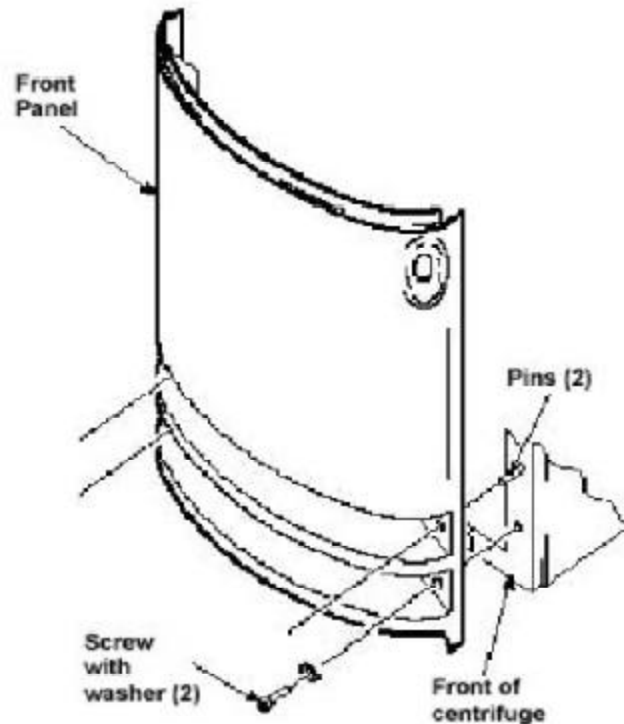


Figure 1

4. Using a 2 mm Allen wrench, loosen the two set screws that secure the slinger to the gyro shaft, then slide the slinger up and off of the gyro shaft.
5. Remove the gyro boot (affixed with RTV adhesive): First work the circumference off of the evaporator rim, then, being careful not to stress the temperature sensor cable, pull the boot (with temperature sensor attached) straight up and off of the gyro housing.
6. Carefully, so as not to damage the gyro boot or temperature sensor cable, work to remove and discard the old RTV sealant remaining from the underside of the boot (do not remove sealant from where the sensor cable feeds through the boot), then set the boot/sensor assembly aside on the evaporator floor.

INSTRUCTIONS

for the
Evolution RC Gyro Replacement Kit
(Kit Catalog No. 73446)

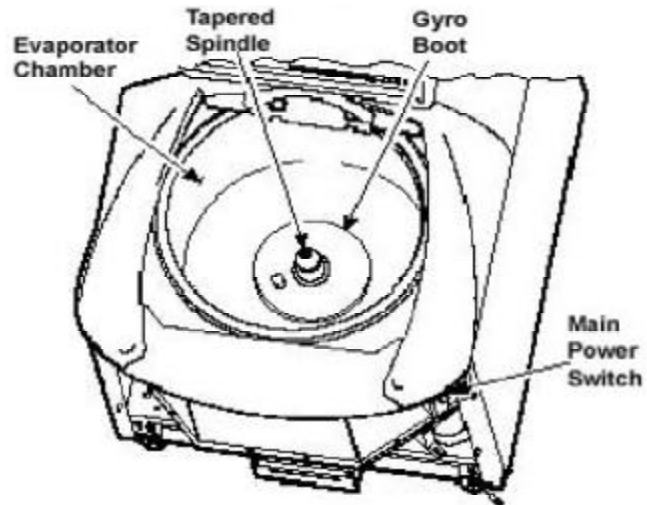


Figure 2

7. One at a time, pull the two insulating disks off of the gyro and place them aside on the evaporator floor, near the boot/sensor assembly.
8. Remove the caulk from around the gyro's outer clamp ring. Discard the caulk.
9. Using a 3 mm Allen wrench, remove the two screws that secure the imbalance sensor to the gyro. Draw the cables from the imbalance and temperature sensors straight up, bend them toward the front of the centrifuge, and hook the cables over the evaporator rim (so that the sensors can stay in the bottom of the chamber and the two cables will be out of the way).
- 10 Using a 4 mm Allen wrench, reinstall the tapered spindle on the gyro shaft.

Note:

The tapered spindle will be used as a handle when lifting the motor from the centrifuge.

INSTRUCTIONS

for the
Evolution RC Gyro Replacement Kit
(Kit Catalog No. 73446)

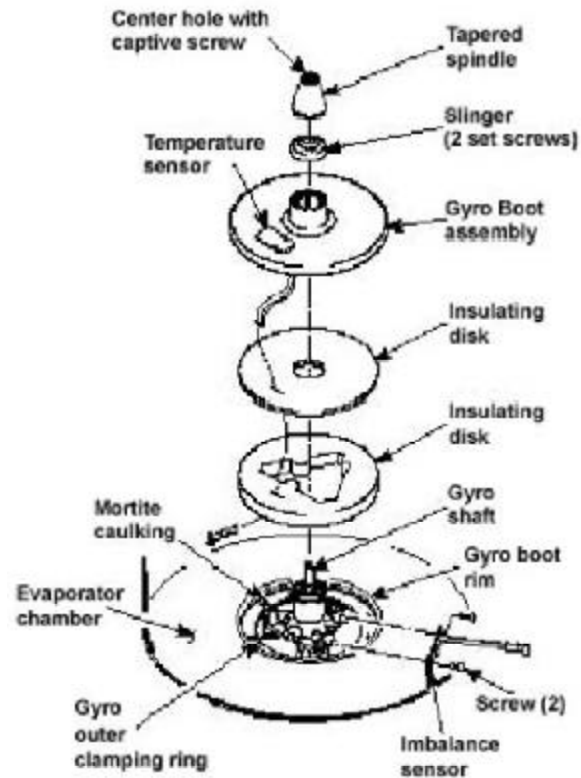


Figure 3

- 11 Working down underneath in front, disconnect all wires coming from the motor shroud:

Note:

Removing the calrod brake resistor from the top of the drive box assembly will allow easier access to the motor mounting nuts referenced in step 12.

- Unplug the motor cable from the drive box and from the Ke P.C. board (if present), and disconnect the ground wires from the frame using a 3 mm Allen wrench.
- Unplug the commutation wires from the drive box.
- Unplug the auxiliary tachometer wires from the drive interface P.C. board.
- Disconnect the motor temperature sensor wires from the lower rear corner of the drive interface board (if present).

- 12 Using a 10 mm box wrench, remove the four nuts that are located up under the evaporator baseplate near the top of the motor shroud.

- 13 From above, using the tapered spindle as a handle, lift the motor/gyro assembly up and, being careful not to crush sensor cables, temporarily set it in the evaporator chamber.

P/N: 73447-2

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 **Kendro**

INSTRUCTIONS

for the Evolution RC Gyro Replacement Kit (Kit Catalog No. 73446)

- 14 From below, feed all motor cables and connectors (disconnected in step a-11) into the motor shroud so that they will lay loose inside the shroud on top of the motor fan.

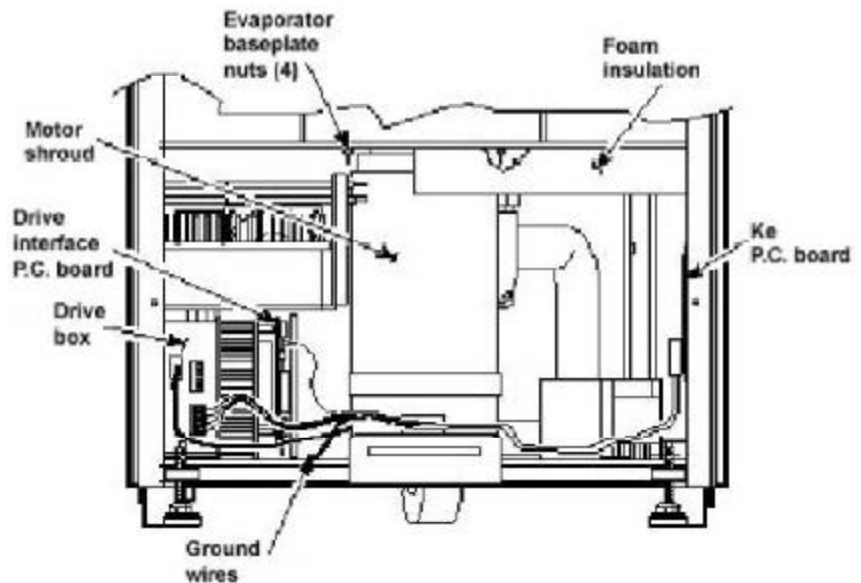


Figure 4

- 15 From above, pull the motor cables up into the evaporator chamber, then lift the motor/gyro assembly from the centrifuge.

b. Removing the Gyro from the Motor

1. Lay the motor/gyro assembly on a clean work surface so that the motor is fully and squarely on the surface and the larger round portions of the gyro assembly extend off the edge.
2. Turn the motor/gyro so that the drive coupling access slot in the gyro faces up.
3. Rotate the tapered spindle/drive shaft until a coupling clamping screw is visible through the access slot. While holding the spindle so that it does not rotate, use a 2.5 mm Allen wrench to loosen the screw. Then rotate the tapered spindle/drive shaft one-half rotation (180°) until the other coupling clamping screw is visible through the access slot, and loosen the second screw.

INSTRUCTIONS

for the
Evolution RC Gyro Replacement Kit
(Kit Catalog No. 73446)

4. Turn the motor/gyro so that the coupling access slot in the gyro faces down (motor cables up).

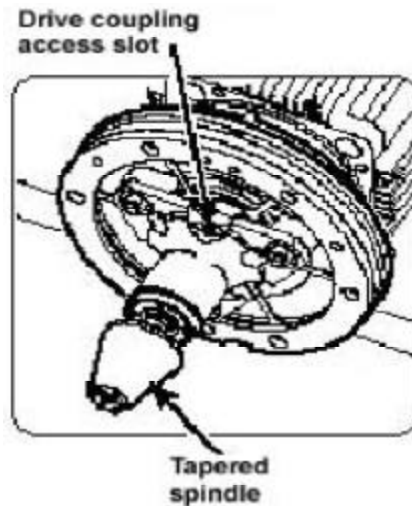


Figure 5

5. Using a 4 mm Allen wrench, remove the tapered spindle from gyro shaft.
6. Using a 4 mm Allen wrench, remove the six screws that secure the outer clamping ring to the backing plate and remove the outer ring. Discard the six screws.
7. Using a 7/16 inch wrench, remove and discard the three 1/4-20 nuts that secure the gyro to the three shock mounts on the backing plate, then remove the gyro/spring assembly.
8. Unscrew the three shock mounts from the backing plate and discard the shock mounts.
9. Using a 4 mm Allen wrench, remove the six screws securing the inner clamping ring and the 6-spoke spring plate to the gyro housing. Retain the inner clamping ring; discard the old gyro.
10. Using the spring plate that was removed in step #9 as a guide select the correct spring plate that is supplied with the new Gyro Kit. Discard the old spring along with the spring that does not match the original spring.

INSTRUCTIONS

for the
Evolution RC Gyro Replacement Kit
(Kit Catalog No. 73446)

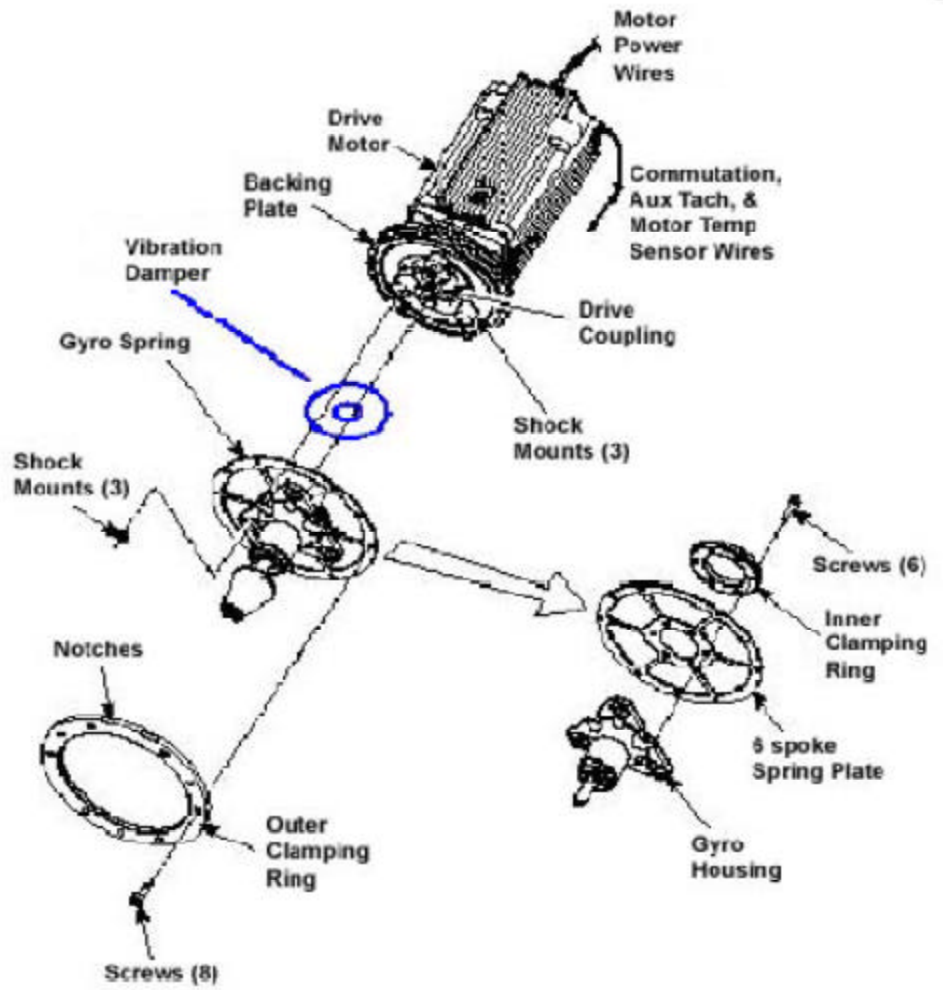


Figure 6

INSTRUCTIONS

for the
Evolution RC Gyro Replacement Kit
(Kit Catalog No. 73446)

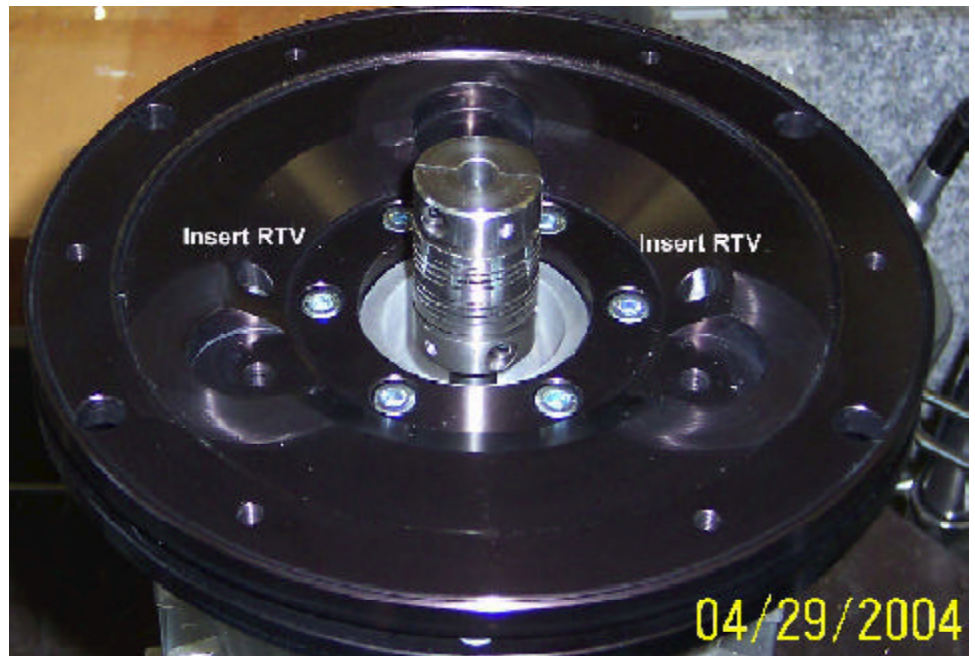


Figure 7

c. Assembling the Gyro on the Motor

1. Using RTV sealant, seal the (2) holes for the gyro backing plate guide pins to prevent moisture from entering the drive motor.
2. One at a time, apply a drop of Loctite ® 222 to studs on one side of each of the three new shock mounts (catalog no. 92786, supplied), then thread the studs with the Loctite ® into the backing plate and tighten each shock mount securely.
3. Apply a drop of Loctite ® 222 to each of six M5 x 12 mm screws (catalog no. 68629, supplied), then attach the new 6-spoke spring plate and inner clamping ring (counterbores out) to the new gyro supplied. Using a 4 mm Allen wrench, tighten the six screws just until snug –do not tighten securely yet.

INSTRUCTIONS

for the
Evolution RC Gyro Replacement Kit
(Kit Catalog No. 73446)

4. Orient the new gyro/spring assembly so that the drive coupling access slot faces downward. Position it on three shock mount studs on the motor assembly making sure that the shock mounts are not twisted. The screw holes around the outside edge of the spring plate must align with the corresponding holes in the backing plate. If they do not, adjust the position by holding the gyro housing securely and rotating the spring plate just enough to align the holes. Once the holes align, gently remove the gyro/spring assembly from the motor assembly and, using a 4 mm Allen wrench, tighten the six screws in the inner clamping ring securely.
5. Place the gyro damping ring under the inner clamping ring prior to assembling the gyro assembly to the motor.
6. Apply a drop of Loctite ® 222 to each of the three shock mount studs (on the backing plate). Orient the gyro/spring assembly so that the drive coupling access slot in the gyro faces downward, then position the assembly on the shock mounts and hold it in position by threading the three new 1/4-20 nuts (catalog no. 61141, supplied) onto the shock mount studs (leave finger-tight).
7. Apply a drop of Loctite ® 222 to each of six remaining M5 x 12 mm screws (supplied), orient the outer clamping ring so that the counter-bore side is out and the two notches in the outer edge align with those in the mounting ring and backing plate (facing upward). Using a 4 mm Allen wrench, insert the screws through the outer ring and spring into the backing plate and tighten.
8. Loosen all three 1/4-20 nuts from the shock mount studs, then using a 7/16 inch wrench, tighten all three securely.
9. Using a 4 mm Allen wrench, install the tapered spindle on the gyro shaft.
10. Turn the motor/gyro assembly so that the drive coupling access slot in the gyro faces upward and rotate the tapered spindle until a coupling clamping screw is visible. Using a torque wrench with a 2.5 mm Allen bit while holding the spindle so that it does not rotate, tighten the coupling clamping screw to 2.37 N/m (21 inch- lbs). Rotate the tapered spindle/drive shaft one-half rotation (180°) until the other clamping screw is visible through the access slot, and tighten the second screw to the same torque.

INSTRUCTIONS

for the Evolution RC Gyro Replacement Kit (Kit Catalog No. 73446)

d. Installing the Motor/Gyro Assembly

1. Work to remove and discard any RTV sealant remaining on the rim around the opening in the bottom of the evaporator.
2. Apply a drop of Loctite ® 222 to each of the four studs on the bottom of the mounting ring, then transport the motor/gyro assembly to the centrifuge and, being careful not to crush sensor cables, temporarily set it down inside the evaporator chamber.
3. Feed the motor cables down into the motor shroud; route the motor drive cable out the hole in the front, and route commutation and auxiliary tachometer cables out the hole on the left side.

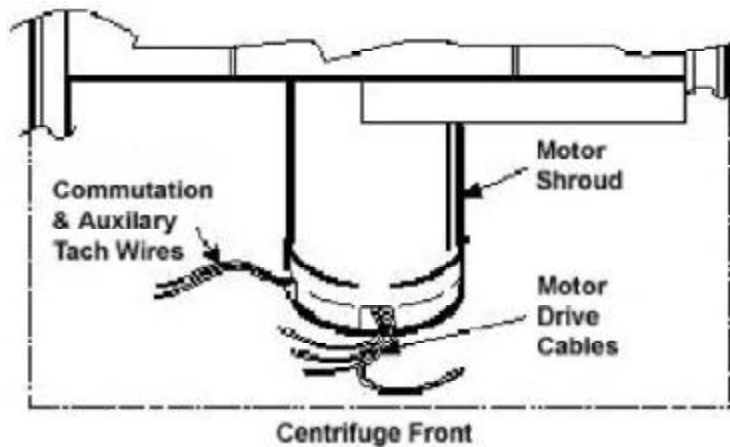


Figure 8

4. Using the tapered spindle as a handle, orient the motor/gyro assembly so that the two notches in the outside edge of the gyro assembly face toward the front of the centrifuge. Lower the motor/gyro assembly into its correct position (being careful not to pinch the sensor wires) so that the four studs in the mounting ring engage the four holes in the evaporator baseplate.
5. Working down underneath in front, thread the four nuts (removed in step A12) onto the four mounting ring studs (located up on the evaporator baseplate near the top of the motor shroud), and tighten each nut securely using a 10 mm box wrench.

INSTRUCTIONS

for the
Evolution RC Gyro Replacement Kit
(Kit Catalog No. 73446)

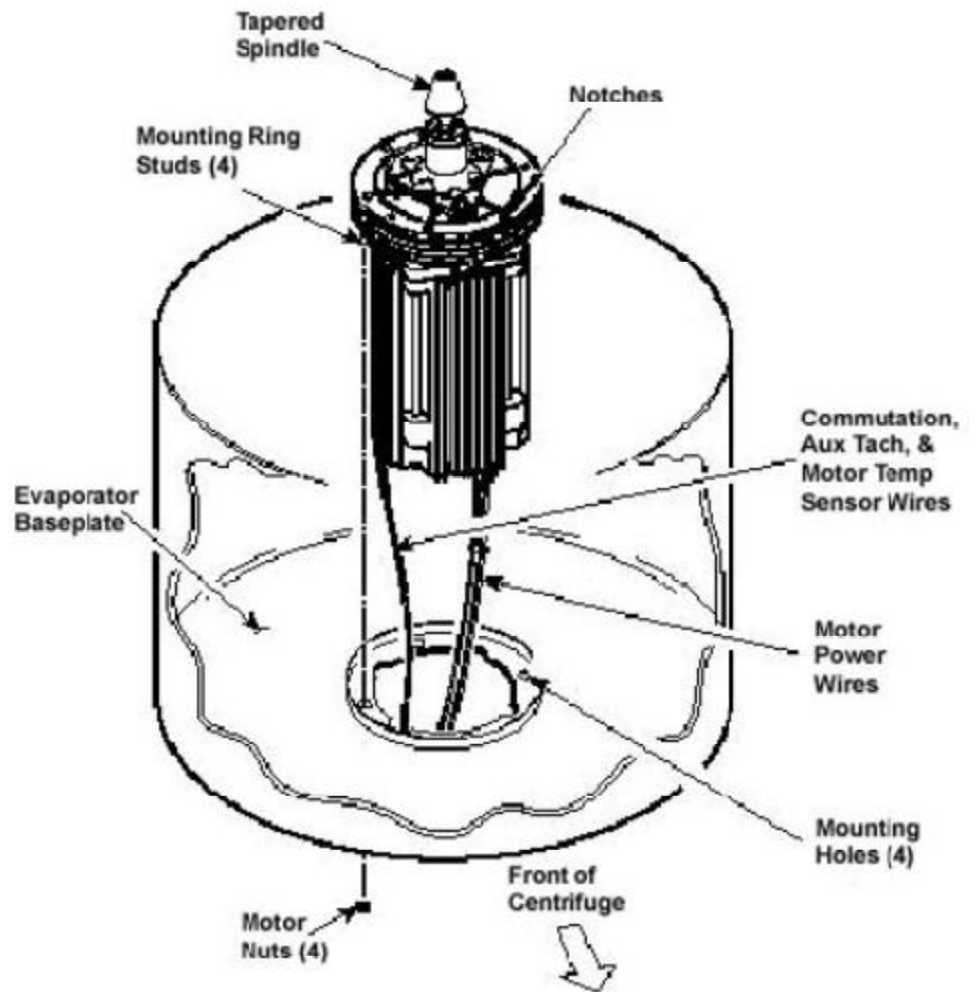


Figure 9

6. Connect all wires coming from the motor shroud:
 - a. Connect the auxiliary tachometer wires to the drive interface P.C. board.
 - b. Connect the commutation wires to the drive box.
 - c. Connect the motor cable to the drive box and to the Ke P.C. board (if present), and reconnect the ground wires to the frame using the hardware removed in step A11 and tighten using a 3 mm Allen wrench.
 - d. Connect the motor temperature sensor wires (if present) to the drive interface board (lower rear corner).

INSTRUCTIONS

for the
Evolution RC Gyro Replacement Kit
(Kit Catalog No. 73446)

7. Working inside the evaporator chamber, use a 4 mm Allen wrench to remove the tapered spindle from the gyro shaft.
8. Using the length of new Mortite caulking cord supplied, seal around the gyro's outer clamp ring.
9. Apply a drop of Loctite ® 222 to each of the two screws that were used to secure the imbalance sensor (removed in step A8), then using a 3 mm Allen wrench, secure the imbalance sensor to the gyro.
10. Orient the lower insulating disk (triangular cutout) so that the flat side of the cutout aligns with the imbalance sensor (the slit with the temperature sensor cable positioned clockwise from the flat side). When installed, the imbalance sensor cable should be completely underneath the disk, and the disk should be fully seated on the gyro.
11. Orient the thin upper insulating disk, smooth side up, then install the disk on the gyro while drawing the cable up through the slit. Properly installed, the upper insulating disk will be tight against the lower disk with slits aligned.

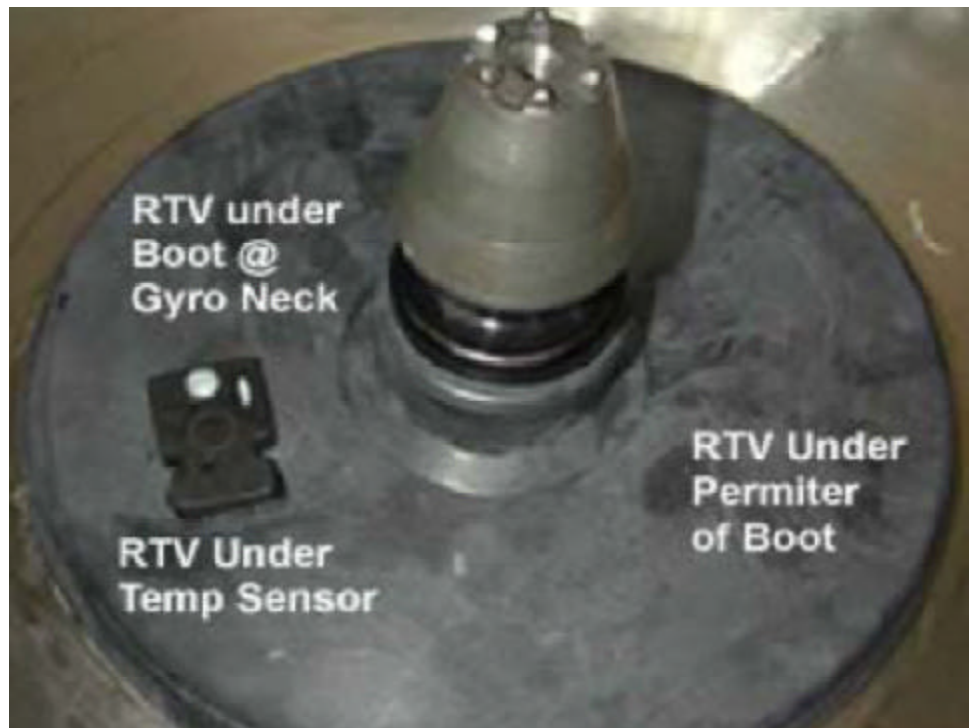


Figure 10

INSTRUCTIONS

for the
Evolution RC Gyro Replacement Kit
(Kit Catalog No. 73446)

12. To the underside of the gyro boot, in the outer groove that runs inside the lip of the large disk portion, apply a continuous bead of RTV adhesive (catalog no. 65664, supplied).
13. Place RTV adhesive under the temperature sensor sealing where the cable passes through the boot.
14. Aligning the temperature sensor with the slots in the insulation, slide the gyro boot onto the gyro until the mouth of the boot is below the rib that runs around the top of the gyro housing.
15. Tuck the temperature sensor cable in under the gyro boot, then work the lip of the boot onto the rim of the evaporator chamber. Make sure the evaporator rim is fully engaged all the way around the boot to ensure that the RTV adhesive will create a proper seal.
16. Grasp the neck of the gyro boot and push it downward to fully expose the rib that runs around the top of the gyro housing. Apply a continuous bead of the RTV adhesive around the gyro housing, just below the rib, then work the mouth of the boot back upward until its annular groove (just inside the mouth of the boot) fully engages the rib on the gyro housing to create a proper seal. Wipe any excess adhesive from the boot and gyro housing, making sure that none gets on the gyro shaft.
17. Slide the slinger (removed in step C6) onto the gyro shaft so that it seats on the shoulder on the shaft, then using a 2 mm Allen wrench, tighten both screws to secure the slinger to the gyro shaft.
18. Apply a drop of Loctite ® 222 to the tapered spindle screw, then using a 4 mm Allen wrench, reinstall and securely tighten the tapered spindle on the gyro shaft.
19. Insert the top of the front panel underneath the top deck and set it in position on the two pins on the front of the centrifuge. Reinstall the two screws with washers (removed in step A2) and, using a 4 mm Allen wrench, tighten the two screws to secure the panel.

INSTRUCTIONS

for the
Evolution RC Gyro Replacement Kit
(Kit Catalog No. 73446)

e. Checking Performance

1. Reconnect power, then turn the main power switch ON.
2. Install a rotor and perform a test run to confirm proper performance and calibrate imbalance per the instructions outlined in the Evolution RC Service Manual..

INSTRUCTIONS

for the Evolution RC Gyro Damper Kit (Kit Catalog No. 73881)

Parts Supplied

Quan	Part Number	Description
1	73873	Evolution Vibration Pad
1	65664	RTV Sealant
6	68629	Screw, Socket Head, M5x12mm
1	90702	Loctite #222 sealant
2 ft	-----	Caulking Cord, Mortite
1	73882	Installation Instructions



Warning:

Because of the presence of high voltage, untrained personnel must not attempt to test, repair, or modify any electrical circuits or systems in this unit.



Warning:

Because of the characteristics of the samples likely to be processed in this centrifuge, biological or radioactive contamination may occur. Always be aware of this possibility, and take normal precautions. The Kendro Service Decontamination Policy states that a completed Decontamination Information Certificate is required before servicing.



Warning:

Hazardous voltages may exist whenever power is connected and circuits are energized. To eliminate potential for serious electrical shock or component damage, turn the main power switch OFF, unplug the centrifuge, then wait four minutes before proceeding.

Tools and Other Items Required

Allen Wrenches, Metric: 2mm, 2.5mm, 3mm, 4mm, & 5mm.
Box Wrench, 10mm.
Wrench, SAE, 7/16 “.
Small Torque Wrench with long reach 2.5mm Allen bit.
Laptop Computer.

Instructions

A.) Removing the Motor/Gyro Assembly

1. Open the chamber door, then turn the main power switch OFF, unplug the centrifuge, and wait four minutes before proceeding.

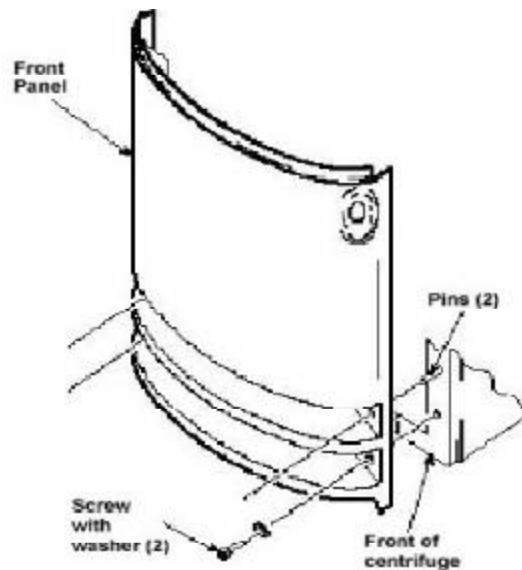


Figure 1

INSTRUCTIONS

for the
Evolution RC Gyro Damper Kit
(Kit Catalog No. 73881)

- Using a 4 mm Allen wrench, remove the two screws with washers from the louver area of the front panel, then remove the front panel.
- Working inside the evaporator chamber, using a 4 mm Allen wrench through the center hole in the tapered spindle, unscrew the captive screw, then pull the tapered spindle up and off of the gyro shaft.

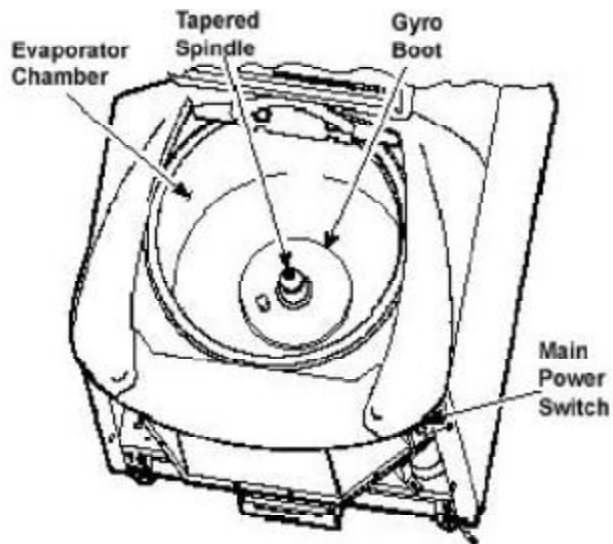


Figure 2

- Using a 2 mm Allen wrench, loosen the two set screws that secure the slinger to the gyro shaft, then slide the slinger up and off of the gyro shaft.
- Remove the gyro boot (affixed with RTV adhesive): First work the circumference off of the evaporator rim, then, being careful not to stress the temperature sensor cable, pull the boot (with temperature sensor attached) straight up and off of the gyro housing.
- Carefully, so as not to damage the gyro boot or temperature sensor cable, work to remove and discard the old RTV sealant remaining from the underside of the boot (do not remove sealant from where the sensor cable feeds through the boot), then set the boot/sensor assembly aside on the evaporator floor.
- One at a time, pull the two insulating disks off of the gyro and place them aside on the evaporator floor, near the boot/sensor assembly.
- Remove the Mortite caulk from around the gyro's outer clamp ring. Discard the caulk.

INSTRUCTIONS

for the Evolution RC Gyro Damper Kit (Kit Catalog No. 73881)

- Using a 3 mm Allen wrench, remove the two screws that secure the imbalance sensor to the gyro. Draw the cables from the imbalance and temperature sensors straight up, bend them toward the front of the centrifuge, and hook the cables over the evaporator rim (so that the sensors can stay in the bottom of the chamber and the two cables will be out of the way).
- Using a 4 mm Allen wrench, reinstall the tapered spindle on the gyro shaft.

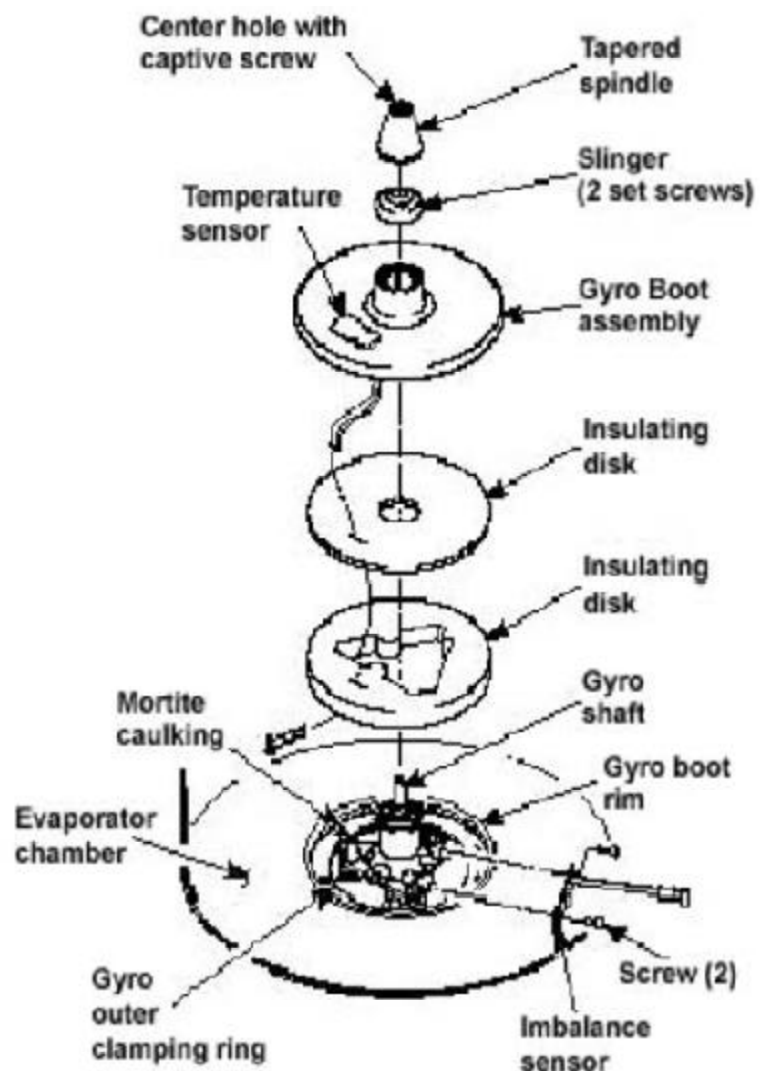


Figure 3

INSTRUCTIONS

for the Evolution RC Gyro Damper Kit (Kit Catalog No. 73881)

Note:

On centrifuges with serial numbers 10300750 and above there will be an additional motor temperature sensor cable connected to the drive interface board. There will also be no Ke board in the system.

Note:

Removing the calrod brake resistor from the top of the drive control module assembly will make access to the rear motor mounting nut easier.

11. Working down underneath in front, disconnect all wires coming from the motor shroud:
 - a. Unplug the motor cable from the drive box and from the Ke P.C. board (if present), and disconnect the ground wires from the frame using a 3 mm Allen wrench.
 - b. Unplug the commutation wires from the drive box.
 - c. Unplug the auxiliary tachometer wires from the drive interface P.C. board.
 - d. Unplug the motor temperature sensor wires (if present) from the lower rear corner of the drive interface board.
12. Using a 10 mm box wrench, remove the four nuts that are located up under the evaporator baseplate near the top of the motor shroud.
13. From above, using the tapered spindle as a handle, lift the motor/gyro assembly up and, being careful not to crush sensor cables, temporarily set it in the evaporator chamber.
14. From below, feed all motor cables and connectors (disconnected in step 11) into the motor shroud so that they will lay loose inside the shroud on top of the motor fan.

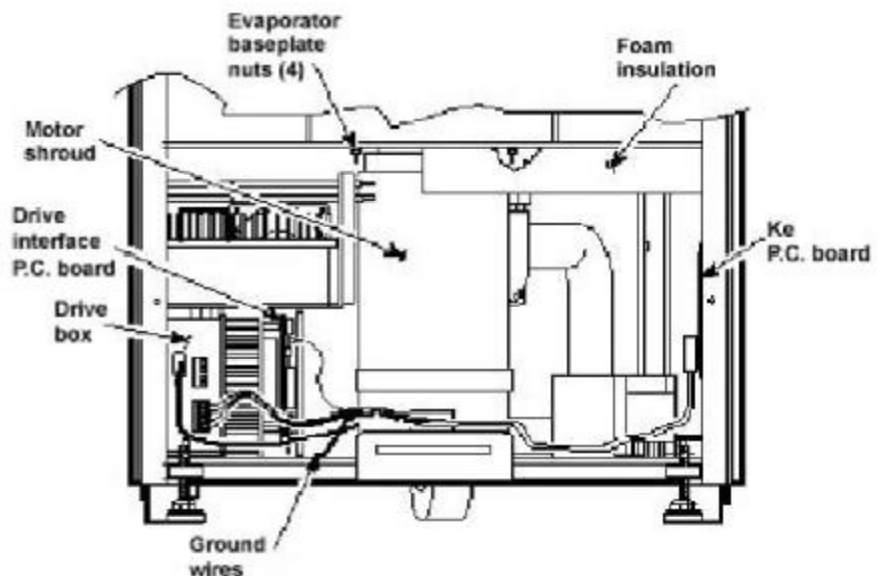


Figure 4

INSTRUCTIONS

for the
Evolution RC Gyro Damper Kit
(Kit Catalog No. 73881)

15. From above, pull the motor cables up into the evaporator chamber, then lift the motor/gyro assembly from the centrifuge.

B.) Removing the Gyro from the Motor

1. Lay the motor/gyro assembly on a clean work surface so that the motor is fully and squarely on the surface and the larger round portions of the gyro assembly extend off the edge.
2. Turn the motor/gyro so that the drive coupling access slot in the gyro faces up.
3. Rotate the tapered spindle/drive shaft until a coupling clamping screw is visible through the access slot. While holding the spindle so that it does not rotate, use a 2.5 mm Allen wrench to loosen the screw. Then rotate the tapered spindle/drive shaft one-half rotation (180°) until the other coupling clamping screw is visible through the access slot, and loosen the second screw.

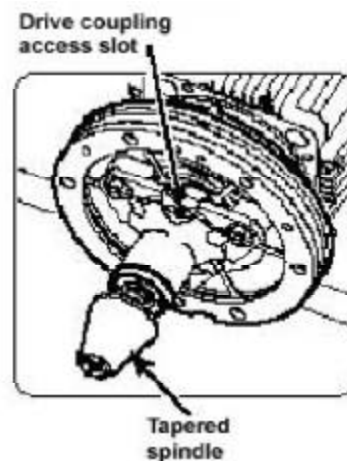


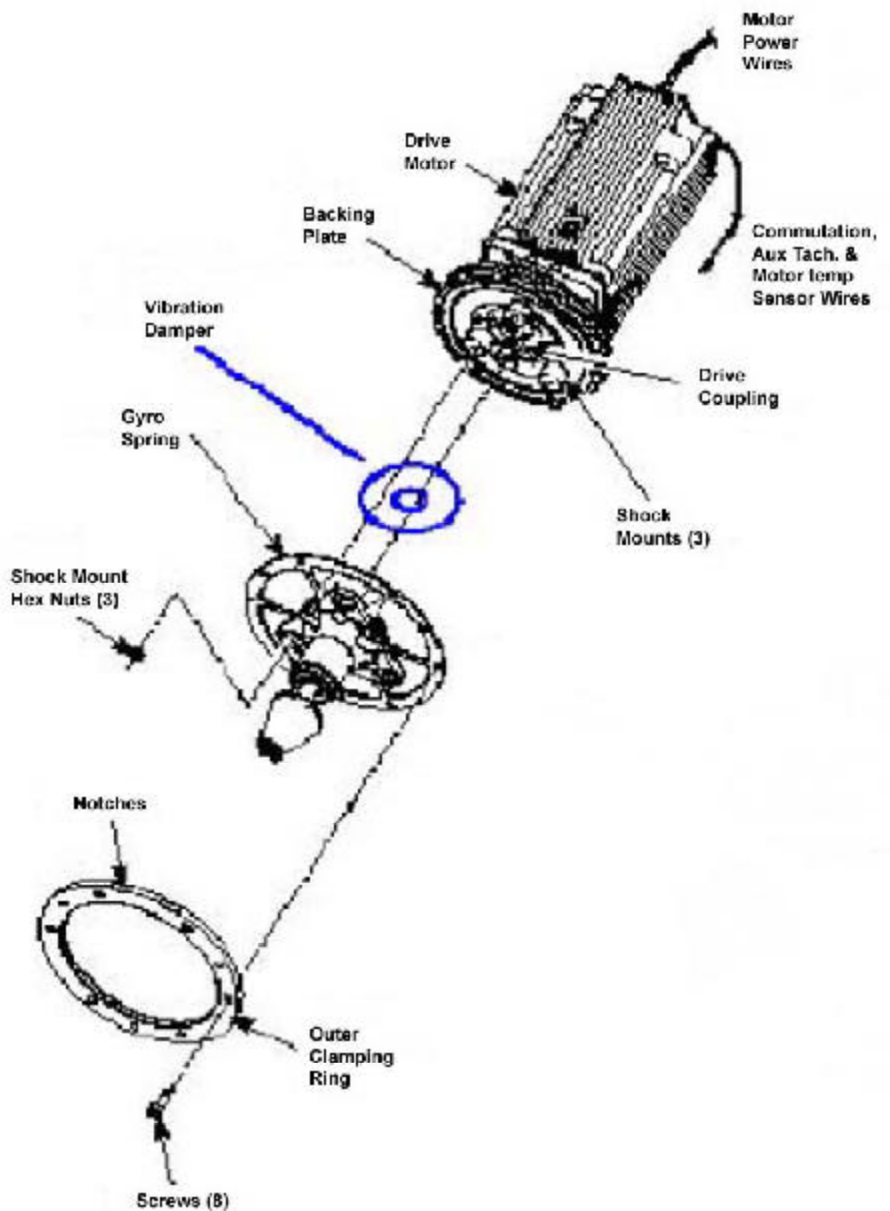
Figure 5

4. Turn the motor/gyro so that the coupling access slot in the gyro faces down (motor cables up).
5. Using a 4 mm Allen wrench, remove the tapered spindle from gyro shaft.
6. Using a 4 mm Allen wrench, remove the six screws that secure the outer clamping ring to the backing plate and remove the outer ring.

INSTRUCTIONS

for the
Evolution RC Gyro Damper Kit
(Kit Catalog No. 73881)

- Using a 7/16 inch wrench, remove the (3) 1/4-20 nuts that secure the gyro to the three shock mounts on the backing plate, then remove the gyro/spring assembly.
- Remove and discard the rubber vibration pad from under the gyro / spring assembly (if present) that was removed in step 7.



INSTRUCTIONS

for the
Evolution RC Gyro Damper Kit
(Kit Catalog No. 73881)

C.) Assembling the Gyro on the Motor

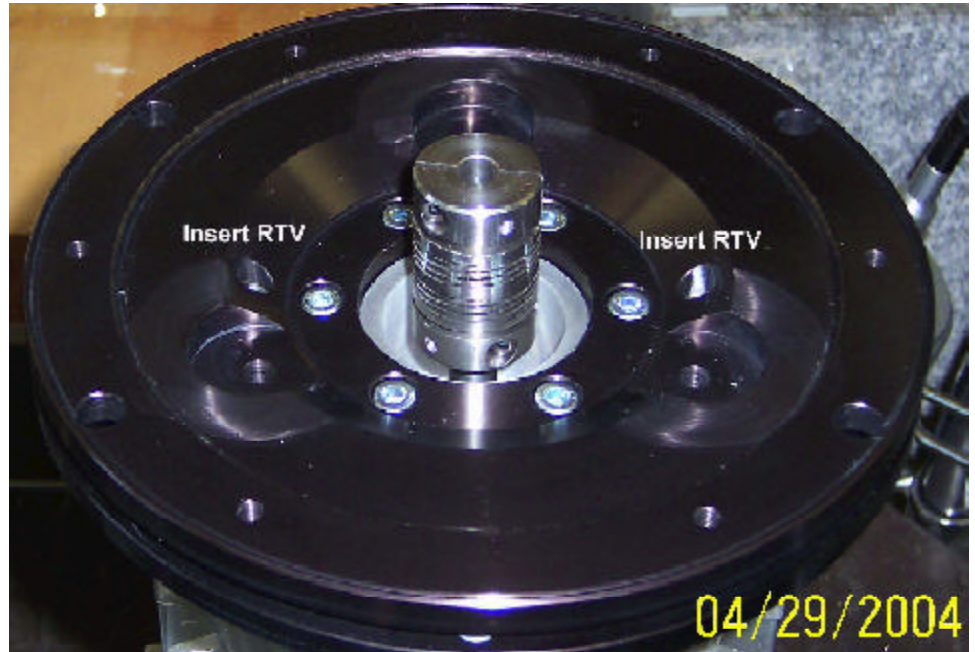


Figure 7

1. Using RTV sealant, seal the (2) holes for the gyro backing plate guide pins to prevent moisture from entering the drive motor.
2. Place the new Evolution vibration pad (supplied) between the gyro inner clamping ring and the gyro backing plate.
3. Orient the gyro/spring assembly so that the drive coupling access slot faces downward, then position it on three shock mount studs on the motor assembly to make sure that, without twisting the shock mounts, the screw holes around the outside edge of the spring plate align with the corresponding holes in the backing plate.
4. Apply a drop of Loctite ® 222 to each of the three shock mount studs (on the backing plate). Thread the (3) 1/4-20 nuts onto the shock mount studs (leave finger-tight).

INSTRUCTIONS

for the
Evolution RC Gyro Damper Kit
(Kit Catalog No. 73881)

5. Apply a drop of Loctite ® 222 to each of six remaining M5 x 12 mm screws, orient the outer clamping ring so that the counter-bore side is out and the two notches in the outer edge align with those in the mounting ring and backing plate (facing upward). Using a 4 mm Allen wrench, insert the screws through the outer ring and spring into the backing plate and tighten.
6. Loosen all three 1/4-20 nuts from the shock mount studs, then using a 7/16 inch wrench, tighten all three securely.
7. Using a 4 mm Allen wrench, install the tapered spindle on the gyro shaft.
8. Turn the motor/gyro assembly so that the drive coupling access slot in the gyro faces upward and rotate the tapered spindle until a coupling clamping screw is visible. Using a torque wrench with a 2.5 mm Allen bit while holding the spindle so that it does not rotate, tighten the coupling clamping screw to 2.37 N . m (21 inch- lbs). Rotate the tapered spindle/drive shaft one-half rotation (180°) until the other clamping screw is visible through the access slot, and tighten the second screw to the same torque.

D.) Installing the Motor/Gyro Assembly

1. Work to remove and discard any RTV sealant remaining on the rim around the opening in the bottom of the evaporator.
2. Apply a drop of Loctite ® 222 to each of the four studs on the bottom of the mounting ring, then transport the motor/gyro assembly to the centrifuge and, being careful not to crush sensor cables, temporarily set it down inside the evaporator chamber.
3. Feed the motor cables down into the motor shroud; route the motor drive cable out the hole in the front, and route commutation and auxiliary tachometer cables out the hole on the left side.

INSTRUCTIONS

for the
Evolution RC Gyro Damper Kit
(Kit Catalog No. 73881)

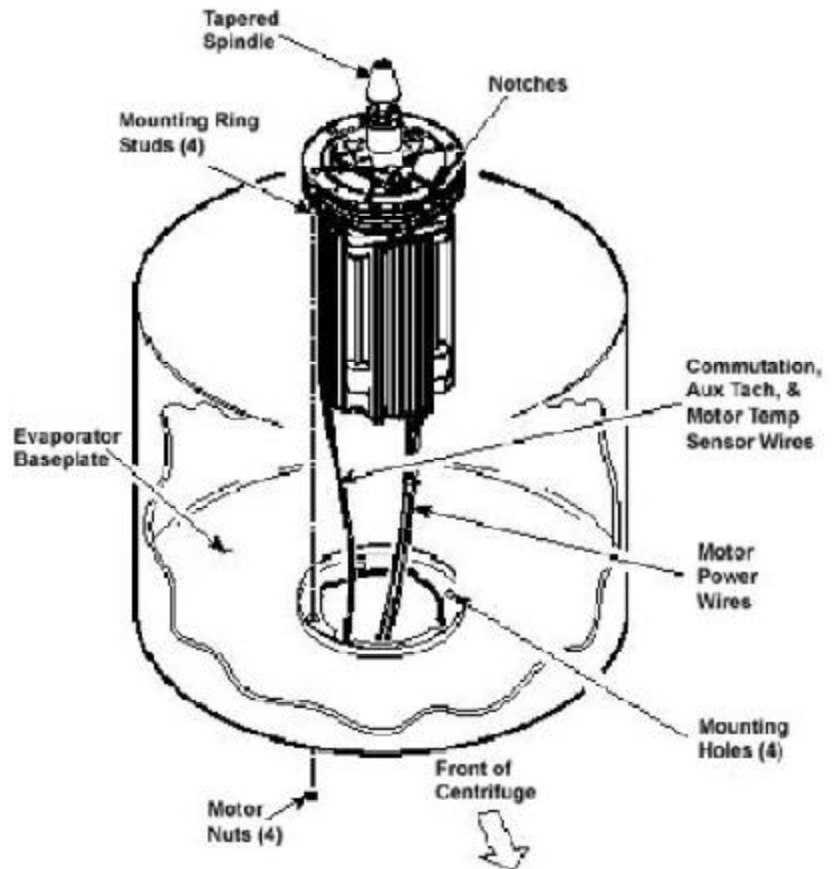


Figure 8

4. Using the tapered spindle as a handle, orient the motor/gyro assembly so that the two notches in the outside edge of the gyro assembly face toward the front of the centrifuge. Lower the motor/gyro assembly into its correct position (being careful not to pinch the sensor wires) so that the four studs in the mounting ring engage the four holes in the evaporator baseplate.
5. Working down underneath in front, thread the four nuts (removed in step A12) onto the four mounting ring studs (located up on the evaporator baseplate near the top of the motor shroud), and tighten each nut securely using a 10 mm box wrench.

INSTRUCTIONS

for the
Evolution RC Gyro Damper Kit
(Kit Catalog No. 73881)

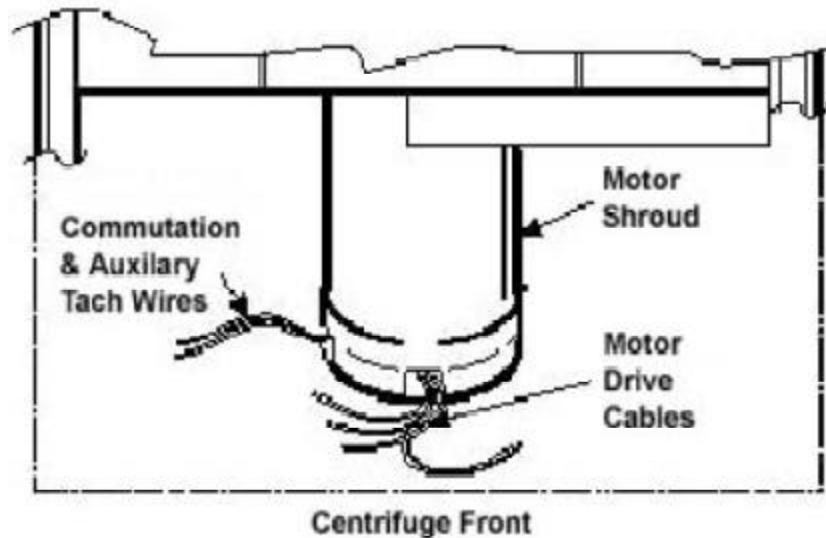


Figure 9

Note:

On centrifuges with serial numbers 10300750 and above there will be an additional motor temperature sensor cable connected to the drive interface board. There will also be no Ke board in the system.

6. Connect all wires coming from the motor shroud:
 - a. Connect the auxiliary tachometer and motor temperature sensor wires (if present) to the drive interface P.C. board.
 - b. Connect the commutation wires to the drive box.
 - c. Connect the motor cable to the drive box and to the Ke P.C. board (if present), and reconnect the ground wires to the frame using the hardware removed in step A11 and tighten using a 3 mm Allen wrench.
7. Working inside the evaporator chamber, use a 4 mm Allen wrench to remove the tapered spindle from the gyro shaft.
8. Using the length of new Mortite caulking cord that is supplied, seal around the gyro's outer clamp ring.
9. Apply a drop of Loctite ® 222 to each of the two screws that were used to secure the imbalance sensor (removed in step A8), then using a 3 mm Allen wrench, secure the imbalance sensor to the gyro.

INSTRUCTIONS

for the
Evolution RC Gyro Damper Kit
(Kit Catalog No. 73881)

10. Orient the lower insulating disk (triangular cutout) so that the flat side of the cutout aligns with the imbalance sensor (the slit with the temperature sensor cable positioned clockwise from the flat side). When installed, the imbalance sensor cable should be completely underneath the disk, and the disk should be fully seated on the gyro.
11. Orient the thin upper insulating disk, smooth side up, then install the disk on the gyro while drawing the cable up through the slit. Properly installed, the upper insulating disk will be tight against the lower disk with slits aligned.
12. To the underside of the gyro boot, in the outer groove that runs inside the lip of the large disk portion, apply a continuous bead of RTV adhesive (catalog no. 65664, supplied).

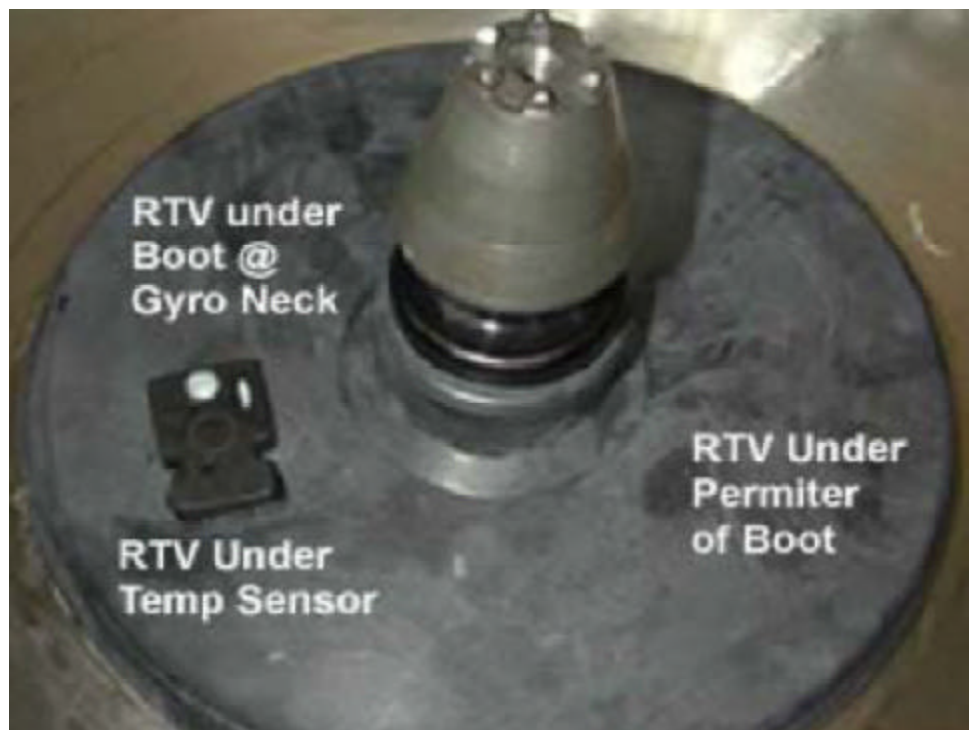


Figure 10

13. Place RTV adhesive under the temperature sensor sealing where the cable passes through the boot.
14. Aligning the temperature sensor with the slots in the insulation, slide the gyro boot onto the gyro until the mouth of the boot is below the rib that runs round the top of the gyro housing.

INSTRUCTIONS

for the
Evolution RC Gyro Damper Kit
(Kit Catalog No. 73881)

15. Tuck the temperature sensor cable in under the gyro boot, then work the lip of the boot onto the rim of the evaporator chamber. Make sure the evaporator rim is fully engaged all the way around the boot to ensure that the RTV adhesive will create a proper seal.
16. Grasp the neck of the gyro boot and push it downward to fully expose the rib that runs around the top of the gyro housing. Apply a continuous bead of the RTV adhesive around the gyro housing, just below the rib, then work the mouth of the boot back upward until its annular groove (just inside the mouth of the boot) fully engages the rib on the gyro housing to create a proper seal. Wipe any excess adhesive from the boot and gyro housing, making sure that none gets on the gyro shaft.
17. Slide the slinger (removed in step C6) onto the gyro shaft so that it seats on the shoulder on the shaft, then using a 2 mm Allen wrench, tighten both screws to secure the slinger to the gyro shaft.
18. Apply a drop of Loctite ® 222 to the tapered spindle screw, then using a 4 mm Allen wrench, reinstall and securely tighten the tapered spindle on the gyro shaft.
19. Insert the top of the front panel underneath the top deck and set it in position on the two pins on the front of the centrifuge. Reinstall the two screws with washers (removed in step A2) and, using a 4 mm Allen wrench, tighten the two screws to secure the panel.

Note:

Insure that the slinger assembly does not contact the rubber gyro boot / temperature sensor assembly.

E.) Checking Performance

1. Reconnect power, then turn the main power switch ON.
2. Install a rotor and perform a test run to confirm proper performance and calibrate imbalance following the procedure outlined in the Evolution RC Service Manual..

INSTRUCTIONS

for the Evolution RC Gyro Spring Replacement Kit (Kit Catalog No. 73833)

Parts Supplied

Quan	Part Number	Description
1	72931	Spring Plate, 6 Spoke
1	73854	Spring Plate, 6 spoke
12	68629	Screw, Socket Head, M5x12mm
1	90702	Loctite #222 sealant
2 ft	-----	Caulking Cord, Mortite
3	92786	Shock Mount
3	61141	Hex Nut, 1/4 - 20
1	73873	Evolution Vibration Pad
1	73834	Installation Instructions



Warning:

Because of the presence of high voltage, untrained personnel must not attempt to test, repair, or modify any electrical circuits or systems in this unit.



Warning:

Because of the characteristics of the samples likely to be processed in this centrifuge, biological or radioactive contamination may occur. Always be aware of this possibility, and take normal precautions. The Kendro Service Decontamination Policy states that a completed Decontamination Information Certificate is required before servicing.



Warning:

Hazardous voltages may exist whenever power is connected and circuits are energized. To eliminate potential for serious electrical shock or component damage, turn the main power switch OFF, unplug the centrifuge, then wait four minutes before proceeding.

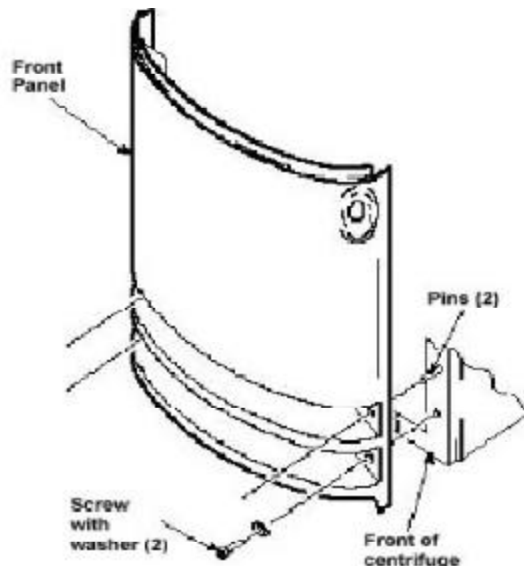
Tools and Other Items Required

Allen Wrenches, Metric: 2mm, 2.5mm, 3mm, 4mm, & 5mm.
Box Wrench, 10mm.
Wrench, SAE, 7/16".
Small Torque Wrench with long reach 2.5mm Allen bit.
Laptop Computer.

Instructions

A.) Removing the Motor/Gyro Assembly

1. Open the chamber door, then turn the main power switch OFF, unplug the centrifuge, and wait four minutes before proceeding.



INSTRUCTIONS

for the Evolution RC Gyro Spring Replacement Kit (Kit Catalog No. 73833)

- Using a 4 mm Allen wrench, remove the two screws with washers from the louver area of the front panel, then remove the front panel.
- Working inside the evaporator chamber, using a 4 mm Allen wrench through the center hole in the tapered spindle, unscrew the captive screw, then pull the tapered spindle up and off of the gyro shaft.

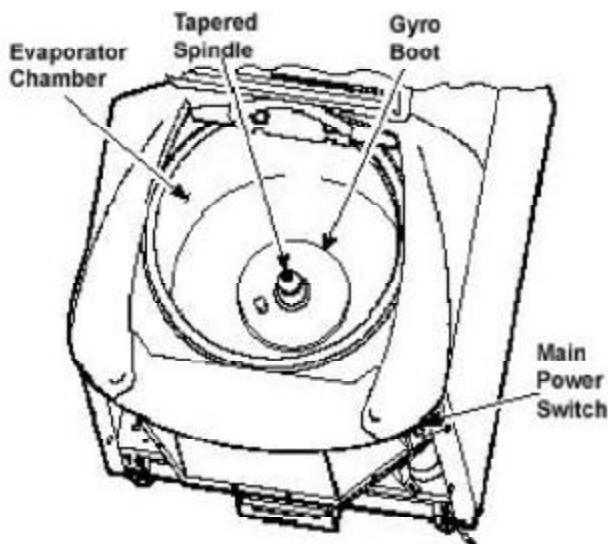


Figure 2

- Using a 2 mm Allen wrench, loosen the two set screws that secure the slinger to the gyro shaft, then slide the slinger up and off of the gyro shaft.
- Remove the gyro boot (affixed with RTV adhesive): First work the circumference off of the evaporator rim, then, being careful not to stress the temperature sensor cable, pull the boot (with temperature sensor attached) straight up and off of the gyro housing.
- Carefully, so as not to damage the gyro boot or temperature sensor cable, work to remove and discard the old RTV sealant remaining from the underside of the boot (do not remove sealant from where the sensor cable feeds through the boot), then set the boot/sensor assembly aside on the evaporator floor.
- One at a time, pull the two insulating disks off of the gyro and place them aside on the evaporator floor, near the boot/sensor assembly.
- Remove the Mortite caulk from around the gyro's outer clamp ring. Discard the caulk.

INSTRUCTIONS

for the Evolution RC Gyro Spring Replacement Kit (Kit Catalog No. 73833)

- Using a 3 mm Allen wrench, remove the two screws that secure the imbalance sensor to the gyro. Draw the cables from the imbalance and temperature sensors straight up, bend them toward the front of the centrifuge, and hook the cables over the evaporator rim (so that the sensors can stay in the bottom of the chamber and the two cables will be out of the way).
- Using a 4 mm Allen wrench, reinstall the tapered spindle on the gyro shaft.

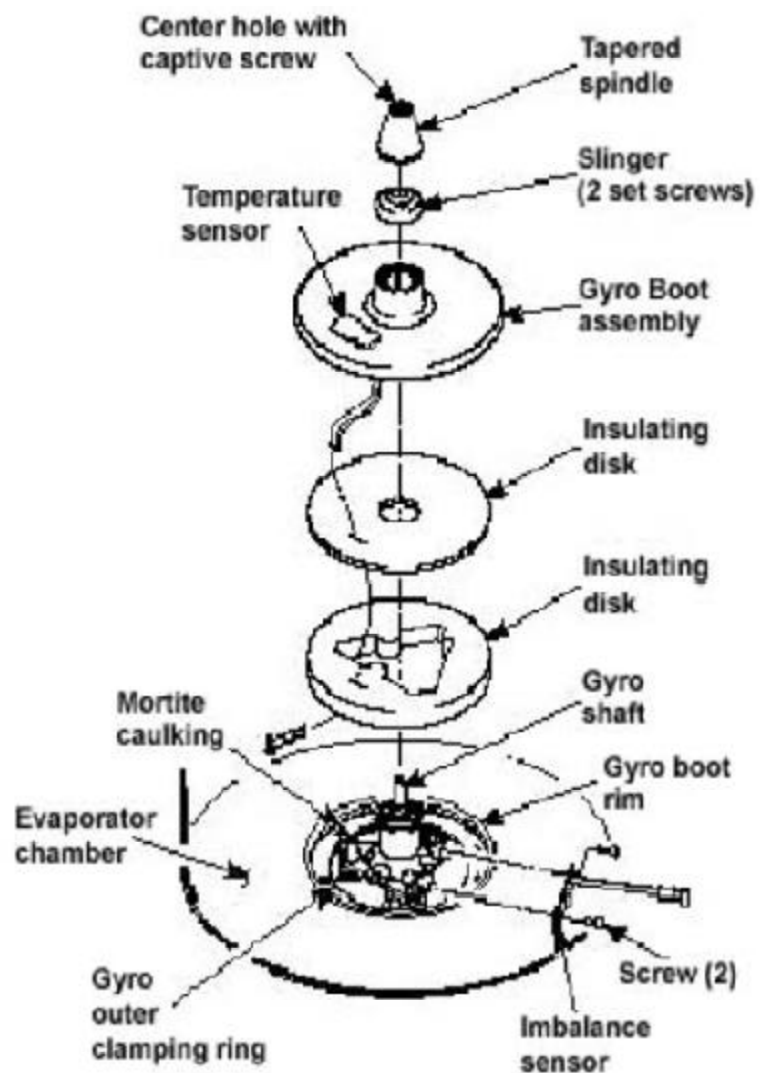


Figure 3

INSTRUCTIONS

for the Evolution RC Gyro Spring Replacement Kit (Kit Catalog No. 73833)

Note:

On centrifuges with serial numbers 10300750 and above there will be an additional motor temperature sensor cable connected to the drive interface board. There will also be no Ke board in the system.

Note:

Removing the calrod brake resistor from the top of the drive control module assembly will make access to the rear motor mounting nut easier.

11. Working down underneath in front, disconnect all wires coming from the motor shroud:
 - a. Unplug the motor cable from the drive box and from the Ke P.C. board (if present), and disconnect the ground wires from the frame using a 3 mm Allen wrench.
 - b. Unplug the commutation wires from the drive box.
 - c. Unplug the auxiliary tachometer wires from the drive interface P.C. board.
 - d. Unplug the motor temperature sensor wires (if present) from the lower rear corner of the drive interface board.
12. Using a 10 mm box wrench, remove the four nuts that are located up under the evaporator baseplate near the top of the motor shroud.
13. From above, using the tapered spindle as a handle, lift the motor/gyro assembly up and, being careful not to crush sensor cables, temporarily set it in the evaporator chamber.
14. From below, feed all motor cables and connectors (disconnected in step 11) into the motor shroud so that they will lay loose inside the shroud on top of the motor fan.

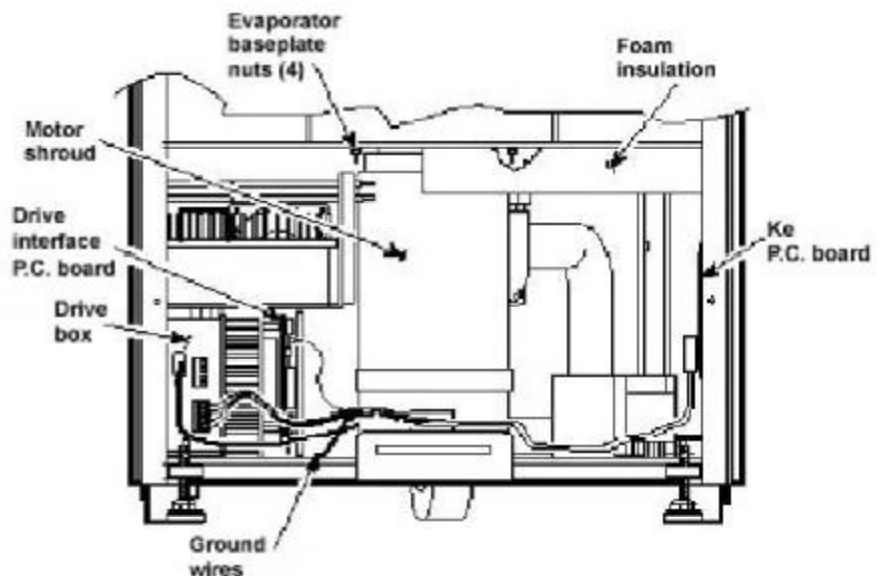


Figure 4

INSTRUCTIONS

for the Evolution RC Gyro Spring Replacement Kit (Kit Catalog No. 73833)

15. From above, pull the motor cables up into the evaporator chamber, then lift the motor/gyro assembly from the centrifuge.

B.) Removing the Gyro from the Motor

1. Lay the motor/gyro assembly on a clean work surface so that the motor is fully and squarely on the surface and the larger round portions of the gyro assembly extend off the edge.
2. Turn the motor/gyro so that the drive coupling access slot in the gyro faces up.
3. Rotate the tapered spindle/drive shaft until a coupling clamping screw is visible through the access slot. While holding the spindle so that it does not rotate, use a 2.5 mm Allen wrench to loosen the screw. Then rotate the tapered spindle/drive shaft one-half rotation (180°) until the other coupling clamping screw is visible through the access slot, and loosen the second screw.

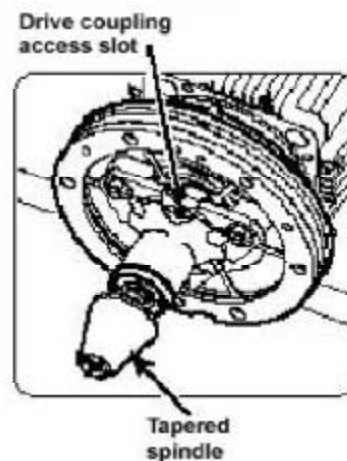


Figure 5

4. Turn the motor/gyro so that the coupling access slot in the gyro faces down (motor cables up).
5. Using a 4 mm Allen wrench, remove the tapered spindle from gyro shaft.
6. Using a 4 mm Allen wrench, remove the six screws that secure the outer clamping ring to the backing plate and remove the outer ring. Discard the six screws.

INSTRUCTIONS

for the Evolution RC Gyro Spring Replacement Kit (Kit Catalog No. 73833)

7. Using a 7/16 inch wrench, remove and discard the (3) 1/4-20 nuts that secure the gyro to the three shock mounts on the backing plate, then remove the gyro/spring assembly.
8. Remove and discard the rubber vibration pad from under the gyro / spring assembly that was removed in step 7.
9. Unscrew the three shock mounts from the backing plate and discard the shock mounts.
10. Using a 4 mm Allen wrench, remove the six screws securing the inner clamping ring and the 6-spoke spring plate to the gyro housing. Retain the inner clamping ring and the Gyro Assembly.
11. Using the spring plate that was removed in step #10 as a guide select the correct spring plate that is supplied with the new Gyro Kit. Discard the old spring along with the spring that does not match the original spring.

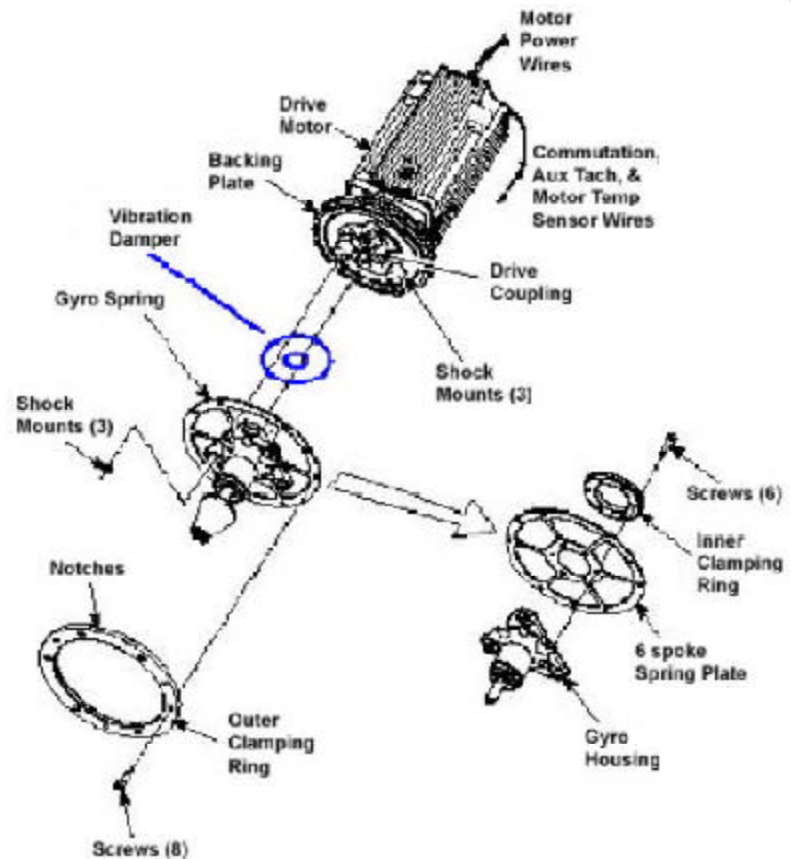


Figure 6

INSTRUCTIONS

for the Evolution RC Gyro Spring Replacement Kit (Kit Catalog No. 73833)

C.) Assembling the Gyro on the Motor

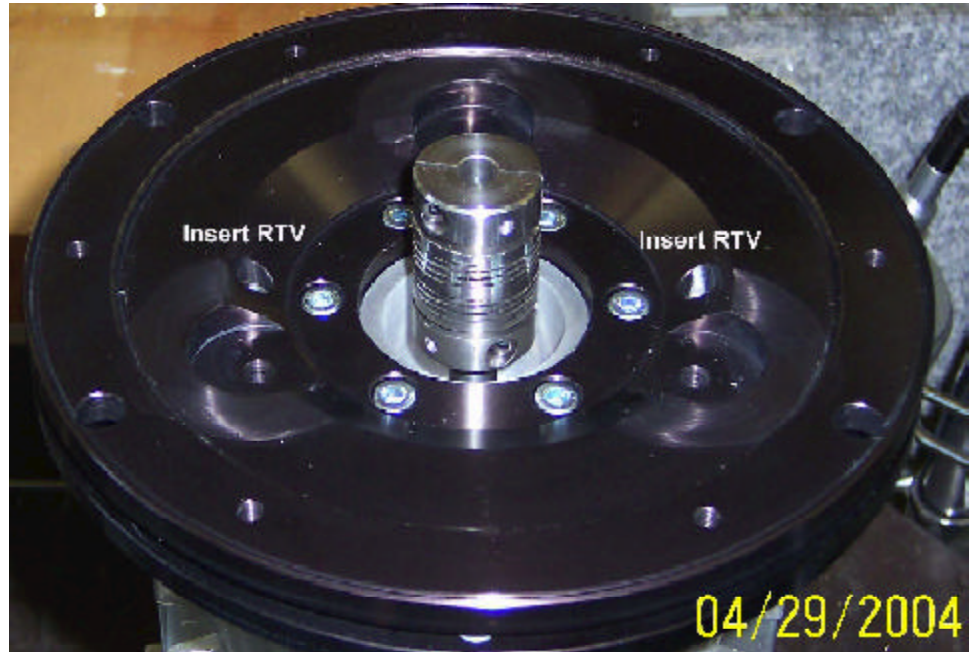


Figure 7

1. Using RTV sealant, seal the (2) holes for the gyro backing plate guide pins to prevent moisture from entering the drive motor.
2. One at a time, apply a drop of Loctite ® 222 to studs on one side of each of the three new shock mounts (catalog no. 92786, supplied), then thread the studs with the Loctite ® into the backing plate and tighten each shock mount securely.
3. Apply a drop of Loctite ® 222 to each of six M5 x 12 mm screws (catalog no. 68629, supplied), then attach the new 6-spoke spring plate and inner clamping ring (counterbores out) to the new gyro supplied. Using a 4 mm Allen wrench, tighten the six screws just until snug –do not tighten securely yet.

INSTRUCTIONS

for the

Evolution RC Gyro Spring Replacement Kit (Kit Catalog No. 73833)

4. Orient the new gyro/spring assembly so that the drive coupling access slot faces downward, then position it on three shock mount studs on the motor assembly to make sure that, without twisting the shock mounts, the screw holes around the outside edge of the spring plate align with the corresponding holes in the backing plate. If they do not, adjust the position by holding the gyro housing securely and rotating the spring plate just enough to align the holes. Once the holes align, gently remove the gyro/spring assembly from the motor assembly and, using a 4 mm Allen wrench, tighten the six screws in the inner clamping ring securely.
5. Place the new Evolution vibration pad (supplied) between the gyro inner clamping ring and the gyro backing plate.
6. Apply a drop of Loctite ® 222 to each of the three shock mount studs (on the backing plate). Orient the gyro/spring assembly so that the drive coupling access slot in the gyro faces downward, then position the assembly on the shock mounts and hold it in position by threading the three new 1/4-20 nuts (catalog no. 61141, supplied) onto the shock mount studs (leave finger-tight).
7. Apply a drop of Loctite ® 222 to each of six remaining M5 x 12 mm screws (supplied), orient the outer clamping ring so that the counter-bore side is out and the two notches in the outer edge align with those in the mounting ring and backing plate (facing upward). Using a 4 mm Allen wrench, insert the screws through the outer ring and spring into the backing plate and tighten.
8. Loosen all three 1/4-20 nuts from the shock mount studs, then using a 7/16 inch wrench, tighten all three securely.
9. Using a 2 mm Allen wrench, loosen the two set screws that secure the new slinger, then slide the slinger up and off of the gyro shaft.
10. Using a 4 mm Allen wrench, install the tapered spindle on the gyro shaft.

INSTRUCTIONS

for the Evolution RC Gyro Spring Replacement Kit (Kit Catalog No. 73833)

D.) Installing the Motor/Gyro Assembly

1. Work to remove and discard any RTV sealant remaining on the rim around the opening in the bottom of the evaporator.
2. Apply a drop of Loctite ® 222 to each of the four studs on the bottom of the mounting ring, then transport the motor/gyro assembly to the centrifuge and, being careful not to crush sensor cables, temporarily set it down inside the evaporator chamber.
3. Feed the motor cables down into the motor shroud; route the motor drive cable out the hole in the front, and route commutation and auxiliary tachometer cables out the hole on the left side.

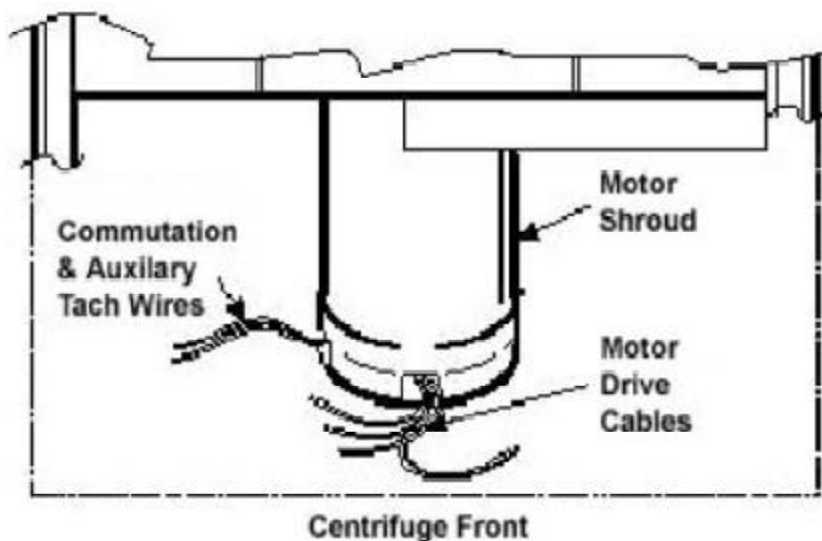


Figure 8

4. Using the tapered spindle as a handle, orient the motor/gyro assembly so that the two notches in the outside edge of the gyro assembly face toward the front of the centrifuge. Lower the motor/gyro assembly into its correct position (being careful not to pinch the sensor wires) so that the four studs in the mounting ring engage the four holes in the evaporator baseplate.
5. Working down underneath in front, thread the four nuts (removed in step A12) onto the four mounting ring studs (located up on the evaporator baseplate near the top of the motor shroud), and tighten each nut securely using a 10 mm box wrench.

INSTRUCTIONS

for the Evolution RC Gyro Spring Replacement Kit (Kit Catalog No. 73833)

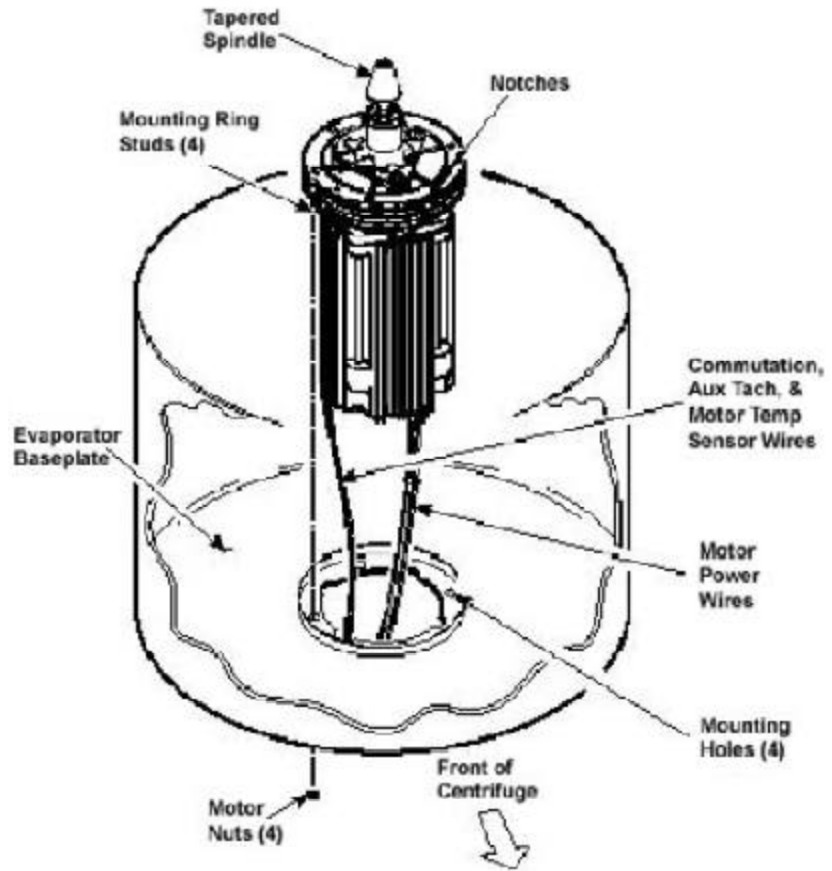


Figure 9

6. Connect all wires coming from the motor shroud:

Note:

On centrifuges with serial numbers 10300750 and above there will be an additional motor temperature sensor cable connected to the drive interface board. There will also be no Ke board in the system.

- a. Connect the auxiliary tachometer and motor temperature sensor wires (if present) to the drive interface P.C. board.
- b. Connect the commutation wires to the drive box.
- c. Connect the motor cable to the drive box and to the Ke P.C. board (if present), and reconnect the ground wires to the frame using the hardware removed in step A11 and tighten using a 3 mm Allen wrench.

7. Working inside the evaporator chamber, use a 4 mm Allen wrench to remove the tapered spindle from the gyro shaft.

INSTRUCTIONS

for the Evolution RC Gyro Spring Replacement Kit (Kit Catalog No. 73833)

8. Using the length of new Mortite caulking cord that is supplied, seal around the gyro's outer clamp ring.
9. Apply a drop of Loctite ® 222 to each of the two screws that were used to secure the imbalance sensor (removed in step A8), then using a 3 mm Allen wrench, secure the imbalance sensor to the gyro.
10. Orient the lower insulating disk (triangular cutout) so that the flat side of the cutout aligns with the imbalance sensor (the slit with the temperature sensor cable positioned clockwise from the flat side). When installed, the imbalance sensor cable should be completely underneath the disk, and the disk should be fully seated on the gyro.
11. Orient the thin upper insulating disk, smooth side up, then install the disk on the gyro while drawing the cable up through the slit. Properly installed, the upper insulating disk will be tight against the lower disk with slits aligned.
12. To the underside of the gyro boot, in the outer groove that runs inside the lip of the large disk portion, apply a continuous bead of RTV adhesive (catalog no. 65664, supplied).

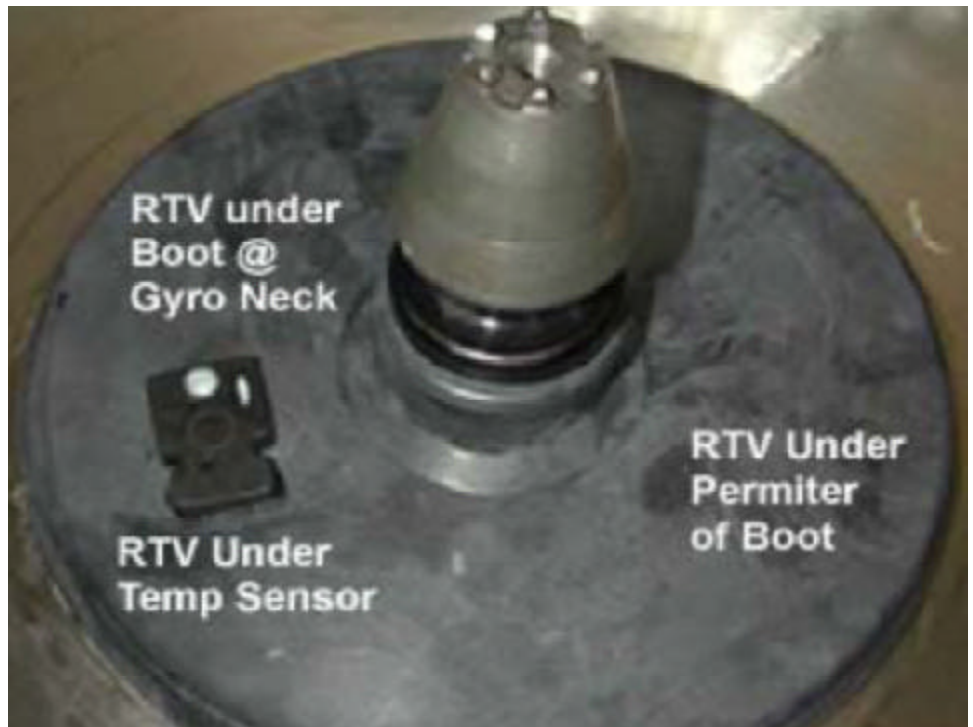


Figure 10

INSTRUCTIONS

for the Evolution RC Gyro Spring Replacement Kit (Kit Catalog No. 73833)

13. Place RTV adhesive under the temperature sensor sealing where the cable passes through the boot.
14. Aligning the temperature sensor with the slots in the insulation, slide the gyro boot onto the gyro until the mouth of the boot is below the rib that runs round the top of the gyro housing.
15. Tuck the temperature sensor cable in under the gyro boot, then work the lip of the boot onto the rim of the evaporator chamber. Make sure the evaporator rim is fully engaged all the way around the boot to ensure that the RTV adhesive will create a proper seal.
16. Grasp the neck of the gyro boot and push it downward to fully expose the rib that runs around the top of the gyro housing. Apply a continuous bead of the RTV adhesive around the gyro housing, just below the rib, then work the mouth of the boot back upward until its annular groove (just inside the mouth of the boot) fully engages the rib on the gyro housing to create a proper seal. Wipe any excess adhesive from the boot and gyro housing, making sure that none gets on the gyro shaft.
17. Slide the slinger (removed in step C6) onto the gyro shaft so that it seats on the shoulder on the shaft, then using a 2 mm Allen wrench, tighten both screws to secure the slinger to the gyro shaft.
18. Apply a drop of Loctite ® 222 to the tapered spindle screw, then using a 4 mm Allen wrench, reinstall and securely tighten the tapered spindle on the gyro shaft.
19. Insert the top of the front panel underneath the top deck and set it in position on the two pins on the front of the centrifuge. Reinstall the two screws with washers (removed in step A2) and, using a 4 mm Allen wrench, tighten the two screws to secure the panel.

Note:

Insure that the slinger assembly does not contact the rubber gyro boot / temperature sensor assembly.

INSTRUCTIONS

for the
Evolution RC Gyro Spring Replacement Kit
(Kit Catalog No. 73833)

E.) Checking Performance

1. Reconnect power, then turn the main power switch ON.
2. Install a rotor and perform a test run to confirm proper performance and calibrate imbalance following the procedure outlined in the Evolution RC Service Manual..

Evolution RC

Imbalance Sensor Replacement Kit

P/N 73358

Parts Supplied

1 ea		Imbalance Sensor Assembly
1 ea	65664	Black RTV Sealant
3 ft	60255	Mortite caulking
1 ea	90702	Loctite Sealant #222

Installation Instructions

WARNING

Because of the characteristics of the samples likely to be processed in this centrifuge, biological or radioactive contamination may occur. Always be aware of this possibility, and take normal precautions. The Kendro Service Decontamination Policy states that a completed Decontamination Information Certificate is required before servicing.

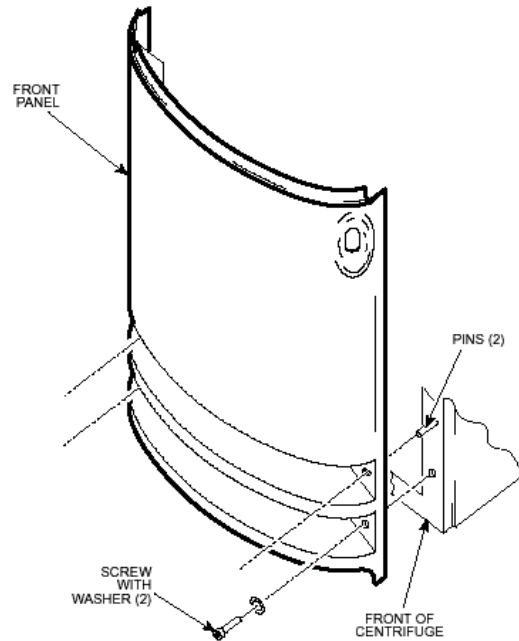
1. Open the chamber door, then turn the main power switch OFF, unplug the centrifuge, and wait four minutes before proceeding.

WARNING

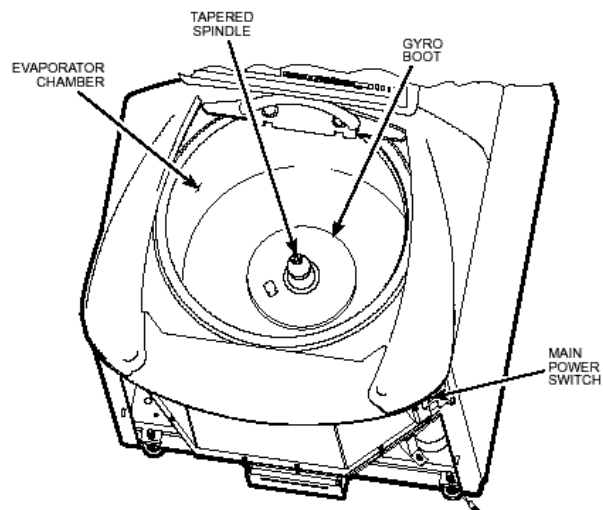
Hazardous voltages may exist whenever power is connected and circuits are energized. To eliminate potential for serious electrical shock or component damage, turn the main power switch OFF, unplug the centrifuge, then wait four minutes before proceeding.

2. If the centrifuge is located so that there is no room to work behind or in front of the centrifuge, raise the front locking stabilizers and roll the centrifuge to a suitable working location.
3. Using a 4 mm Allen wrench, remove the two screws with washers from the louver area of the front panel, then remove the front panel.

Evolution RC Imbalance Sensor Replacement Kit P/N 73358



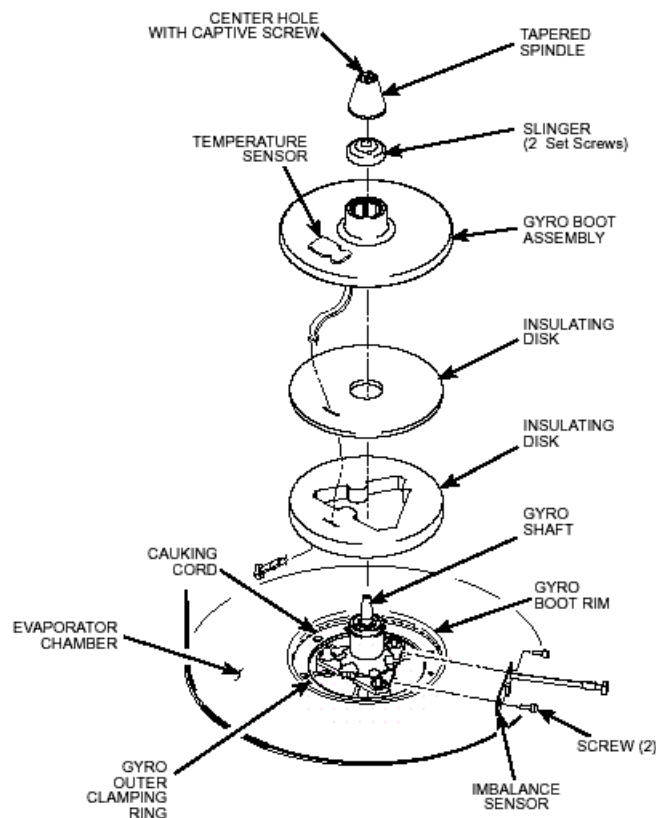
4. Working inside the evaporator chamber, using a 4 mm Allen wrench through the center hole in the tapered spindle, unscrew the captive screw, then pull the tapered spindle up and off of the gyro shaft.



5. Using a 2 mm Allen wrench, loosen the two set-screws that secure the slinger to the gyro shaft, then slide the slinger up and off of the gyro shaft.

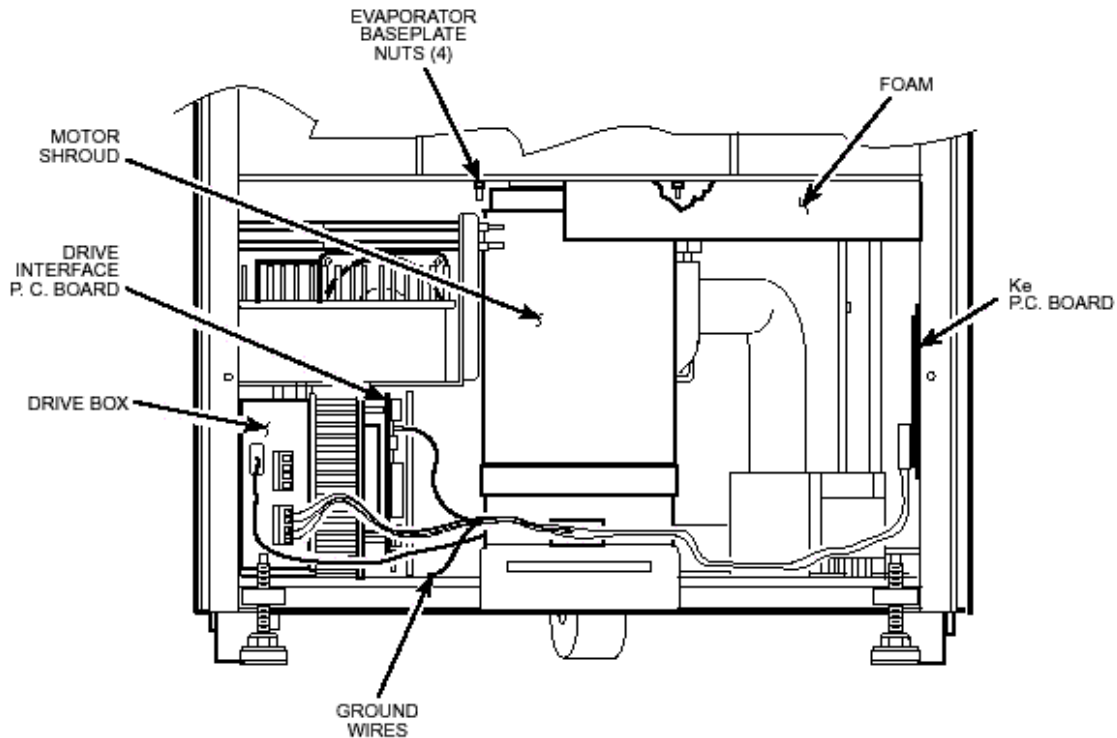
Evolution RC Imbalance Sensor Replacement Kit P/N 73358

6. Remove the gyro boot (affixed with RTV adhesive). First, work the circumference off of the evaporator rim, then, being careful not to stress the temperature sensor cable, pull the boot (with temperature sensor attached) straight up and off of the gyro housing. Set the boot/sensor assembly aside on the evaporator floor.
7. One at a time, pull the two insulating disks off of the gyro.
8. Remove the caulk from around the gyro's outer clamp ring. Discard the caulk.
9. Using a 3 mm Allen wrench, remove the two screws that secure the imbalance sensor to the gyro. Draw the cables from the imbalance and temperature sensors straight up, bend them toward the front of the centrifuge, and hook the cables over the evaporator rim (so that the sensors can stay in the bottom of the chamber and the two cables will be out of the way).
10. Using a 4 mm Allen wrench, reinstall the tapered spindle on the gyro shaft.



Evolution RC Imbalance Sensor Replacement Kit P/N 73358

11. Working down underneath in front, disconnect the imbalance sensor ribbon cable from J-7 on the Drive Interface printed circuit board that is located at the lower left corner of the centrifuge next to the drive box assembly. (J-7 is labeled “Accelerometer”)
12. Using a 10 mm box wrench, remove the four nuts that are located up under the evaporator base-plate near the top of the motor shroud.
13. From above, using the tapered spindle as a handle, lift the motor/gyro assembly up so that the gyro mounting studs just clear the centrifuge mid-plate (approximately 1”). Once the studs are clear of the plate, rotate the motor approximately 1° in either direction and allow the motor assembly to rest on the mid-plate. (This will make enough room for the imbalance cable to be fed through the centrifuge mid plate.)



Installing the New Imbalance Sensor Assembly

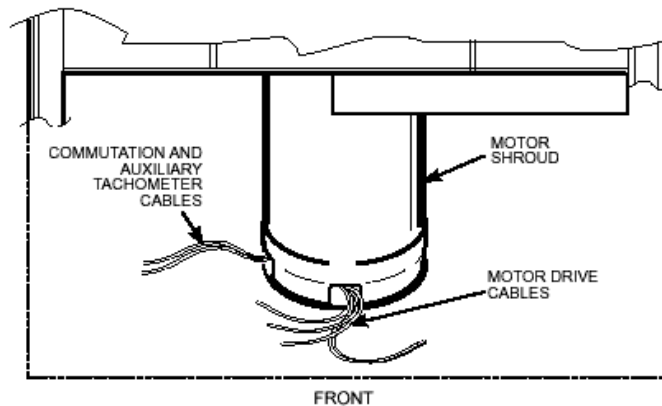
1. Place the new Imbalance Sensor on the chamber floor and route the cable to the Drive Interface board. Connect the cable to the J-7 on the Drive Interface board.

Evolution RC Imbalance Sensor Replacement Kit P/N 73358

2. After placing the assembly in position on the chamber floor fold the cable over the lip of the chamber so that the cable is not pinched when the motor is reinstalled.

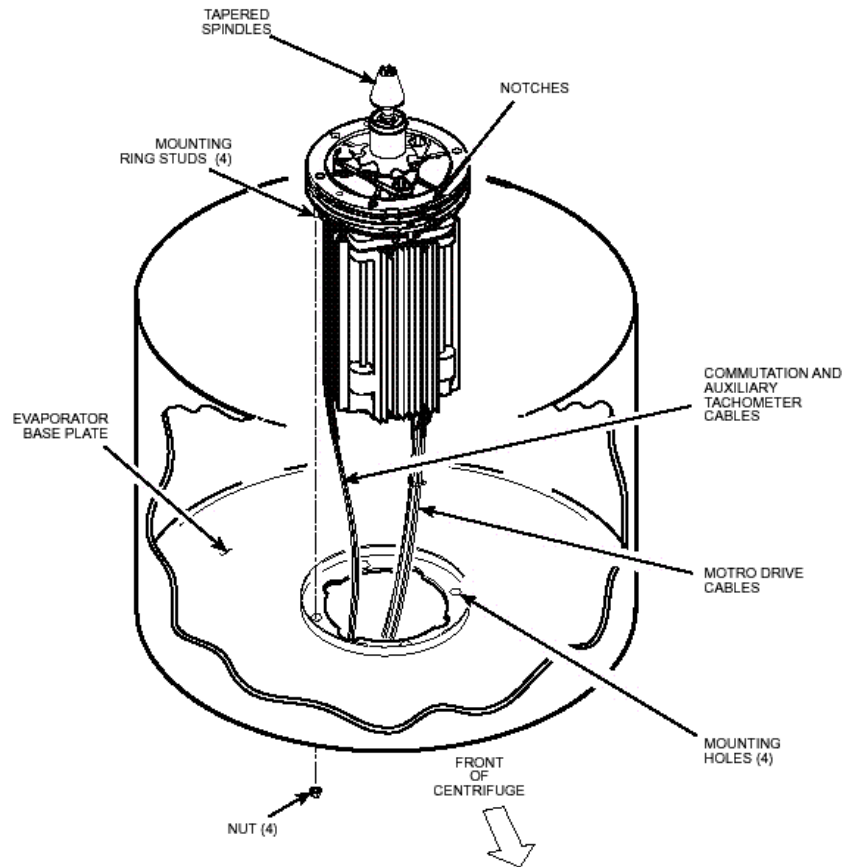
Installing the Motor/Gyro Assembly

1. Work to remove and discard any RTV sealant remaining on the rim around the opening in the bottom of the evaporator.



2. Using the tapered spindle as a handle, lift the motor from its resting place on the centrifuge mid-plate, rotate the motor so the motor assembly mounting studs slip into their respective holes on the centrifuge mid-plate.

Evolution RC Imbalance Sensor Replacement Kit P/N 73358



3. Working down underneath in front, thread the four nuts (removed in previous step) onto the four mounting ring studs (located up on the evaporator base-plate near the top of the motor shroud). Tighten each nut securely using a 10 mm box wrench.
4. Working inside the evaporator chamber, use a 4 mm Allen wrench to remove the tapered spindle from the gyro shaft.
5. Using the length of new caulking cord supplied, seal around the gyro's outer clamp ring.
6. Apply a drop of Loctite ® 222 to each of the two screws that were used to secure the imbalance sensor removed earlier, then using a 3 mm Allen wrench, secure the imbalance sensor to the gyro.

Evolution RC

Imbalance Sensor Replacement Kit

P/N 73358

7. Orient the lower insulating disk (triangular cutout) so that the flat side of the cutout aligns with the imbalance sensor. When installed, the imbalance sensor cable should be completely underneath the disk, and the disk should be fully seated on the gyro.
8. Orient the thin upper insulating disk smooth side up, then install the disk on the gyro.
9. To the underside of the gyro boot, in the outer groove that runs inside the lip of the large disk portion, apply a continuous bead of RTV adhesive (catalog no. 65664, supplied).
10. Aligning the temperature sensor at the 7 o'clock position with relation to the motor shaft, slide the gyro boot onto the gyro until the mouth of the boot is below the rib that runs around the top of the gyro housing.
11. Tuck the temperature sensor cable in under the gyro boot, then work the lip of the boot onto the rim of the evaporator chamber. Make sure the evaporator rim is fully engaged all the way around the boot to ensure that the RTV adhesive will create a proper seal.
12. Grasp the neck of the gyro boot and push it downward to fully expose the rib that runs around the top of the gyro housing. Apply a continuous bead of the RTV adhesive around the gyro housing, just below the rib, then work the mouth of the boot back upward until its annular groove (just inside the mouth of the boot) fully engages the rib on the gyro housing to create a proper seal. Wipe any excess adhesive from the boot and gyro housing, making sure that none gets on the gyro shaft.
13. Slide the slinger (removed earlier) onto the gyro shaft so that it seats on the shoulder on the shaft, then using a 2 mm Allen wrench, tighten both screws to secure the slinger to the gyro shaft.
14. Apply a drop of Loctite ® 222 to the tapered spindle screw, then using a 4 mm Allen wrench, reinstall and securely tighten the tapered spindle on the gyro shaft.
15. Insert the top of the front panel underneath the top deck and set it in position on the two pins on the front of the centrifuge, then reinstall the two screws with washers (removed earlier) and, using a 4 mm Allen wrench, tighten the two screws to secure the panel.
16. If the centrifuge was moved, return it to its original operating location and level it using the front locking stabilizers.

Evolution RC
Imbalance Sensor Replacement Kit
P/N 73358

Calibrating Imbalance

1. Calibrate the centrifuge imbalance following the procedure outlined in the Calibration & Software section of the Evolution RC™ Service Manual.

Evolution RC

Knob Conversion Kit P/N 73839

Installation Instructions

Parts Included

-----	Knob Version Control Panel
73840	Installation Instructions

Caution:

The printed circuit boards contained in the control console assembly are static sensitive and must be handled with the appropriate static control procedures. Always use an anti static wrist-strap and workstation (Kendro part #73369).

1. Turn off the centrifuge power and disconnect the instrument power cord from the mains supply.
2. Disconnect the power supply cable and the IIC cable from the rear of the control console.
3. Using a 3mm Allen wrench remove the (4) socket head screws from the rear of the console assembly (1 in each corner). Remove the trim ring from the front of the control console and set aside.
4. Using a 3mm Allen wrench, remove the (4) screws that secure the control panel from the console assembly. Remove the control panel and place on a stable workbench insuring that an anti-static workstation (73369) is used.
5. Unplug the following connectors from the PC-104 processor.
 - Battery backup cable (73300)
 - Serial interface cable (73389)
 - Hard drive interface cable (73826)
 - J-10 on the display board
6. Using a 2.5mm Allen wrench, remove the (3) socket head screws that secure the PC-104 processor to the display board assembly. Using a 5.5mm wrench (nut driver) remove the remaining nut used to secure the PC-104 processor to the display board assembly.
7. Remove the PC-104 processor from the existing control panel assembly and install it on the new assembly.
8. Using a 5.5mm wrench (nut driver) remove the (4) nuts that secure the hard disk assembly to the control console assembly. Remove the hard disk assembly and set aside.

Evolution RC

Knob Conversion Kit P/N 73839

Installation Instructions

9. Using a 5.5mm wrench (nut driver), remove the (4) standoffs that secure the hard disk assembly to the control console assembly. Install the standoffs onto the new console assembly.
10. Install the hard disk assembly onto the new control console assembly and secure it with the (4) 5.5mm hex nuts that were removed in step #8.
11. Install the following connectors onto the PC-104 processor / display board.

J-10 on the display board
Hard disk interface cable (73826)
Serial interface cable (73389)
Battery backup (73300)

12. Install the new control panel assembly into the console using the (4) 3mm socket head screws that were removed in step #4.
13. Connect the power supply cable and the IIC cable into the rear of the control console assembly.
14. Connect the centrifuge line cord to the mains supply.
15. Locate the serial interface ribbon cable hanging just above the control console. Connect a null serial modem cable between the interface cable and the serial port on the laptop computer (null modem cable Kendro #73827).
16. On centrifuges that have the Advanced Features Option (LCD Touch Screen) connect the Null Modem Interface Cable (73389) (located inside the console assembly) to the pigtail cable that is attached to the PC-104 processor. (When the Null Modem Interface Cable is connected to the centrifuge the LCD Touch Screen will be disabled.)
17. Open the Hyperterminal program that is found in Windows 95, 98, 2000, & NT set for a baud rate of 9600. If there is a copy of the Evolution software update disk available the "Evolution Diagnostic" icon can be moved to the computer desktop and utilized.

Note:

On centrifuges with software revision #41 (or higher) skip steps 18 - 23 and resume at step 24.

18. Turn the centrifuge instrument power "**ON**". As the Evolution RC instrument boots interrupt the boot process by depressing "**CONTROL C**" on the computer just after the "EVOL" program starts to run. See Figure #1.

Evolution RC

Knob Conversion Kit P/N 73839

Installation Instructions

```
HOT cable detected, Serial Loader starting.  
Press ESC to abort Hard disk boot  
Booting Hard Drive  
Loading...
```

```
DR DOS Release 5.0  
Copyright (c) 1976,1982,1988,1990 Digital Research Inc. All rights reserved.  
Ampro Computers, Inc.
```

```
C>ECHO ON
```

```
C>evol
```

Figure #1

19. When the message displays “**Halt the Batch Process**” answer by typing “**Y**”.
20. Rename the Autoexec.bat file so that the instrument cannot be booted. (Rename the file something that will not be forgotten).

```
C>rename autoexec.bat steve
```

In this case the Autoexec was renamed “**steve**”.

21. Re-boot the Evolution RC instrument by cycling the power “**OFF**” then back “**ON**”.
22. The instrument will re-boot then ask for the date and the time. If no changes are to be made depress “**ENTER**” 2 times.

```
HOT cable detected, Serial Loader starting.  
Press ESC to abort Hard disk boot  
Booting Hard Drive  
Loading...
```

```
DR DOS Release 5.0  
Copyright (c) 1976,1982,1988,1990 Digital Research Inc. All rights reserved.  
Ampro Computers, Inc.
```

```
Date: Sat 3-17-2001  
Enter date (mm-dd-yy):
```

```
Time: 4:00:54.87  
Enter time:
```

```
C>
```

Evolution RC

Knob Conversion Kit P/N 73839

Installation Instructions

Figure #2

23. At the “C>” start the Evolution Diagnostics by typing “**EVOL D**”. This will start the diagnostics program for the centrifuge and will display the menu depicted in figure #3.
24. On centrifuges with software revision #41 (or higher) type "d" on the connected PC to enter the system diagnostics after the centrifuge has booted up. This will cause the centrifuge display to change to "PLEASE WAIT" and the diagnostics menu will appear on the connected PC.

```
C>evol d

MAIN MENU
-----
c) configuration
d) diagnostic tests
s) Service Menu(s)
a) exit menus (start application)
e) exit application
-----
your choice: c
```

Figure #3

25. Select “**configuration**” by typing “**c**”. The display shown in figure #4 will show the “configuration menu”.

```
SYSTEM CONFIGURATION MENU
-----
p) panel
m) miscellaneous configuration
b) back to main menu
-----
your choice: p
```

Figure #4

26. Select “**panel**” by typing “**p**”. The current panel configuration will be displayed. The configuration of the panel will be displayed on the first line. In the case of the instrument depicted in figure #5 the panel was set up for knobs (NVRAM knobs = 1). If the diagnostic screen indicates “buttons = 1” the configuration must be changed by typing “**K**”. This will change the configuration from “buttons” to “knobs”.

Evolution RC

Knob Conversion Kit P/N 73839

Installation Instructions

CURRENT PANEL CONFIGURATION

current state: NVRAM: knobs = 1
NVRAM: LM76 = 1
NVRAM: LCD = 0
NVRAM: KeValue = 9.210
NVRAM: KeGain = 1.240
NVRAM: Machine gain = 0.000 machine offset = 0.000
NVRAM: Sensor Slope = 0.0000000 Sensor offset = 0.0000000
knob panel

- k) knob panel
- b) button panel
- 5) using LM75
- 6) using LM76
- l) LCD present
- n) LCD NOT present
- e) exit panel configuration

your choice:

Figure #5

27. Return to the configuration menu by typing “e”.

SYSTEM CONFIGURATION MENU

- p) panel
- m) miscellaneous configuration
- b) back to main menu

your choice:

Figure #6

28. Return to the main menu by typing “b”.

MAIN MENU

- c) configuration
- d) diagnostic tests
- s) Service Menu(s)
- a) exit menus (start application)
- e) exit application

your choice:

Evolution RC

Knob Conversion Kit P/N 73839

Installation Instructions

Figure #7

29. Select the service menu by typing “s”.

```
-----  
k) Read and Store Ke Value  
r) Read and Store Ke Adjustment Ratio  
m) Machine Temp Gain and Offset  
s) Sensor Slope & Offset  
a) Accelerometer menu  
b) back to Main  
-----  
your choice:
```

Figure #8

30. Select “Read and Store Ke Value” by typing “k”. The current Ke value will be displayed on the screen. Check the instrument Ke value that can be located on the motor power cable at the drive control module. Enter the motor Ke value that was read on the motor tag. After entering the motor Ke value the screen will indicate that the value was “**Completed**”. The display will return to the service menu.

Note:

A numeric value must be entered even if it’s the same as the current Ke value.

```
your choice: k  
read and store ke value  
KE value read is 9.210  
Enter new value 9.210  
Completed
```

```
-----  
k) Read and Store Ke Value  
r) Read and Store Ke Adjustment Ratio  
m) Machine Temp Gain and Offset  
s) Sensor Slope & Offset  
a) Accelerometer menu  
b) back to Main  
-----  
your choice:
```

Figure #9

Evolution RC

Knob Conversion Kit P/N 73839

Installation Instructions

31. Select “Read and Store Ke Adjustment Ratio” by typing “**r**”. The display will show the Ke Adjustment Ratio that is currently in the memory. Enter the new Ke Adjustment Ratio (1.325 for software revision 37 or 1.250 for software revisions for revision 38 or above).

your choice: r
read and store Adjustment Ratio value
KE Adjustment Ratio value read is 1.325
Enter new value
b) back to menu
1.325
Completed

k) Read and Store Ke Value
r) Read and Store Ke Adjustment Ratio
m) Machine Temp Gain and Offset
s) Sensor Slope & Offset
a) Accelerometer menu
c) Compressor Selection
b) back to Main

Figure #10

32. Select “Machine Temp Gain and Offset” by typing “**m**”. Enter the gain and offset (both must always be 0.000).

your choice: m
Read and store Machine gain and offset values
Machine gain is 0.000 Machine offset is 0.000
Enter new gain
o) offset
b) back to menu
0.000
Enter new offset
b) back to menu
0.000
Completed

k) Read and Store Ke Value
r) Read and Store Ke Adjustment Ratio
m) Machine Temp Gain and Offset
s) Sensor Slope & Offset
a) Accelerometer menu
c) Compressor Selection
b) back to Main

Evolution RC

Knob Conversion Kit P/N 73839

Installation Instructions

Figure #11

33. Select “Back to Main Menu” by typing “b”.

your choice: b

MAIN MENU

c) configuration
d) diagnostic tests
s) Service Menu(s)
a) exit menus (start application)
e) exit application

your choice: e

Figure #12

34. Exit the service diagnostics by selecting exit application “e”
35. Calibrate the imbalance following the procedure that is outlined in the Calibration & Software section of the Evolution RC™ Service Manual.
36. On centrifuges that use software revisions #41 and above turn the centrifuge main power OFF after the imbalance calibration is complete. Disconnect the computer and tuck the interface ribbon cable into the control console. Install the trim ring using the 3mm Allen Wrench.
37. On centrifuges that use software revision #37 cycle the main power after the imbalance calibration is complete. At the “C>” prompt rename the Autoexec.bat file back to “**Autoexec.bat**”.
38. Cycle the Evolution RC power “OFF” then back “ON”. The instrument will now boot up normally. No other calibrations are needed and the instrument should run normally.
39. Disconnect the computer and tuck the interface ribbon cable into the control console. Install the trim ring using the 3mm Allen Wrench.

INSTRUCTIONS

for the
Evolution RC Motor Replacement Kit
(Catalog No. 73448)

Parts Included

Quantity	Part #	Description
1 ea		Motor assembly
1 ea		Caulking cord 600mm (2 ft)
4 ea	69180	Screw, socket cap head, M6x16
12 ea	68629	Screw, socket cap head, M5x12
1 ea	73339	Software upgrade kit
1 ea	90392	Fan guard
1 ea	65664	RTV silicon sealant
1 ea	90702	Sealant, Loctite #222
1 ea	73957	Evolution coupling gap gauge
1 ea	73449	Installation instructions

Warning:

Because of the characteristics of the samples likely to be processed in this centrifuge, biological or radioactive contamination may occur. Always be aware of this possibility, and take normal precautions. The Kendro Service Decontamination Policy states that a completed Decontamination information Certificate is required before servicing.

Warning

Hazardous voltages may exist whenever power is connected and circuits are energized. To eliminate potential for serious electrical shock or component damage, turn the main power switch OFF, unplug the centrifuge, then wait four minutes before proceeding.

Tools and Other Items Required

- Allen Wrenches, Metric: 2, 2.5, 3, 4, 5, and 6 mm
- Box Wrench, Metric, 10 mm
- Wrench, SAE, 7/16 inch
- Small Torque Wrench with long-reach 2.5 mm Allen bit
- Digital Voltmeter
- Small Screwdriver, Precision type (for potentiometer adjust)
- RTV Sealant, Silicone
- Calibration P.C. Board (Catalog No. 73373)

Instructions

A) Removing the Motor/Gyro Assembly

1. Open the chamber door, then turn the main power switch OFF, unplug the centrifuge, and wait four minutes before proceeding.
2. Using a 4 mm Allen wrench, remove the two screws with washers from the louver area of the front panel, then remove the front panel.

INSTRUCTIONS

for the
Evolution RC Motor Replacement Kit
(Catalog No. 73448)

Note:

Some early Evolution RC Centrifuges may use a hard disk for the centrifuge memory. If so, it is recommended to replace the hard disk with a compact Flash memory / PC-104 printed circuit board (#73340).

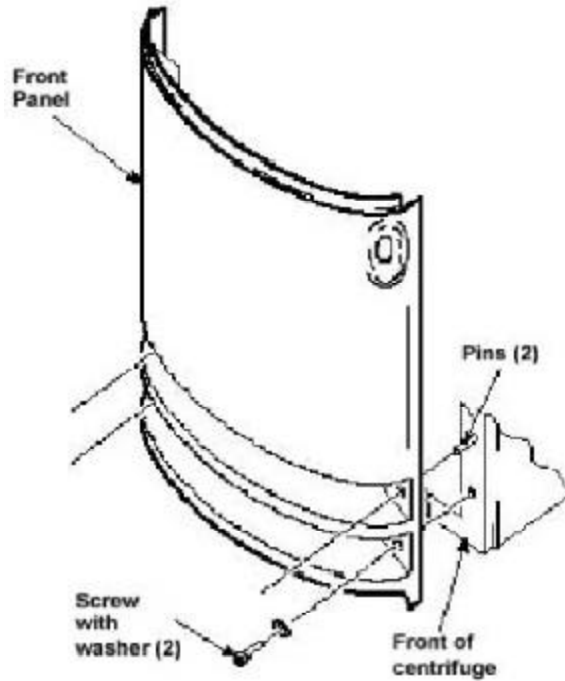


Figure 1

3. Working inside the evaporator chamber, using a 4 mm Allen wrench through the center hole in the tapered spindle, unscrew the captive screw, then pull the tapered spindle up and off of the gyro shaft.
4. Using a 2 mm Allen wrench, loosen the two set screws that secure the slinger to the gyro shaft, then slide the slinger up and off of the gyro shaft
5. Remove the gyro boot (affixed with RTV adhesive): First work the circumference off of the evaporator rim, then, being careful not to stress the temperature sensor cable, pull the boot (with temperature sensor attached) straight up and off of the gyro housing.
6. Carefully, so as not to damage the gyro boot or temperature sensor cable, work to remove and discard the old RTV sealant remaining from the underside of the boot (do not remove sealant from where the sensor cable feeds through the boot), then set the boot/sensor assembly aside on the evaporator floor.
7. One at a time, pull the two insulating disks off of the gyro and place them aside on the evaporator floor, near the boot/sensor assembly.

INSTRUCTIONS

for the
Evolution RC Motor Replacement Kit
(Catalog No. 73448)

8. Remove the caulk from around the gyro's outer clamp ring. Discard the caulk.
9. Using a 3 mm Allen wrench, remove the two screws that secure the imbalance sensor to the gyro. Draw the cables from the imbalance and temperature sensors straight up, bend them toward the front of the centrifuge, and hook the cables over the evaporator rim (so that the sensors can stay in the bottom of the chamber and the two cables will be out of the way).
10. Using a 4 mm Allen wrench, reinstall the tapered spindle on the gyro shaft.

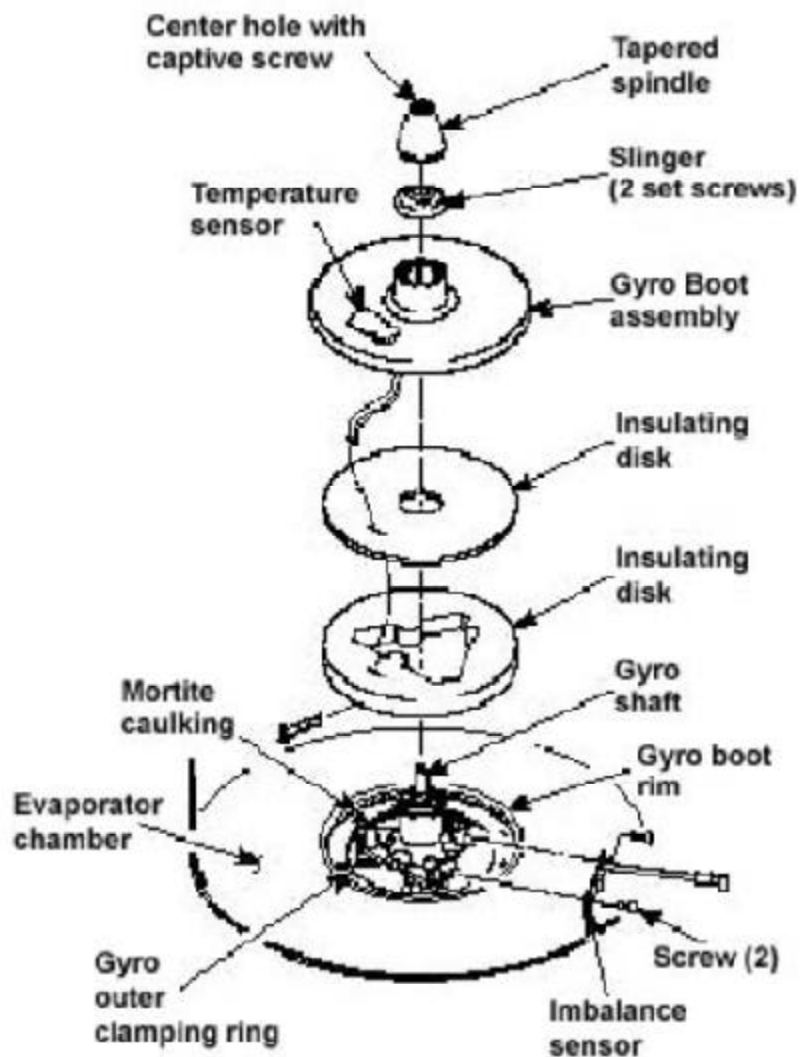


Figure 2

INSTRUCTIONS

for the
Evolution RC Motor Replacement Kit
(Catalog No. 73448)

11. Working down underneath in front, disconnect all wires coming from the motor shroud:
 - a. Unplug the motor cable from the drive box and from the Ke P.C. board, and disconnect the ground wires from the frame using a 3 mm Allen wrench.
 - b. Unplug the commutation wires from the drive box.
 - c. Unplug the auxiliary tachometer wires from the drive interface P.C. board.
12. Using a 10 mm box wrench, remove the four nuts that are located up under the evaporator baseplate near the top of the motor shroud.
13. From above, using the tapered spindle as a handle, lift the motor/gyro assembly up and, being careful not to crush sensor cables, temporarily set it in the evaporator chamber.
14. From below, feed all motor cables and connectors (disconnected in step 11) into the motor shroud so that they will lay loose inside the shroud on top of the motor fan.

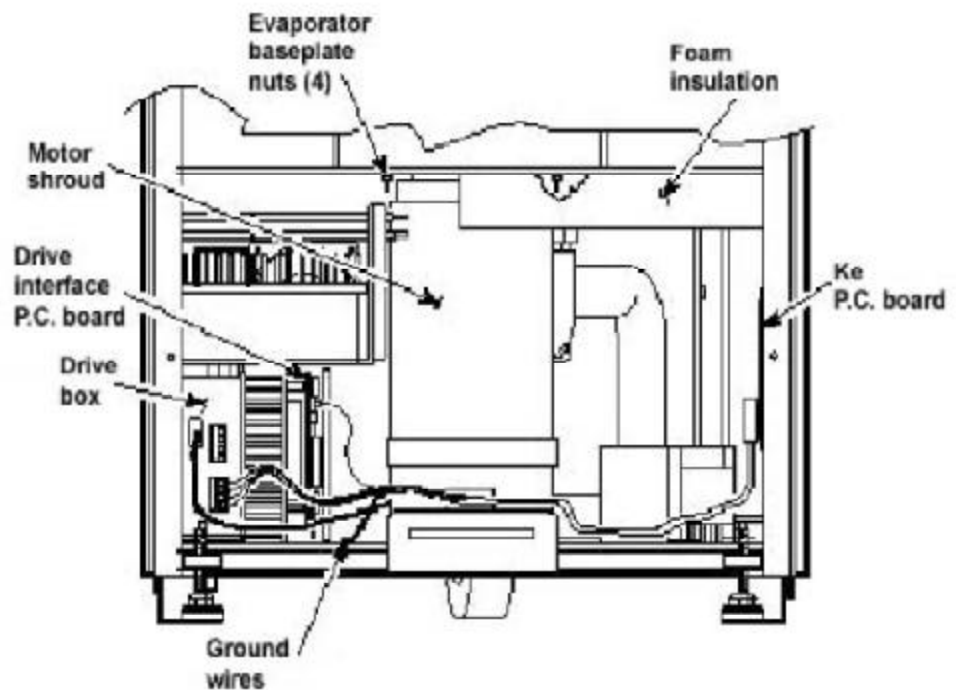


Figure 3

15. From above, pull the motor cables up into the evaporator chamber, then lift the motor/gyro assembly from the centrifuge.

INSTRUCTIONS

for the
Evolution RC Motor Replacement Kit
(Catalog No. 73448)

B) Install new fan guard

Note:

Look inside the motor shroud and determine whether there is a chrome fan guard on the motor cooling fan. If the guard is present disregard section B.

Note:

The fan guard should be located above the plastic motor shroud and the fan assembly.

1. Using a 4mm Allen wrench remove the 2 screws that secure the motor shroud to the brackets located on the centrifuge floor. Remove the motor shroud and cooling fan from the centrifuge.
2. Using a 4mm Allen wrench, remove the 2 screws located inside the motor shroud that secure the cooling fan to the shroud assembly.
3. Place the supplied fan guard into the motor shroud and secure the guard along with the motor fan to the shroud.
4. Re-install the shroud assembly into the centrifuge using the hardware that was removed in step #B-1.

C) Removing the gyro from the motor

1. Lay the motor/gyro assembly on a clean work surface so that the motor is fully and squarely on the surface and the larger round portions of the gyro assembly extend off the edge.
2. Turn the motor/gyro so that the drive coupling access slot in the gyro faces up.
3. Rotate the tapered spindle/drive shaft until a coupling clamping screw is visible through the access slot, and while holding the spindle so that it does not rotate, use a 2.5 mm Allen wrench to loosen the screw. Then rotate the tapered spindle/drive shaft one-half rotation (180°) until the other coupling clamping screw is visible through the access slot, and loosen the second screw.
4. Turn the motor/gyro so that the coupling access slot in the gyro faces down (motor cables up).
5. Using a 4 mm Allen wrench, remove the six screws that secure the outer clamping ring to the backing plate and remove the outer ring.

INSTRUCTIONS

for the
Evolution RC Motor Replacement Kit
(Catalog No. 73448)

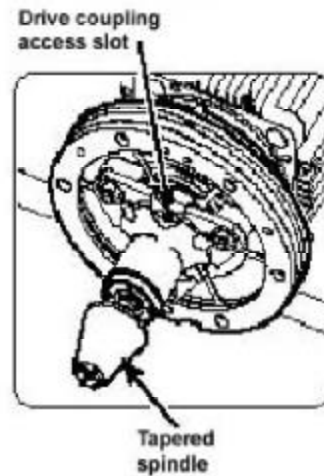


Figure 4

6. Using a 7/16 inch wrench, remove the three nuts that secure the gyro to the three shock mounts on the backing plate, then remove the gyro/spring assembly. Inspect the three shock mounts; if worn or in poor condition, replace them (order three of catalog no. 92786).
7. Using a 4 mm Allen wrench, remove the six screws that secure the backing plate to the motor mount end plate, then carefully pry at different points around the periphery to separate the plate from the mounting ring/motor assembly.
8. Pull the mounting ring/damping ring assembly off of the motor mount end plate. Inspect the rubber damping ring; if worn or in poor condition, replace it (order catalog no. 72839).
9. On centrifuges with serial number 10300735 and below use a 5 mm Allen wrench, remove the four screws that secure the motor mount end plate to the motor. Being careful not to damage the surface of the motor mount end plate, separate and remove the end plate from the motor. Discard the motor mount end plate.
10. Using a 2.5 mm Allen wrench, loosen the two coupling clamping screws and remove the drive coupling from the motor shaft.

Note:

The motor mount end plate is now part of the motor end bell. The plate removed in step C-9 is no longer needed.

INSTRUCTIONS

for the
Evolution RC Motor Replacement Kit
(Catalog No. 73448)

D) Assembling the gyro onto the motor

1. Place the new motor on the work surface next to the old motor and turn it so it is oriented the same way (motor cables up), then remove the old motor and reassemble the gyro on the new motor.

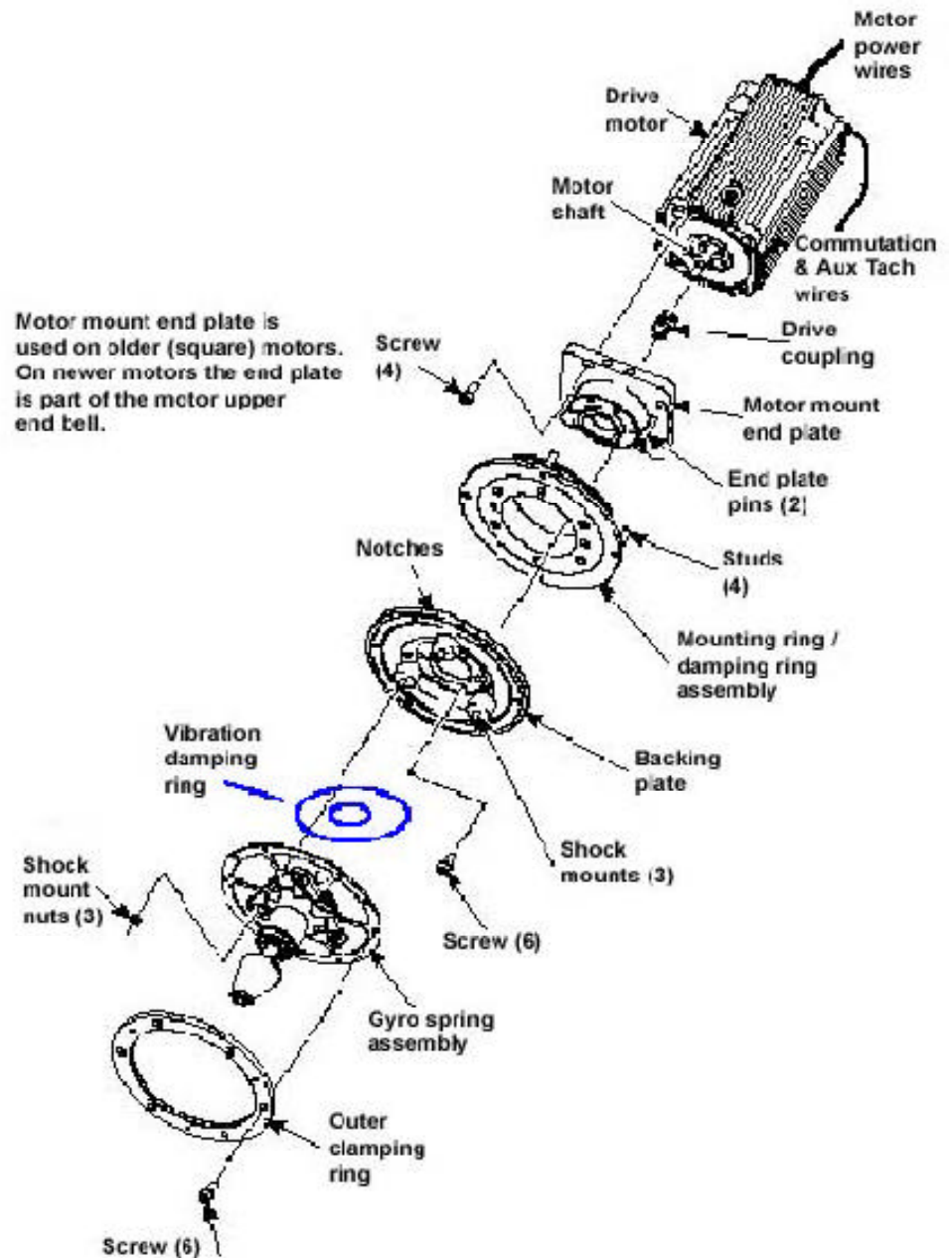


Figure 5

INSTRUCTIONS

for the
Evolution RC Motor Replacement Kit
(Catalog No. 73448)

2. Slide the drive coupling onto the motor shaft until it rests against a shoulder on the motor shaft and, using a small torque wrench with a 2.5 mm Allen bit, tighten one of the coupling clamping screws (on the end closest to the motor) to 2.37 N/m (21 inch-lbs). Then rotate the coupling/drive shaft one-half rotation (180°), and tighten the second screw to the same torque.
3. Apply a thin film of vacuum grease to the inside of the damping ring. Orient the mounting ring/damping ring assembly so that the two notches in the outer edge of the mounting ring are facing upward and the holes in the damping ring align with the two pins, then slide the assembly onto the motor mount until the damping ring is fully seated.
4. Apply a drop of Loctite ® 222 to each of two M5 x 12 mm screws then orient the backing plate so that the two notches in the outer edge align with those in the mounting ring (facing upward), insert the two screws into opposing positions around the center hole, and using a 4 mm Allen wrench, alternately tighten the two screws into the motor mount end plate until the backing plate is fully seated on the end plate.
5. Apply a drop of Loctite ® 222 to each of four more of the M5 x 12 mm screws (supplied), then insert them into the remaining backing plate positions, and using a 4 mm Allen wrench, securely tighten the four screws and double-check tightness on the other two.



Figure 6

INSTRUCTIONS

for the
Evolution RC Motor Replacement Kit
(Catalog No. 73448)

6. After installing the gyro backing plate fill the two guide holes with RTV silicone sealant (reference figure #6).
7. Place the vibration pad under the Inner Clamping Ring on the Gyro / Spring assembly.
8. Apply a drop of Loctite ® 222 to each of the three shock mount studs (on the backing plate), orient the gyro/spring assembly so that the drive coupling access slot in the gyro faces downward, then position the assembly on the shock mounts and hold it in position by threading the three 7/16 inch nuts (removed in step C-6) onto the shock mount studs (leave finger-tight).
9. Apply a drop of Loctite ® 222 to each of six remaining M5 x 12 mm screws (supplied). Orient the outer clamping ring so that the counterbore side is out and the two notches in the outer edge align with those in the mounting ring and backing plate (facing upward). Using a 4 mm Allen wrench, insert the screws through the outer ring and spring into the backing plate and tighten.
10. Loosen all three 7/16 inch nuts from the shock mount studs, then tighten all three securely.
11. Turn the motor/gyro assembly so that the drive coupling access slot in the gyro faces upward and rotate the tapered spindle until a coupling clamping screw is visible. Using a torque wrench with a 2.5 mm Allen bit while holding the spindle so that it does not rotate, tighten the coupling clamping screw to 2.37 N/m (21 inch-lbs). Then rotate the tapered spindle/drive shaft one-half rotation (180°) until the other clamping screw is visible through the access slot, and tighten the second screw to the same torque.
12. Find the Ke value label on the motor and copy the listed Ke value from that label onto the Ke label on the front of the frame and cross-out the old Ke value (from the old motor).

INSTRUCTIONS

for the
Evolution RC Motor Replacement Kit
(Catalog No. 73448)

E) Installing the motor/gyro assembly

1. Work to remove and discard any RTV sealant remaining on the rim around the opening in the bottom of the evaporator.
2. Insert the motor/gyro assembly into the centrifuge chamber and, being careful not to crush sensor cables, temporarily set it down inside the evaporator chamber.
3. Feed the motor cables down into the motor shroud; route the motor drive cable out the hole in the front, and route commutation and auxiliary tachometer cables out the hole on the left side.

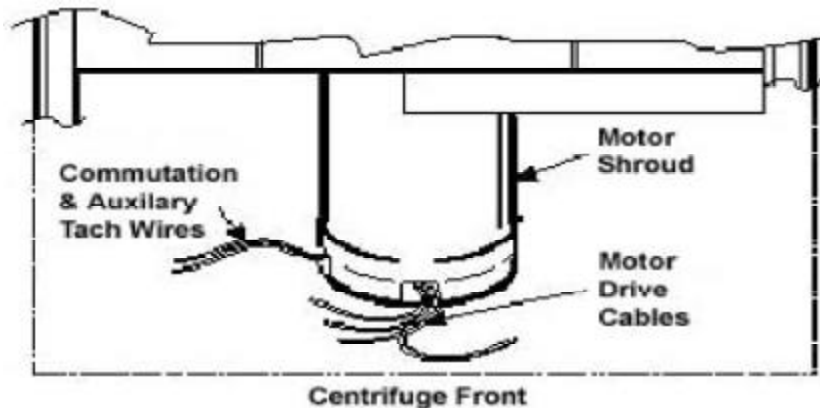


Figure 7

4. Using the tapered spindle as a handle, orient the motor/gyro assembly so that the two notches in the outside edge of the gyro assembly face toward the front of the centrifuge. Then lower the motor/gyro assembly into its correct position (being careful not to pinch the sensor wires) so that the four studs in the mounting ring engage the four holes in the evaporator baseplate.
5. Working down underneath in front, thread the four nuts (removed in step A12) onto the four mounting ring studs (located up on the evaporator baseplate near the top of the motor shroud). Tighten each nut securely using a 10 mm box wrench.

INSTRUCTIONS

for the
Evolution RC Motor Replacement Kit
(Catalog No. 73448)

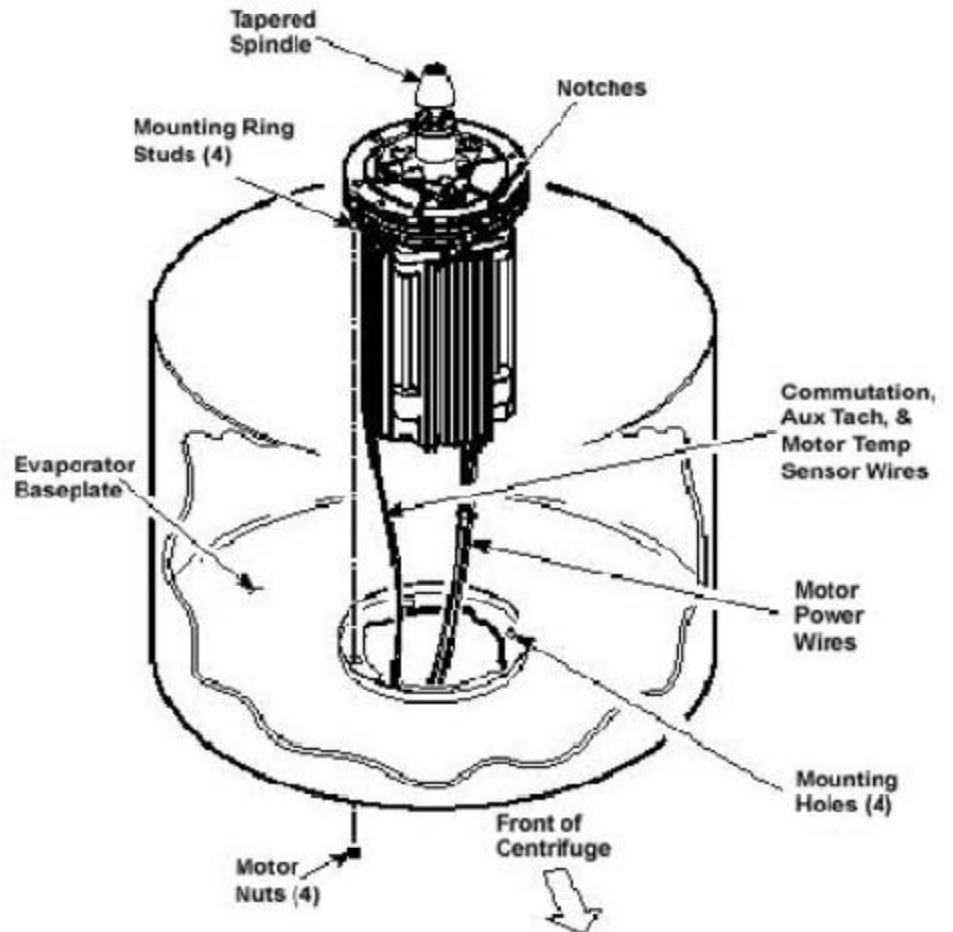


Figure 8

6. Connect all wires coming from the motor shroud:
 - a. Connect the auxiliary tachometer wires to the drive interface P.C. board.
 - b. Connect the commutation wires to the drive box.
 - c. Connect the motor cable to the drive box and reconnect the ground wires to the frame using the hardware removed in step A11 and tighten using a 3 mm Allen wrench.
 - d. Connect the motor temperature sensor wires to J-4 on the drive interface pcb (lower rear corner)
7. Working inside the evaporator chamber, use a 4 mm Allen wrench to remove the tapered spindle from the gyro shaft.
8. Using the length of new caulking cord supplied, seal around the gyro's outer clamp ring.

INSTRUCTIONS

for the
Evolution RC Motor Replacement Kit
(Catalog No. 73448)

9. Apply a drop of Loctite ® 222 to each of the two screws that were used to secure the imbalance sensor (removed in step A-9), then using a 3 mm Allen wrench, secure the imbalance sensor to the gyro.
10. Orient the lower insulating disk (triangular cutout) so that the flat side of the cutout aligns with the imbalance sensor (the slit with the temperature sensor cable positioned clockwise from the flat side). When installed, the imbalance sensor cable should be completely underneath the disk, and the disk should be fully seated on the gyro.
11. Orient the thin upper insulating disk, smooth side up, then install the disk on the gyro while drawing the cable up through the slit. Properly installed, the upper insulating disk will be tight against the lower disk with slits aligned.
12. To the underside of the gyro boot, in the outer groove that runs inside the lip of the large disk portion, apply a continuous bead of RTV adhesive (catalog no. 65664, supplied).
13. Place RTV adhesive under the temperature sensor where the cable passes through the boot.

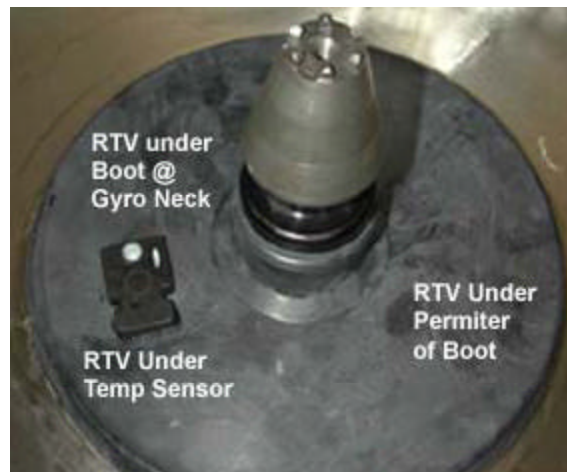


Figure 9

14. Aligning the temperature sensor with the slots in the insulation, slide the gyro boot onto the gyro until the mouth of the boot is below the rib that runs around the top of the gyro housing.

INSTRUCTIONS

for the Evolution RC Motor Replacement Kit (Catalog No. 73448)

15. Tuck the temperature sensor cable in under the gyro boot, then work the lip of the boot onto the rim of the evaporator chamber. Make sure the evaporator rim is fully engaged all the way around the boot to ensure that the RTV adhesive will create a proper seal.
16. Grasp the neck of the gyro boot and push it downward to fully expose the rib that runs around the top of the gyro housing. Apply a continuous bead of the RTV adhesive around the gyro housing, just below the rib, then work the mouth of the boot back upward until its annular groove (just inside the mouth of the boot) fully engages the rib on the gyro housing to create a proper seal. Wipe any excess adhesive from the boot and gyro housing, making sure that none gets on the gyro shaft.
17. Slide the slinger (removed in step C6) onto the gyro shaft so that it seats on the shoulder on the shaft, then using a 2 mm Allen wrench, tighten both screws to secure the slinger to the gyro shaft.
18. Apply a drop of Loctite ® 222 to the tapered spindle screw, then using a 4mm Allen wrench, reinstall and securely tighten the tapered spindle on the gyro shaft.

Note:

Insure that the slinger is not rubbing on any part of the gyro. If so, loosen the slinger, slide the slinger up slightly, and retighten.

F) Installing System Software:

1. Install the system software following the instructions included with the enclosed software update kit.

G) Removing the Ke Circuit Board

1. Using a 3 mm Allen wrench remove the cover from the Ke printed circuit board and also remove and discard the Ke printed circuit board.
2. Remove the I2C cable from between the Drive Interface printed circuit board and the Ke board.

Note:

The combination of the new motor and the upgraded software that is needed to run the motor the Ke board is no longer needed. Faults will be generated if the board is not removed.

H) Calibration

1. Leaving the PC connected to the centrifuge turn the centrifuge power “ON” and allow the centrifuge to boot.
2. After the centrifuge becomes active type the letter “d” on the connected computer to start the centrifuge diagnostics program.

INSTRUCTIONS

for the
Evolution RC Motor Replacement Kit
(Catalog No. 73448)

3. From the main diagnostics menu select “s” for the Service Menus.

MAIN MENU

- c) configuration
 - d) diagnostic tests
 - s) Service Menu(s)
 - i) I2C Diagnostics
 - a) exit menus (start application)
 - e) exit application
-

your choice: s

Figure 10

4. Select “n” (Ke Board Not Present). This will remove the Ke board from the software.

SERVICE MENU

Ke-Board is not installed

- p) KE Board Present
 - n) KE Board not Present
 - k) Read and Store Ke Value
 - r) Read and Store Ke Adjustment Ratio
 - m) Machine Temp Gain and Offset
 - d) Display Temp Sensor Data
 - a) Accelerometer menu
 - c) Compressor Selection
 - l) Calibrate LCD Touch Panel
 - b) back to Main
-

your choice: n

Figure 11

Note:

On centrifuges that contain the Advanced Features (LCD) option the short interconnecting cable that interfaces with the computer must be removed and stowed. Failure to do so will cause the LCD option to not function.

5. Calibrate the imbalance as outlined in the Evolution RC Service Manual.
6. After the imbalance is calibrated disconnect the computer and install all of the centrifuge panels.

INSTRUCTIONS

for the
Evolution RC Software Upgrade Kit
(Catalog No. 73339)

Parts Included

Quantity	Part #	Description
1 ea		Evolution RC Software Update Disk
1 ea	73344	Installation Instructions



Warning:

This kit provides operating system software to be installed on the SORVALL® Evolution™ RC Centrifuge. In the process, files will be downloaded to centrifuge memory. Follow the procedure provided exactly and in its entirety. Failure to do so can cause the centrifuge to exhibit problems, or render it inoperable. These instructions assume the installer is familiar with using a computer running an MS Windows® operating system.

Note:

On centrifuges that use the Advanced Features Option (LCD Touch Screen) skip step #3 and resume on step #4.

Note:

Connecting the Null Modem Interface cable will cause the LCD Touch Screen to become inactive with no display.

Tools and Other Items Required

- 3mm Allen Wrench
- Null Modem Cable (73827)
- Computer (Windows 98 or higher)

Instructions

a. Software Installation

1. Set the centrifuge main POWER switch to the OFF (O) position.
2. From the behind the control console, use a 3 mm Allen wrench to remove the four screws (one from each corner) that secure the bezel in position on the control panel, and remove the bezel.
3. Locate the interface ribbon cable, marked 73389, that is stowed inside the top of the control console, behind the control panel SPEED display. Draw the loose end of the ribbon cable forward, then plug one end of the null modem cable into the ribbon cable connector.
4. On centrifuges that have the Advanced Features Option (LCD Touch Screen), connect the Null Modem Interface Cable (73389) (located in a cable clamp attached to the bottom interior of the control console) to the pigtail cable that is attached to the PC-104 processor.
5. Connect the other end of the null modem cable to the laptop computer serial port.

INSTRUCTIONS

for the Evolution RC Software Upgrade Kit (Catalog No. 73339)

6. Turn the laptop computer ON, wait for the start-up routine to finish so that the desktop appears, then insert the *Evolution™ RC System Software* disk (supplied) into the computer's disk drive.
7. Locate and open the disk drive on the computer desktop to access the files on the disk, then double-click on the “**Evolution Diagnostics**” file. This will launch HyperTerminal at a baud rate of 9600 and enable the computer to connect to the centrifuge.
8. If the “**Evolution Diag**” or “**Evolution Download**” Hyperterminal icons are not present on the Evolution RC software update disk open the Hyperterminal program and set the following parameters for each window.

Evolution Diag:

Bits per second: 9600
Data Bits: 8
Parity: none
Stop bits: 1
Flow control: Hardware

Note:

On centrifuges that use software revision #41 (or higher) skip steps 9 Through 12 and resume at step #13.

Evolution Download:

Bits per second: 57600
Data Bits: 8
Parity: none
Stop bits: 1
Flow control: Hardware

9. Set the centrifuge main POWER switch to the ON (I) position, place your fingers in a ready position over the computer “**Ctrl**” and “**C**” keys, and watch the computer screen as the centrifuge goes into its start-up routine. Text will scroll upward and, shortly after “**C:\>ECHO OFF**” appears, “**C:\>evol**” will appear. Immediately after “**C:\>evol**” appears, interrupt the start up routine by pressing the “**Ctrl**” and “**c**” keys simultaneously.

INSTRUCTIONS

for the
Evolution RC Software Upgrade Kit
(Catalog No. 73339)

```
HOT cable detected, Serial Loader starting.  
Press ESC to abort Hard disk boot  
Booting Hard Drive  
Loading...  
DR DOS Release #  
Copyright (c) year. All rights reserved.  
C:\>ECHO ON  
C:\>evol
```

Figure 1

10. Type “**Y**” and the “**c:\>**” prompt will appear. If this process does not work and values appear in the centrifuge displays, “**Ctrl**” and “**c**” were not pressed in time to interrupt start-up, set the centrifuge main POWER switch to the OFF (O) position, then go back to step 9.
11. Delete the Autoexec.bat file by typing “**erase autoexec.bat**”, then press the “**ENTER**” (return) key. A new autoexec.bat file will be downloaded later.
12. Set the centrifuge main POWER switch to the OFF (O) position, then turn it back ON (I); the computer will show the centrifuge start-up process, then will stop scrolling and prompt to enter the date. Press the “**ENTER**” key twice, the first time to bypass the “**Enter date**” prompt, then a second time to bypass the “**Enter time**” prompt.

```
HOT cable detected, Serial Loader starting.  
Press ESC to abort Hard disk boot  
Booting Hard Drive  
Loading...  
DR DOS Release #  
Copyright (c) year. All rights reserved.  
Date: Sat 3-17-2001  
Enter date (mm-dd-yy):  
Time: 4:00:54.87  
Enter time:
```

Figure 2

13. On centrifuges using software revision #41 (or higher) type “**T**” on the connected PC after the centrifuge has booted. This will cause the centrifuge display to change to “**PLEASE WAIT**” and the “**c:\>**” will be displayed on the PC screen.

INSTRUCTIONS

for the Evolution RC Software Upgrade Kit (Catalog No. 73339)

Note:

Deleting the remaining system files will insure that no conflicts occur when downloading the new system files.



Warning:

Erase only the files that are listed in steps #14 & #15. Erasing files other than the files that are listed can cause the file transfer process to not operate properly and will render the centrifuge inoperable.

14. Delete the Autoexec.bat file by typing “**erase autoexec.bat**”, then press the “**ENTER**” (return) key. A new autoexec.bat file will be downloaded later.

15. Delete the remaining system files following the procedure that is outlined in step 14.

evol.exe
faults.txt
rotors50
rotors60
egavga.bgi
enghflts.lng
English.lng
frchflts.lng
French.lng
German.lng
grmnflts.lng
Spanish.lng
Spnhflts.lng
Lcdfile
Password

16. At the “**C:\>**” prompt that appears, type “**msk315m**” then press the “**Enter**” key. This will run a program that is required to change the centrifuge baud rate from 9,600 to 57,600. When finished, text will stop scrolling up on the screen and garbled text/characters will be at the bottom of the screen.

17. Quit HyperTerminal. A dialog box will appear to ask if you “**are sure you want to disconnect now**”, click “**YES**” to quit.

18. Double-click on the “**Evolution Download**” file located in the “**disk drive**” window. This will connect HyperTerminal at a 57,600 baud rate.

19. Download the “**autoexec.bat**” file. From the toolbar, click “**Transfer**” then “**Send File**”. In the filename dialog box that appears, type “**D:\autoexec.bat**” and make sure the “**KERMIT**” protocol is selected in the lower box, then click “**SEND**”. The file will be downloaded from the disk to the centrifuge.

INSTRUCTIONS

for the
Evolution RC Software Upgrade Kit
(Catalog No. 73339)

20. Repeat the process for the following files.

evol.exe
faults.txt
rotors50
rotors60
egavga.bgi
enghflts.lng
English.lng
frchflts.lng
French.lng
German.lng
grmnflts.lng
Spanish.lng
Spnhflts.lng
Lcdfile
Password

Note:

The example in step #18 uses the “D:\” drive. If the software update disk is located in another drive that drive should be referenced. For example “A:\autoexec.bat”.

21. After all required files have been downloaded, quit HyperTerminal. A dialog box will appear and ask if you “are you sure that you want to disconnect now?“, click “YES” to quit.

b. System Configuration

1. Double-click on the “Evolution Diagnostics” file. This will reconnect HyperTerminal at a 9600 baud rate.
2. Set the centrifuge main POWER switch to the OFF (O) position, then turn it back ON (I); The centrifuge should boot up normally.
3. Using the connected computer type the letter “d” to enter the system diagnostics.
4. At the main diagnostic screen select “configuration” by typing the letter “c”.

INSTRUCTIONS

for the
Evolution RC Software Upgrade Kit
(Catalog No. 73339)

MAIN MENU

- c) configuration
 - d) diagnostic tests
 - s) Service Menu(s)
 - a) exit menus (start application)
 - e) exit application
-

your choice: c

Figure 3

5. At the configuration menu select “**panel**” by typing the letter “**p**”.

SYSTEM CONFIGURATION MENU

- p) panel
 - m) miscellaneous configuration
 - b) back to main menu
-

your choice: p

Figure 4

6. At the panel configuration screen select “**LCD present**” by typing the letter “**i**” if the centrifuge has a LCD Touch Screen. Select “**LCD NOT present**” by typing the letter “**n**” if the centrifuge does not have the LCD Touch Screen.

CURRENT PANEL CONFIGURATION

current state: NVRAM: knobs = 1
NVRAM: LCD = 0
NVRAM: KeBoard = 1
NVRAM: KeValue = 9.400
NVRAM: KeGain = 1.250
NVRAM: Temp. gain = 0.0000000 Temp. offset = 0.0000000
NVRAM: Sensor Slope = -0.0133040 Sensor offset = 0.6832100
NVRAM: Compressor Type = 60 Hertz
knob panel
k) knob panel
b) button panel
l) LCD present
n) LCD NOT present
e) exit panel configuration

your choice: n

Figure 5

INSTRUCTIONS

for the
Evolution RC Software Upgrade Kit
(Catalog No. 73339)

7. Select “**exit panel configuration**” by typing the letter “**e**”.

CURRENT PANEL CONFIGURATION

current state: NVRAM: knobs = 1
NVRAM: LCD = 0
NVRAM: KeBoard = 1
NVRAM: KeValue = 9.400
NVRAM: KeGain = 1.250
NVRAM: Temp. gain = 0.0000000 Temp. offset = 0.0000000
NVRAM: Sensor Slope = -0.0133040 Sensor offset = 0.6832100
NVRAM: Compressor Type = 60 Hertz
knob panel
k) knob panel
b) button panel
l) LCD present
n) LCD NOT present
e) exit panel configuration

your choice: e

Figure 6

8. Select “**back to main menu**” by typing the letter “**b**”.

SYSTEM CONFIGURATION MENU

p) panel
m) miscellaneous configuration
b) back to main menu

your choice: b

Figure 7

9. Select “**service menu(s)**” by typing the letter “**s**”.

MAIN MENU

c) configuration
d) diagnostic tests
s) Service Menu(s)
a) exit menus (start application)
e) exit application

your choice: s

Figure 8

INSTRUCTIONS

for the
Evolution RC Software Upgrade Kit
(Catalog No. 73339)

Note:

If you are unsure as to whether the centrifuge contains a KE Board remove the centrifuge lower front panel and look for the KE Board that should be located on the lower right side of the centrifuge frame (behind the autotransformer).

10. On centrifuges with serial numbers 10300735 and below select **“KE Board Present”** by typing the letter **“p”**. On centrifuges with serial numbers 10300736 and above or on older centrifuges that have had the motor upgraded to the Servo Magnetics motor select **“KE Board Not Present”** by typing the letter **“n”**.

SERVICE MENU
Ke-Board is installed

- p) KE Board Present
 - n) KE Board not Present
 - k) Read and Store Ke Value
 - r) Read and Store Ke Adjustment Ratio
 - m) Machine Temp Gain and Offset
 - d) Display Temp Sensor Data
 - a) Accelerometer menu
 - c) Compressor Selection
 - l) Calibrate LCD Touch Panel
 - b) back to Main
-

your choice: p

Figure 9

11. Select **“Read and Store Ke Adjustment Ratio”** by typing the letter **“r”**. The computer will display the current adjustment ratio (1.325 for software revision #37 or 1.250 for software revision #41 or higher). Enter the value **“1.250”** to correspond with the new software revision. Entering the wrong Ke adjustment ratio will result in poor centrifuge performance.

INSTRUCTIONS

for the
Evolution RC Software Upgrade Kit
(Catalog No. 73339)

SERVICE MENU
Ke-Board is installed

- p) KE Board Present
 - n) KE Board not Present
 - k) Read and Store Ke Value
 - r) Read and Store Ke Adjustment Ratio
 - m) Machine Temp Gain and Offset
 - d) Display Temp Sensor Data
 - a) Accelerometer menu
 - c) Compressor Selection
 - l) Calibrate LCD Touch Panel
 - b) back to Main
-

your choice: r
read and store Adjustment Ratio value
KE Adjustment Ratio value read is 1.250
Enter new value
b) back to menu
1.250
Completed

Figure 10

12. Select **“Compressor Selection”** by typing the letter **“c”**.

SERVICE MENU
Ke-Board is installed

- p) KE Board Present
 - n) KE Board not Present
 - k) Read and Store Ke Value
 - r) Read and Store Ke Adjustment Ratio
 - m) Machine Temp Gain and Offset
 - d) Display Temp Sensor Data
 - a) Accelerometer menu
 - c) Compressor Selection
 - l) Calibrate LCD Touch Panel
 - b) back to Main
-

your choice: c

Figure 11

13. Select **“60 Hertz”** by typing numeral **“1”** if the line power of the installed centrifuge is 60 Hz. Select **“50 Hertz”** by typing the numeral **“2”** if the line power of the installed centrifuge is 50 Hz.

INSTRUCTIONS

for the
Evolution RC Software Upgrade Kit
(Catalog No. 73339)

CURRENT Compressor CONFIGURATION

60 Hertz

- 1) 60 Hertz
 - 2) 50 Hertz
 - 3) 50 Hertz single phase
 - 4) 50 Hertz polyphase
 - b) back to menu
-

your choice: 1

Figure 12

14. Select “**back to menu**” by typing the letter “**b**” to return to the main menu.

SERVICE MENU

Ke-Board is installed

- p) KE Board Present
 - n) KE Board not Present
 - k) Read and Store Ke Value
 - r) Read and Store Ke Adjustment Ratio
 - m) Machine Temp Gain and Offset
 - d) Display Temp Sensor Data
 - a) Accelerometer menu
 - c) Compressor Selection
 - l) Calibrate LCD Touch Panel
 - b) back to Main
-

your choice: b

Figure 13

15. Set the centrifuge main POWER switch to the OFF (O) position, then turn it back ON (I); the centrifuge will now start up normally (during start-up, the new software revision (**REL**) number will momentarily appear in the Temperature display). No calibrations are required the preexisting Ke value and imbalance calibration remain in memory.
16. Open the chamber door, install a rotor, then verify that the instrument operates correctly.
17. If the centrifuge operates correctly, quit HyperTerminal. A dialog box will appear to ask “**you are sure you want to disconnect now**”; click “**YES**” to quit.

INSTRUCTIONS

for the
Evolution RC Software Upgrade Kit
(Catalog No. 73339)

18. Set the centrifuge main POWER switch to the OFF (O) position, remove the system software disk from the computer, and shut down the computer.
19. Disconnect the modem cable from the computer, and from the centrifuge interface ribbon cable, return the ribbon cable to its original location inside the top of the control console, behind the SPEED display, positioned so that the connector pins will not contact p.c. board circuits.
20. On centrifuges with the Advanced Features Option (LCD Touch Screen) disconnect the Null Modem Interface Cable (73389) from the pigtail that is connected to the PC-104 processor and tuck the cable into the cable clamp located inside the console assembly. (Failure to disconnect the interface cable will cause the LCD Touch Screen to be disabled.)
21. Reinstall the bezel on the control console using the four screws removed in step 2, and tighten using a 3 mm Allen wrench.

INSTRUCTIONS

for the
Suction Line Replacement Kit
(Catalog No. 73456)
for the
SORVALL® Evolution™ RC Centrifuge

This kit contains items necessary for replacement of the refrigeration system suction line in a SORVALL® Evolution™ RC centrifuge. Check the two lists that follow to be sure you have received all parts and have all necessary tools before beginning this procedure.



CAUTION

This procedure should only be attempted by a qualified technician who has been trained in the proper servicing of SORVALL® Evolution™ RC centrifuges and SORVALL® centrifuge refrigeration systems. These instructions assume that the repairer has such expertise.

Parts Supplied

Quantity	Catalog Number	Description
1	–	Suction Line Assembly
1	–	Cork Tape, 3000 mm (10 ft)
1	–	Foam Tape, 3000 mm (10 ft)
1	–	Caulking Cord, 600 mm (2 ft)
2	61768	Seal, Teflon®, 7/8 inch i.d.
1	66952	Seal, Teflon®, 5/8 inch i.d.
1	–	Filter/Dryer Assembly
1	90702	Loctite® 222, 2 ml tube
1	65664	RTV Adhesive Sealant, Silicone Rubber, 82.8 ml tube

Tools and Other Items Required

Allen Wrenches, Metric: 2, 3, 4, 5, and 6 mm

Box Wrench, Metric, 10 mm

Open-end Wrenches, SAE: 7/8, 1, 1-1/8, 1-1/4 and 1-3/8 inch

Torque Wrench, 68–81 N·m (50–60 ft-lb), with SAE Open-End Wrench Ends: 1-1/4 and 1-3/8 inch

Flare Nut Wrenches, SAE: 5/8 and 11/16 inch

(continued)

Tubing Cutter, Mini (for 3/8-inch [9.5 mm] copper tubing)
Swagelok® Gap Inspection Gauge (Kendro Catalog No. 90401)
Leak-lock® Fitting Sealant
Helium Test Kit (Kendro Service-Issue)
SORVALL® Centrifuge Refrigeration Service Guide (Kendro Service-Issue)
Refrigeration Recovery/Charging Equipment
Suva® HP62 (R404A) HFC Refrigerant
Laptop Computer with serial port, running MSWindows 95® or later
Null Modem Cable, DB9 F to DB9 F (Kendro Catalog No. 73827)

Suction Line Replacement Procedure



W A R N I N G

Because of the characteristics of the samples likely to be processed in this centrifuge, biological or radioactive contamination may occur. Always be aware of this possibility, and take normal precautions. The Kendro Service Decontamination Policy states that a completed Decontamination Information Certificate is required before servicing.

Replace the suction line as follows (save all parts for reassembly unless directed otherwise):

A. Removing the Cabinet Panels

1. Open the chamber door, then turn the main power switch OFF, unplug the centrifuge, and wait four minutes before proceeding.



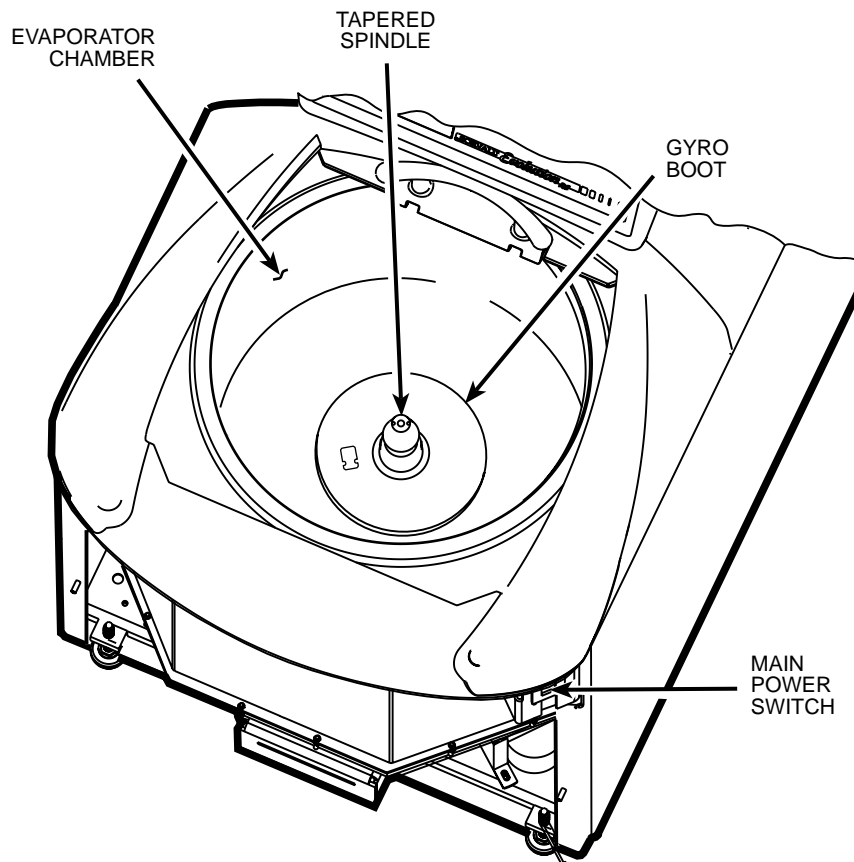
W A R N I N G

Hazardous voltages may exist whenever power is connected and circuits are energized. To eliminate potential for serious electrical shock or component damage, turn the main power switch OFF, unplug the centrifuge, then wait four minutes before proceeding.

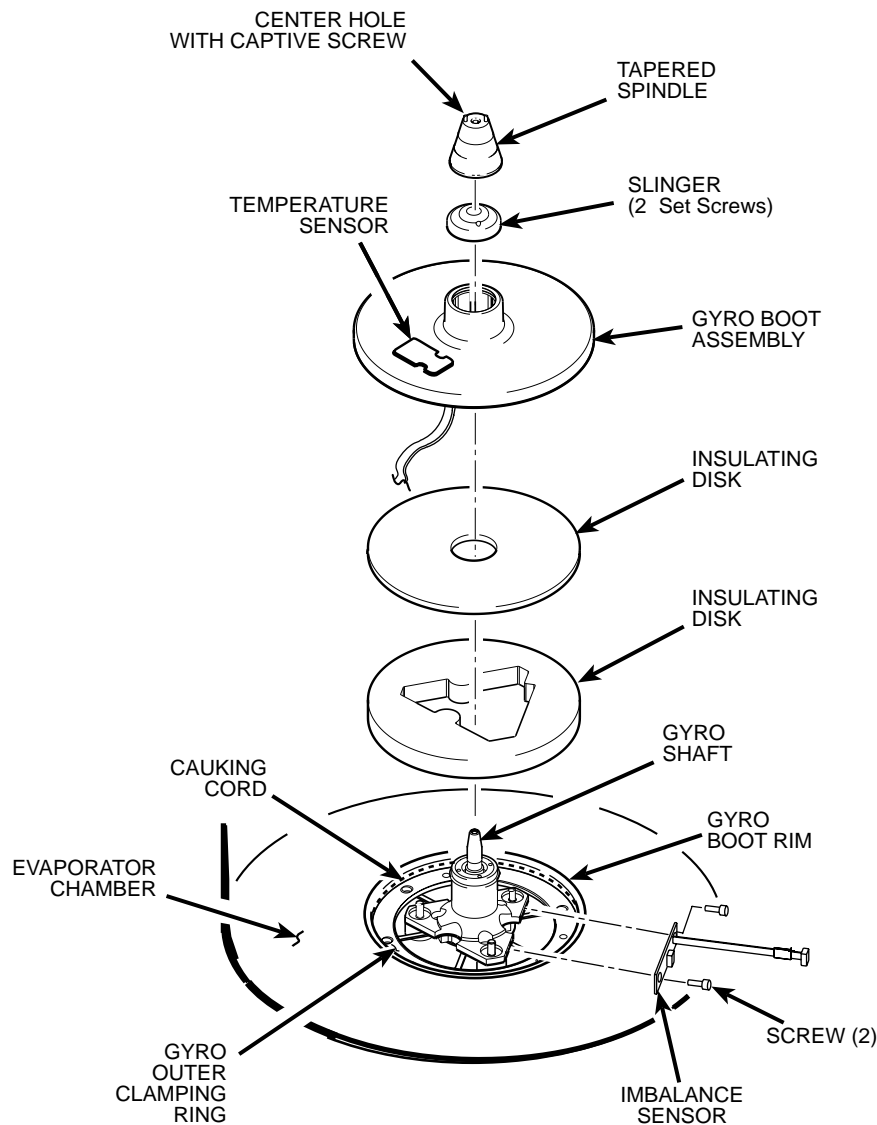
2. If the centrifuge is located so that there is no room to work behind or in front of the centrifuge, raise the front locking stabilizers and roll the centrifuge to a suitable working location.
3. Using a 4 mm Allen wrench, remove the two screws with washers from the louver area of the front panel, then remove the front panel.
4. Using a 6 mm Allen wrench, remove the two screws that secure the back of the top rear deck.
5. Using a 5 mm Allen wrench, remove the single screw from the center of the control console bracket, then remove the top rear deck.
6. Using a 3 mm Allen wrench, remove the six screws securing the rear panel, and remove the panel.
7. Using a 3 mm Allen wrench, remove the two screws that secure the drip tray between the door rails, then remove the drip tray.

B. Removing the Motor/Gyro Assembly

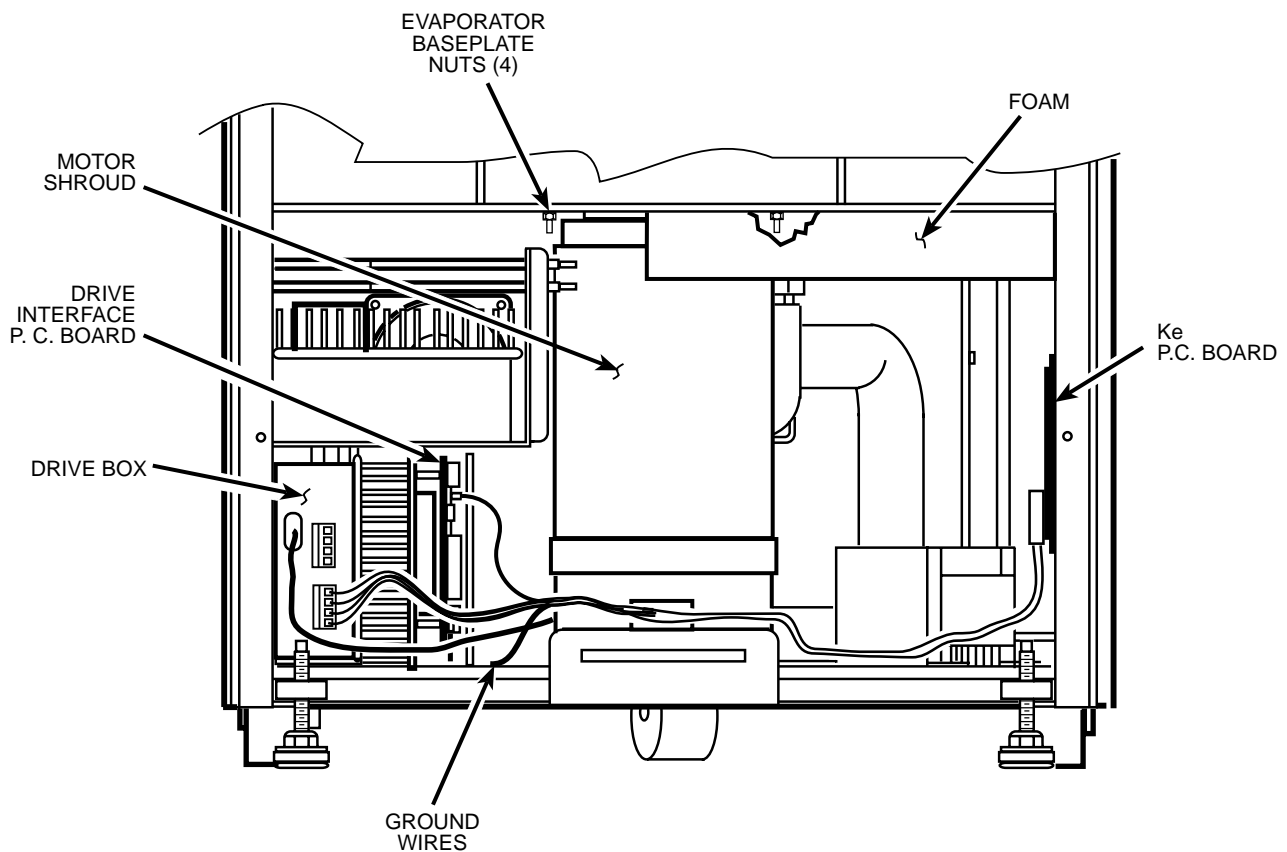
1. Working inside the evaporator chamber, using a 4 mm Allen wrench through the center hole in the tapered spindle, unscrew the captive screw, then pull the tapered spindle up and off of the gyro shaft.



2. Using a 2 mm Allen wrench, loosen the two set screws that secure the slinger to the gyro shaft, then slide the slinger up and off of the gyro shaft.
3. Remove the gyro boot (affixed with RTV adhesive): First work the circumference off of the evaporator rim, then, being careful not to stress the temperature sensor cable, pull the boot (with temperature sensor attached) straight up and off of the gyro housing.
4. Carefully, so as not to damage the gyro boot or temperature sensor cable, work to remove and discard the old RTV sealant remaining from the underside of the boot (do not remove sealant from where the sensor cable feeds through the boot), then set the boot / sensor assembly aside on the evaporator floor.
5. One at a time, pull the two insulating disks off of the gyro.
6. Remove the caulk from around the gyro's outer clamp ring. Discard the caulk.
7. Using a 3 mm Allen wrench, remove the two screws that secure the imbalance sensor to the gyro. Draw the cables from the imbalance and temperature sensors straight up, bend them toward the front of the centrifuge, and hook the cables over the evaporator rim (so that the sensors can stay in the bottom of the chamber and the two cables will be out of the way).
8. Using a 4 mm Allen wrench, reinstall the tapered spindle on the gyro shaft.



9. Working down underneath in front, disconnect all wires coming from the motor shroud:
 - a. Unplug the motor cable from the drive box and from the Ke P.C. board, and disconnect the ground wires from the frame using a 3 mm Allen wrench.
 - b. Unplug the commutation wires from the drive box.
 - c. Unplug the auxiliary tachometer wires from the drive interface P.C. board.
10. Using a 10 mm box wrench, remove the four nuts that are located up under the evaporator baseplate near the top of the motor shroud.
11. From below, feed all motor cables and connectors (disconnected in step B9 above) into the motor shroud so that they will lay loose inside the shroud on top of the motor fan.
12. From above, using the tapered spindle as a handle, lift the motor / gyro assembly up and, being careful not to crush sensor cables, temporarily set it in the evaporator chamber.

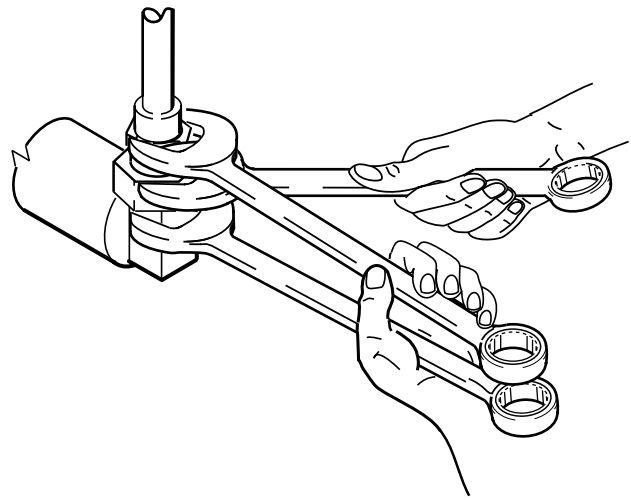
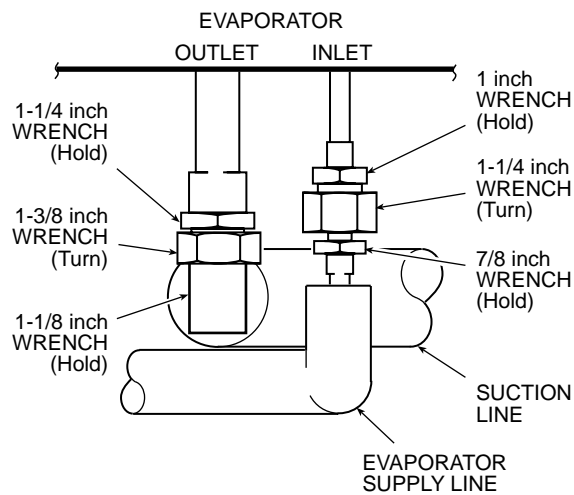


13. Pull the motor cables up into the evaporator chamber, then lift the motor/gyro assembly from the centrifuge.

C. Removing the Condenser Assembly and Suction Line

NOTE For the purposes of these instructions, "Condenser Assembly" refers to the main assembled refrigeration unit (condenser, condenser fans, compressor, interconnecting tubing with control valves and filter/dryer, capacitors, relay, refrigeration P.C. board, and baseplate). It does not refer to remaining refrigeration system components such as the suction line or evaporator.

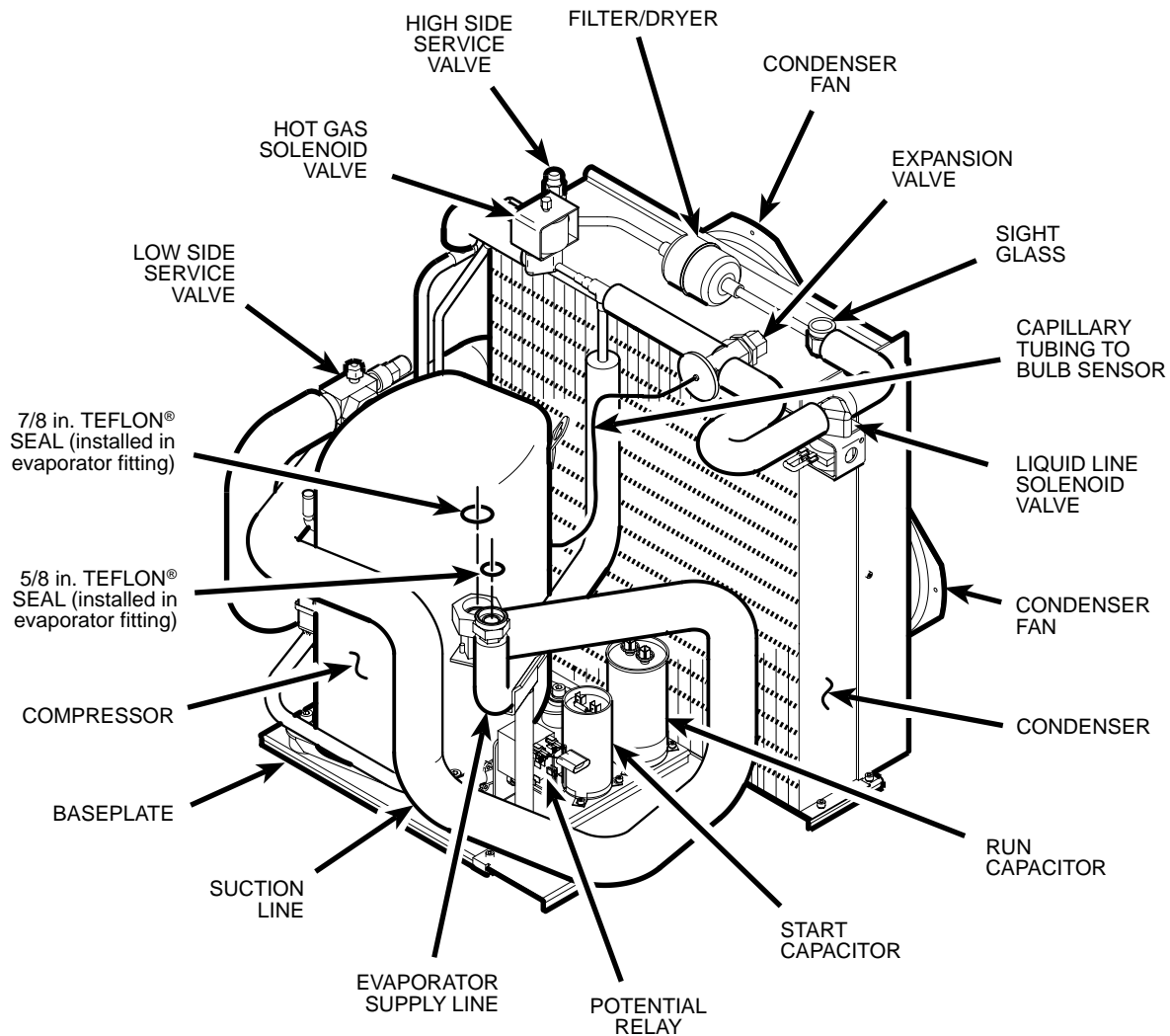
1. From below, unplug the two wires from the motor fan, then using a 4 mm Allen wrench, remove the two screws securing the motor fan mounting brackets to the centrifuge frame baseplate. Remove the motor fan/shroud assembly.
2. Remove insulating tape as required to access the two refrigeration system service valves (see illustration on page 7 for valve locations), then connect refrigeration equipment and recover the refrigerant (Suva® HP62 [R404A]).
3. Remove insulating tape from the two evaporator fittings. Using three SAE open-end wrenches (top to bottom, 1, 1-1/4, and 7/8 inch) so that the two stationary fittings and connected tubing will not be twisted as the Rotalock® nut turns, disconnect the evaporator supply line from the evaporator fitting (see illustration on next page). Plug the end of both the supply line and the evaporator intake to seal them (to minimize moisture contamination).



4. Using three larger SAE open-end wrenches (top to bottom, 1-1/4, 1-3/8, and 1-1/8 inch), disconnect the suction line, then plug both the end of the evaporator output and the end of the suction line.
5. Using a 4 mm Allen wrench, remove the screw securing the inside edge of the condenser assembly baseplate (the corner of the baseplate directly below the evaporator fittings).
6. Disconnect the two power wires (nos. 16 & 17) from the compressor relay (solid state relay is located on the rear wall behind the evaporator chamber, to the right as you face the rear).
7. Working behind the centrifuge, disconnect all wires/cables that connect to the condenser assembly: unplug the fan harness connector, the hot gas solenoid (two wires, located above the condenser near the high side service valve), and the cables running to the refrigeration P.C. board.
8. Using a 4 mm Allen wrench, remove the two screws securing the back corners of the condenser assembly baseplate (one from each corner).
9. Carefully (the assembly is heavy) remove the condenser assembly with the suction line attached from the centrifuge; also remove the round rubber cushioning pads that were positioned underneath the condenser assembly baseplate.
10. Remove any remaining insulating tape from the Rotalock® fitting where the suction line connects to the compressor (at the low side service valve), then on the horizontal section of suction line below the fitting, cut and peel back the insulation where the expansion valve bulb sensor is attached.
11. Note the position of the expansion valve bulb sensor on the suction line (for reassembly), then remove the bulb sensor from the suction line (leave the thermocouple sensor attached to the suction line).
12. Note the position of the suction line relative to the condenser assembly (for reassembly), then using the three larger SAE open-end wrenches, remove the suction line from the compressor and discard.

D. Installing the New Suction Line Assembly

1. Remove and discard the Teflon® seal from the mating edge of the compressor's suction line fitting. Install a new 7/8-inch seal (catalog no. 61768, supplied) into the end of the compressor fitting, then apply Leak Lock® sealant to the fitting.

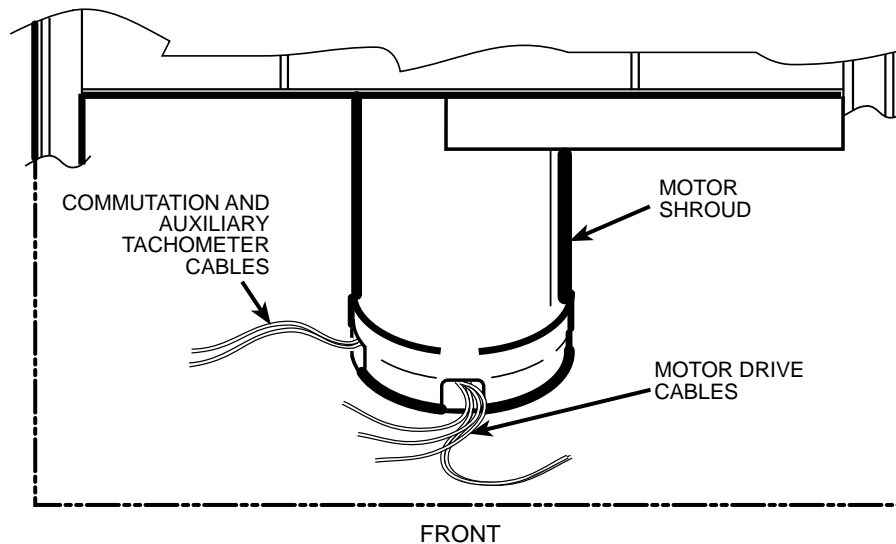


2. Remove the plug from the end of the new suction line (supplied) that attaches to the compressor fitting (do not remove the plug from the other end), then while holding the suction line in position, thread the suction line Rotalock® nut onto the compressor fitting. Again using three wrenches to avoid damage (1-1/4, 1-3/8, and 1-1/8 inch), but this time with the middle wrench being a torque wrench with an open-end adapter, tighten the Rotalock® nut to 68 to 81 N·m (50 to 60 ft·lb).
3. Install the expansion valve bulb on the new suction line. Use insulating tape (supplied) to seal the insulation where the expansion valve capillary tubing and the thermocouple sensor wires exit the suction line insulation.
4. Remove and discard the original filter/dryer. If Swagelok® fittings are not on either side of the original filter/dryer, use a mini tubing cutter to cleanly cut the filter/dryer from the system: Cut the tubing at 82.5 mm (3.25 inches) from the center of the filter/dryer (the filter/dryer housing has a center rib; distance from the center of the filter/dryer applies in either direction, for both cuts).
5. Install the new filter/dryer assembly (supplied), making sure that the flow arrows on the filter/dryer housing point toward the sight glass. Using flare nut wrenches and a Swagelok® gap inspection gauge, follow standard procedures for Swagelok® fittings to ensure proper sealing.
6. Working inside the centrifuge underneath the center plate, remove and discard the Teflon® seal from the mating edge of both evaporator fittings. Insert a new Teflon® seal (catalog nos. 61768 and 66952, supplied) into the end of each evaporator fitting, then apply Leak Lock® sealant to both fittings.

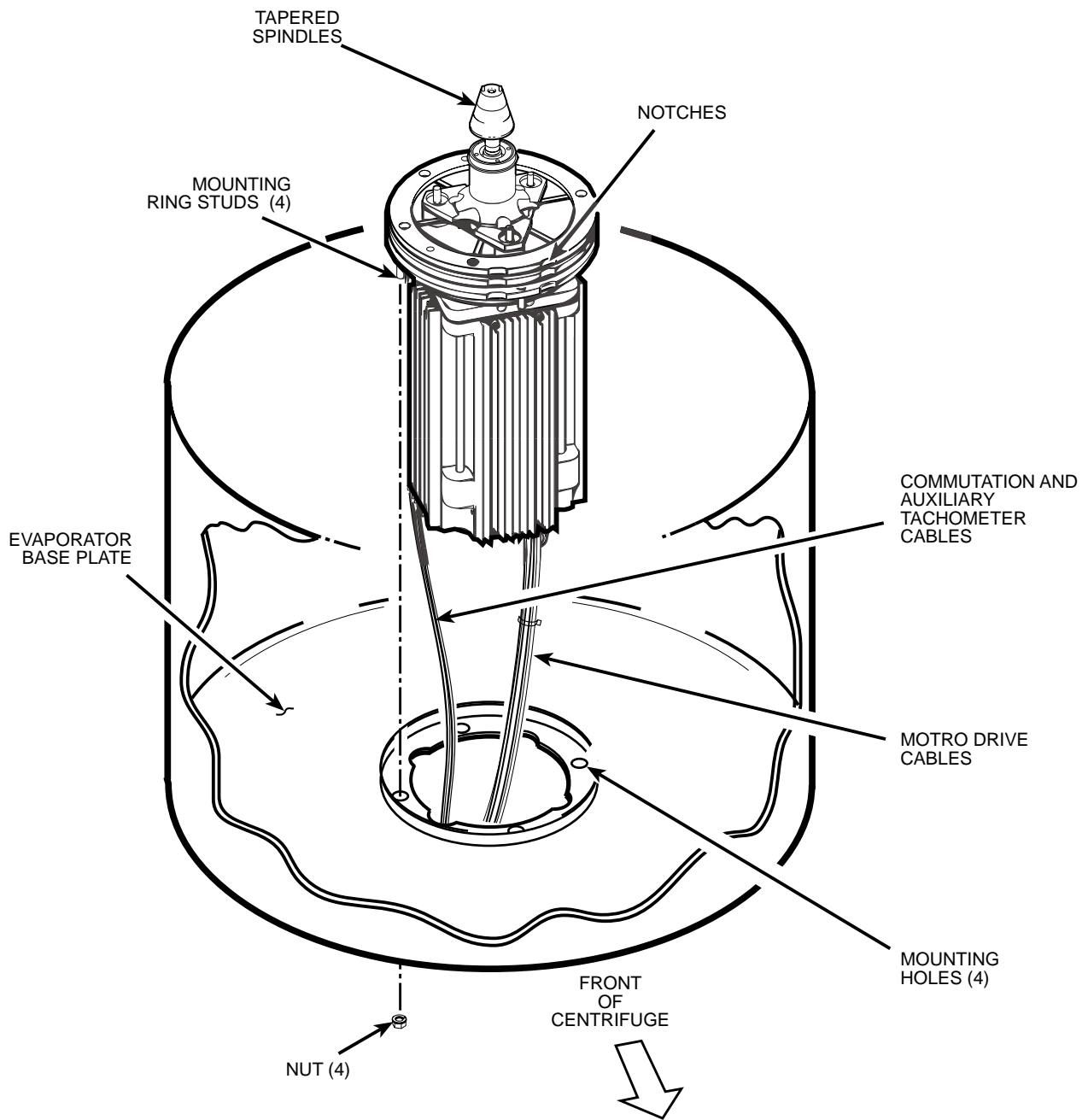
7. Slide the condenser assembly back into position inside the centrifuge frame, installing the round rubber cushioning pads (removed in step C9) underneath the assembly baseplate. Using a 4 mm Allen wrench, secure the condenser assembly in place using hardware removed in steps C5 and C8.
8. Being careful not to dislodge the Teflon® seals, remove the plugs from the two evaporator fittings.
9. Remove the plug from the end of the suction line, then thread the Rotalock® nut onto the larger evaporator fitting. Using the same three wrenches used in step D2 earlier, tighten the suction line Rotalock® nut to 68 to 81 N·m (50 to 60 ft-lb).
10. Remove the plug from the end of the evaporator supply line, then thread the Rotalock® nut onto the smaller evaporator fitting. Using three smaller wrenches (again with the middle being a torque wrench, top to bottom, 1, 1-1/4, and 7/8 inch), tighten the evaporator supply line Rotalock® nut to 68 to 81 N·m (50 to 60 ft-lb).
11. Using helium, pressurize the refrigeration system through both service valves, then check for leaks by applying liquid soap at each of the five fittings and watching for bubbles. If a leak is detected, using appropriate wrenches to avoid damage, tighten the fitting enough to seal.
12. If no leaks are detected, configure refrigeration equipment for evacuation, then release the helium and evacuate the system. Continue with the procedure while the system is being evacuated, checking the vacuum level from time to time. Once the vacuum reading gets to 29 inches Hg (1.2 kPa) or greater, note the time – then continue to evacuate the system for a minimum of one hour from that point.
13. Wipe the liquid soap from the filter / dryer fittings and refrigeration lines, as well as from the top of the condenser (if any dripped).
14. Wipe the liquid soap from the two evaporator fittings and refrigeration lines, from the connection at other end of the suction line, as well as from the frame baseplate, then insulate the three fittings using the tape supplied (apply the cork tape first, then use the foam tape to cover it).
15. Reconnect the two power wires (nos. 16 & 17, disconnected in step C6) to the compressor relay, then behind the centrifuge, reconnect all condenser assembly wires / cables (disconnected in step C7).
16. Reinstall the motor fan/shroud assembly (removed in step C1) and secure it in place using a 4 mm Allen wrench. Reconnect the motor fan wires.

E. Installing the Motor/Gyro Assembly

1. Remove any RTV sealant remaining on the rim of the opening in the bottom of the evaporator.
2. Apply a drop of Loctite® 222 to each of the four studs on the bottom of the mounting ring, then transport the motor / gyro assembly to the centrifuge and, being careful not to crush sensor cables, temporarily set it down inside the evaporator chamber.
3. Tape the auxiliary tachometer cable to the commutation cable (tape is temporary, to aid routing), then feed the motor cables down through the motor shroud; route the motor drive cable out the hole in the front, and route commutation and auxiliary tachometer cables out the hole on the left side.



4. Using the tapered spindle as a handle, orient the motor /gyro assembly so that the two notches in the outside edge of the gyro assembly face toward the front of the centrifuge, then lower the motor /gyro assembly into its correct position (being careful not to pinch the sensor wires) so that the four studs in the mounting ring engage the four holes in the evaporator baseplate (see illustration on next page).
5. Working down underneath in front, thread the four nuts (removed in step B10) onto the four mounting ring studs (located up on the evaporator baseplate near the top of the motor shroud), and tighten each nut securely using a 10 mm box wrench.
6. Connect all wires coming from the motor shroud:
 - a. Separate the auxiliary tachometer cable from the commutation cable by removing the tape applied in step E3, then connect the auxiliary tachometer wires to the drive interface P.C. board.
 - b. Connect the commutation wires to the drive box.
 - c. Connect the motor cable to the drive box and to the Ke P.C. board, and reconnect the ground wires to the frame using the hardware removed in step B9 and tighten using a 3 mm Allen wrench.
7. Working inside the evaporator chamber, use a 4 mm Allen wrench to remove the tapered spindle from the gyro shaft.
8. Using the length of new caulking cord supplied, seal around the gyro's outer clamp ring.
9. Apply a drop of Loctite® 222 to each of the two screws that were used to secure the imbalance sensor (removed in step B7), then using a 3 mm Allen wrench, secure the imbalance sensor to the gyro.
10. Orient the lower insulating disk (with triangular cutout) so that the flat side of the cutout aligns with the imbalance sensor. When installed, the imbalance sensor cable should be completely underneath the disk, and the disk should be fully seated on the gyro.
11. Orient the thin upper insulating disk smooth side up, then install the disk on the gyro so that it seats flush against the lower disk.
12. Apply a continuous bead of RTV adhesive around the underside of the gyro boot, in the outer groove that runs just inside the lip of the large disk portion.



13. Orient the gyro boot above the gyro so that the temperature sensor cable is not twisted and so that the sensor is aligned with where the sensor cable feeds down past the gyro, then slide the gyro boot onto the gyro until the mouth of the boot is below the rib that runs around the top of the gyro housing.
14. Bundle and tuck the temperature sensor cable in under the gyro boot, then work the lip of the boot onto the rim of the evaporator chamber. Make sure the evaporator rim is fully engaged all the way around the boot to ensure that the RTV adhesive will create a proper seal.
15. Grasp the neck of the gyro boot and push it downward to fully expose the rib that runs around the top of the gyro housing. Apply a continuous bead of RTV adhesive around the gyro housing, just below the rib, then work the mouth of the boot back upward until its annular groove (just inside the mouth of the boot) fully engages the rib on the gyro housing to create a proper seal. Wipe any excess adhesive from the boot and gyro housing, making sure that none gets on the gyro shaft.

16. Slide the slinger (removed in step B2) down onto the gyro shaft until it seats, then slide it back upward just a small amount to ensure that it isn't touching the gyro boot. Using a 2 mm Allen wrench, tighten both screws to secure the slinger to the gyro shaft.
17. Apply a drop of Loctite® 222 to the tapered spindle screw, then using a 4 mm Allen wrench, reinstall and securely tighten the tapered spindle on the gyro shaft.
18. Insert the top of the front panel underneath the top deck and set it in position on the two pins on the front of the centrifuge, then reinstall the two screws with washers (removed in step A3) and, using a 4 mm Allen wrench, tighten the two screws to secure the panel.

F. Charging the Refrigeration System and Checking Performance

1. After the refrigeration system vacuum level has been at 29 inches Hg (1.2 kPa) or greater for at least one hour, charge the refrigeration system. Refrigeration charging specifications for the Evolution™ RC are supplied below.

Evolution™ RC Refrigeration Charging Specifications

Refrigerant Type	Suva® HP62 (R404A) HFC
Initial Refrigerant Charge Weight	3.00 lbs. (1360 grams)
(during Superheat/Cond.T.D. optimization, additional liquid refrigerant will be added through low-side throttling valve)	
Specified Heat Load Rotor	SS-34
Operating Superheat Value	19°F (10.6°C)
Maximum Condenser T.D. Value	25°F (13.9°C)

2. After optimizing the refrigerant charge based on condenser T.D. and superheat, perform a test run to check centrifuge performance and temperature control (if the centrifuge was moved, be sure to use the front locking stabilizers to level the centrifuge before operation).
3. Make sure the two service valve ports are closed securely, then remove the refrigeration equipment, reinstall all service valve caps, and apply insulation tape to the low-side service valve.
4. Position the drip tray between the door rails, reinstall the two screws (removed in step A7) and, using a 3 mm Allen wrench, tighten the two screws to secure the drip tray.
5. Position the rear panel on the rear of the centrifuge frame, and using a 3 mm Allen wrench, secure the panel in place using the six screws (removed in step A6).
6. Position the top rear deck on the frame, then using a 5 mm Allen wrench, reinstall the single screw in the center of the control console bracket. Using a 6 mm Allen wrench, reinstall the two screws that secure the back of the top rear deck.
7. If the centrifuge was moved, return it to its original operating location and level it using the front locking stabilizers.

Calibrate the centrifuge imbalance following the procedure outlined in the Calibration & Software section of the Evolution RC Service Manual.

Evolution RC Temperature Sensor / Gyro Boot Replacement Kit P/N 73360

Parts Supplied

1 ea		Temperature Sensor / Gyro Boot Assembly
1 ea	65664	Black RTV Sealant
3 ft	60255	Mortite caulking

Installation Instructions

WARNING:

Because of the characteristics of the samples likely to be processed in this centrifuge, biological or radioactive contamination may occur. Always be aware of this possibility, and take normal precautions. The Kendro Service Decontamination Policy states that a completed Decontamination Information Certificate is required before servicing.

Removing the Motor/Gyro Assembly:

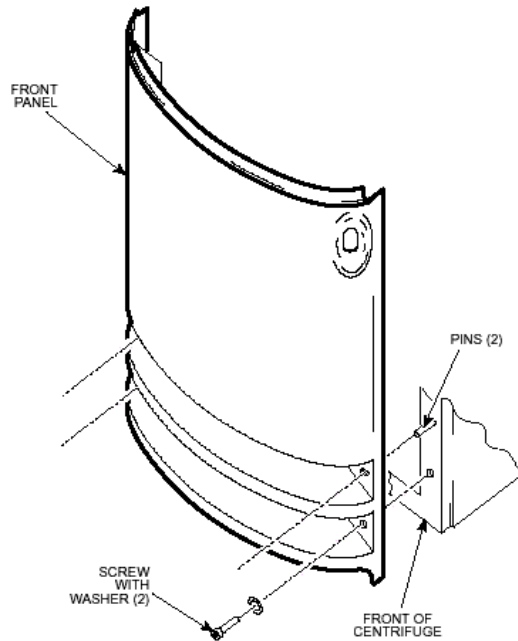
1. Open the chamber door, then turn the main power switch OFF, unplug the centrifuge, and wait four minutes before proceeding.

WARNING

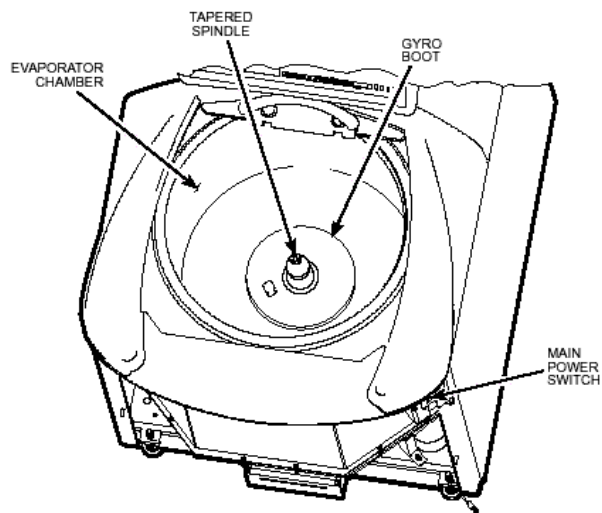
Hazardous voltages may exist whenever power is connected and circuits are energized. To eliminate potential for serious electrical shock or component damage, turn the main power switch OFF, unplug the centrifuge, then wait four minutes before proceeding.

2. If the centrifuge is located so that there is no room to work behind or in front of the centrifuge, raise the front locking stabilizers and roll the centrifuge to a suitable working location.
3. Using a 4 mm Allen wrench, remove the two screws with washers from the lower area of the front panel, then remove the front panel.

Evolution RC Temperature Sensor / Gyro Boot Replacement Kit P/N 73360



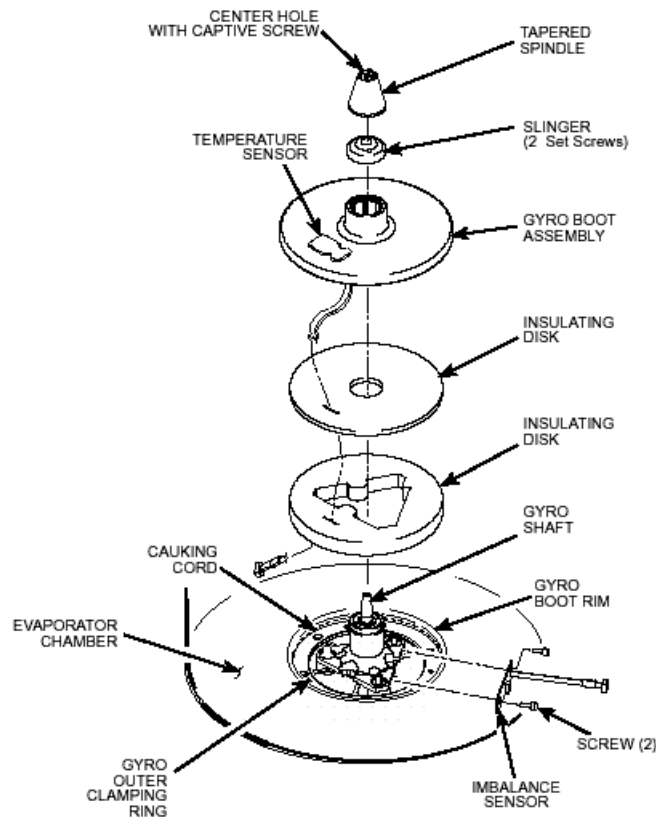
4. Working inside the evaporator chamber, using a 4 mm Allen wrench through the center hole in the tapered spindle, unscrew the captive screw, then pull the tapered spindle up and off of the gyro shaft.



5. Using a 2 mm Allen wrench, loosen the two set-screws that secure the slinger to the gyro shaft, then slide the slinger up and off of the gyro shaft.

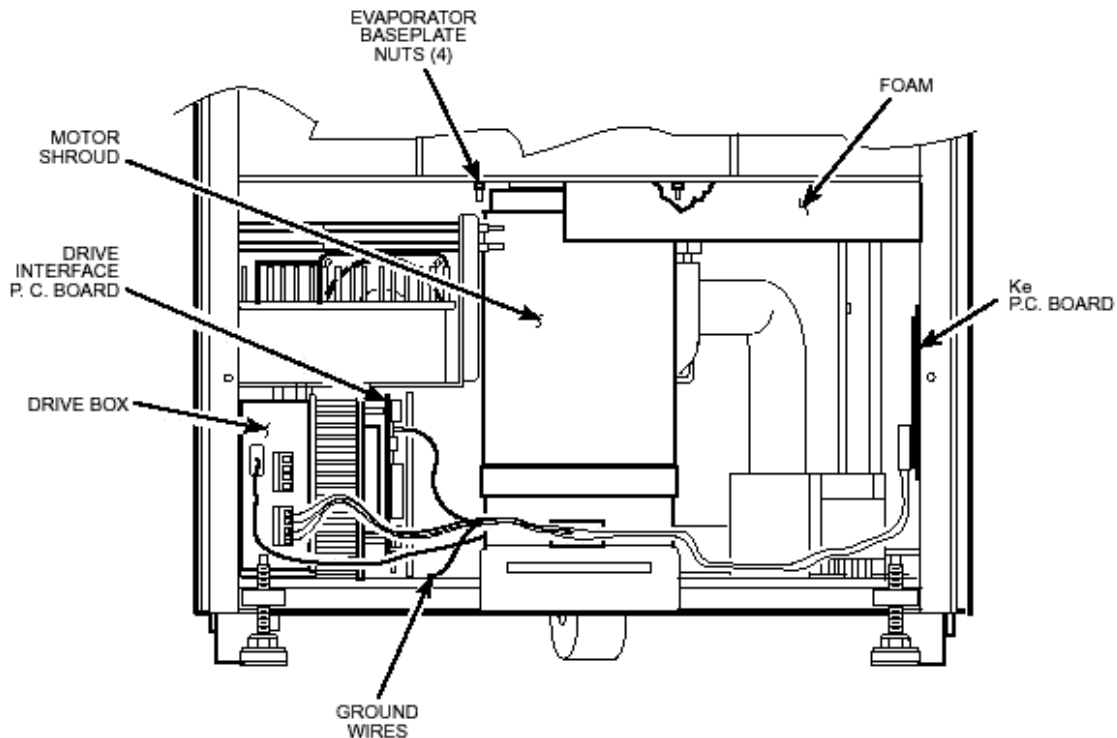
Evolution RC Temperature Sensor / Gyro Boot Replacement Kit P/N 73360

6. Remove the gyro boot (affixed with RTV adhesive): First work the circumference off of the evaporator rim, then, being careful not to stress the temperature sensor cable, pull the boot (with temperature sensor attached) straight up and off of the gyro housing. Set the boot/sensor assembly aside on the evaporator floor.
7. One at a time, pull the two insulating disks off of the gyro.
8. Remove the caulk from around the gyro's outer clamp ring. Discard the caulk.
9. Using a 3 mm Allen wrench, remove the two screws that secure the imbalance sensor to the gyro. Draw the cables from the imbalance and temperature sensors straight up, bend them toward the front of the centrifuge, and hook the cables over the evaporator rim (so that the sensors can stay in the bottom of the chamber and the two cables will be out of the way).
10. Using a 4 mm Allen wrench, reinstall the tapered spindle on the gyro shaft.



Evolution RC Temperature Sensor / Gyro Boot Replacement Kit P/N 73360

11. Working down underneath in front, disconnect all wires coming from the motor shroud:
 - A. Unplug the motor cable from the drive box and from the Ke P.C. board, and disconnect the ground wires from the frame using a 3 mm Allen wrench.
 - B. Unplug the commutation wires from the drive box.
 - C. Unplug the auxiliary tachometer wires from the drive interface P.C. board.
12. Using a 10 mm box wrench, remove the four nuts that are located up under the evaporator base-plate near the top of the motor shroud.
13. From above, using the tapered spindle as a handle, lift the motor/gyro assembly up and, being careful not to crush sensor cables, temporarily set it in the evaporator chamber.



Evolution RC

Temperature Sensor / Gyro Boot Replacement Kit

P/N 73360

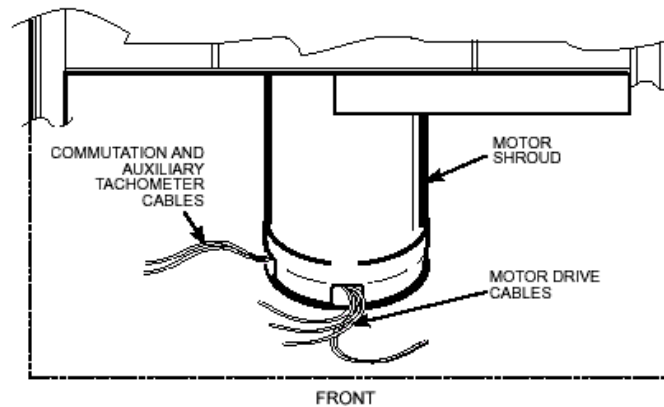
Installing the New Temperature Sensor/Gyro Boot Assembly:

1. Using a 6 mm Allen wrench, remove the two screws that secure the back of the top rear deck.
2. Using a 5 mm Allen wrench, remove the single screw from the center of the control console bracket, then remove the top rear deck.
3. Using a 3 mm Allen wrench, remove the six screws securing the rear panel, and remove the panel.
4. Locate the Temperature Interface Board located on the lower right corner of the condenser assembly. Disconnect the Temperature Sensor cable (small ribbon cable) and feed the wire toward the front of the centrifuge.
5. Remove and discard the old Temperature Sensor/Gyro Boot.
6. Place the new Temperature Sensor/Gyro Boot on the chamber floor and route the cable to the Refrigeration Interface board. Connect the cable to the board.
7. After placing the assembly in position on the chamber floor fold the cable over the lip of the chamber so that the cable is not pinched when the motor is reinstalled.

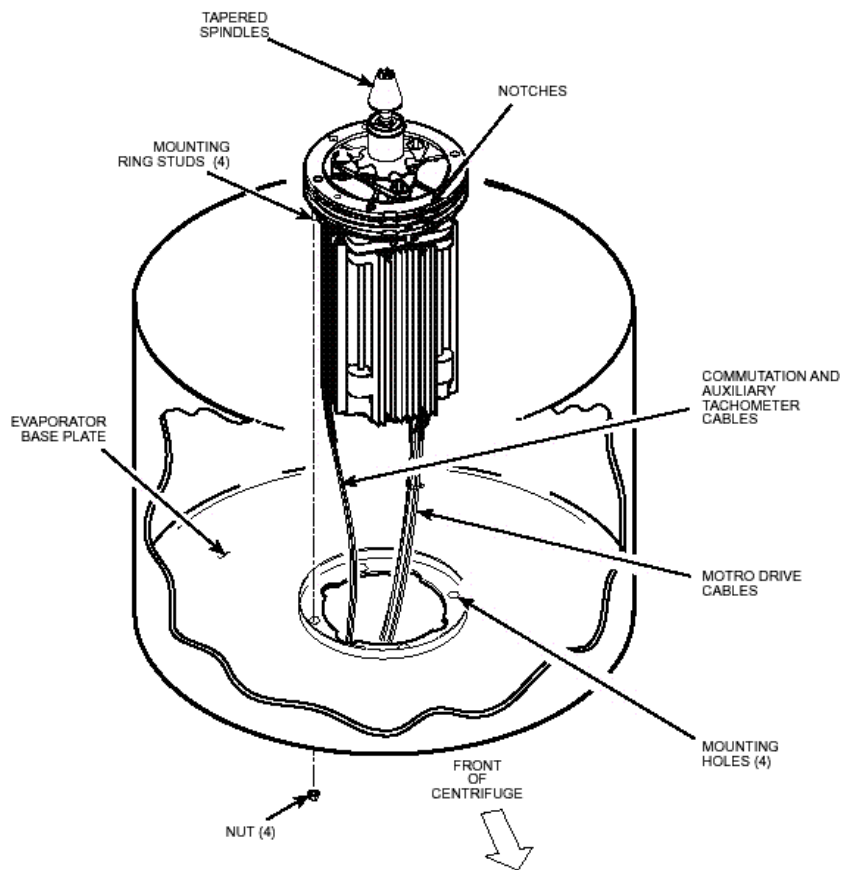
Installing the Motor/Gyro Assembly:

1. Work to remove and discard any RTV sealant remaining on the rim around the opening in the bottom of the evaporator.
2. Feed the motor cables down into the motor shroud; route the motor drive cable out the hole in the front, and route commutation and auxiliary tachometer cables out the hole on the left side.

Evolution RC Temperature Sensor / Gyro Boot Replacement Kit P/N 73360



- Using the tapered spindle as a handle, orient the motor/gyro assembly so that the two notches in the outside edge of the gyro assembly face toward the front of the centrifuge. Lower the motor/gyro assembly into its correct position (being careful not to pinch the sensor wires) so that the four studs in the mounting ring engage the four holes in the evaporator base-plate.



Evolution RC

Temperature Sensor / Gyro Boot Replacement Kit

P/N 73360

4. Working down underneath in front, thread the four nuts (removed in previous step) onto the four mounting ring studs (located up on the evaporator base-plate near the top of the motor shroud). Tighten each nut securely using a 10 mm box wrench.
5. Connect all wires coming from the motor shroud:
 - A. Connect the auxiliary tachometer wires to the drive interface P.C. board.
 - B. Connect the commutation wires to the drive box.
 - C. Connect the motor cable to the drive box and to the Ke P.C. board, and reconnect the ground wires to the frame using the hardware removed earlier and tighten using a 3 mm Allen wrench.
6. Working inside the evaporator chamber, use a 4 mm Allen wrench to remove the tapered spindle from the gyro shaft.
7. Using the length of new caulking cord supplied, seal around the gyro's outer clamp ring.
8. Apply a drop of Loctite ® 222 to each of the two screws that were used to secure the imbalance sensor removed earlier, then using a 3 mm Allen wrench, secure the imbalance sensor to the gyro.
9. Orient the lower insulating disk (triangular cutout) so that the flat side of the cutout aligns with the imbalance sensor. When installed, the imbalance sensor cable should be completely underneath the disk, and the disk should be fully seated on the gyro.
10. Orient the thin upper insulating disk smooth side up, then install the disk on the gyro.
11. To the underside of the gyro boot, in the outer groove that runs inside the lip of the large disk portion, apply a continuous bead of RTV adhesive (catalog no. 65664, supplied).
12. Aligning the temperature sensor at the 7 o'clock position with relation to the motor shaft, slide the gyro boot onto the gyro until the mouth of the boot is below the rib that runs around the top of the gyro housing.
13. Tuck the temperature sensor cable in under the gyro boot, then work the lip of the boot onto the rim of the evaporator chamber. Make sure the evaporator rim is fully engaged all the way around the boot to ensure that the RTV adhesive will create a proper seal.

Evolution RC

Temperature Sensor / Gyro Boot Replacement Kit

P/N 73360

14. Grasp the neck of the gyro boot and push it downward to fully expose the rib that runs around the top of the gyro housing. Apply a continuous bead of the RTV adhesive around the gyro housing, just below the rib, then work the mouth of the boot back upward until its annular groove (just inside the mouth of the boot) fully engages the rib on the gyro housing to create a proper seal. Wipe any excess adhesive from the boot and gyro housing, making sure that none gets on the gyro shaft.
15. Slide the slinger (removed earlier) onto the gyro shaft so that it seats on the shoulder on the shaft, then using a 2 mm Allen wrench, tighten both screws to secure the slinger to the gyro shaft.
16. Apply a drop of Loctite ® 222 to the tapered spindle screw, then using a 4 mm Allen wrench, reinstall and securely tighten the tapered spindle on the gyro shaft.
17. Insert the top of the front panel underneath the top deck and set it in position on the two pins on the front of the centrifuge, then reinstall the two screws with washers (removed earlier) and, using a 4 mm Allen wrench, tighten the two screws to secure the panel.
18. Position the rear panel on the rear of the centrifuge frame, and using a 3 mm Allen wrench, secure the panel in place using the six screws (removed earlier).
19. Position the top rear deck on the frame, then using a 5 mm Allen wrench, reinstall the single screw in the center of the control console bracket. Using a 6 mm Allen wrench, reinstall the two screws that secure the back of the top rear deck.
20. If the centrifuge was moved, return it to its original operating location and level it using the front locking stabilizers.

Calibrating Temperature:

1. No calibrations are required for the temperature circuit.

Calibrating Imbalance:

1. Calibrate the centrifuge imbalance following the procedure outlined in the Calibration & Software section of the Evolution RC™ Service Manual.

Evolution RC

Table of Contents

7.0 Calibration & Software

7.1 Low Voltage Power Supply Calibration

7.2 Motor Ke Calibration

7.3 Imbalance Calibration

7.4 Software Installation

7.5 Runlog / Faultlog Retrieval

7.6 LCD Contrast Calibration

7.7 LCD Touch Screen Calibration

Evolution RC Power Supply Calibration

1. Connect the calibration P.C. board (catalog no. 73373) to the open port on the back of the control console.
2. Reconnect power, then turn the main power switch ON.
3. Using a voltmeter, check voltage at the calibration P.C. board from one of the ground test points to one of the 5 V test points. Voltage should read 5.25 V, ± 0.05 V. *If not in range, adjust voltage as follows:*
 - A. Using a 6 mm Allen wrench, remove the two large screws at the back of the rear top deck.

WARNING:

When the rear panel is removed, hazardous voltages will exist because power is connected and circuits are energized. To reduce potential for serious electrical shock, be aware of the danger and be careful to avoid contact with hazardous circuits.

- B. Using a 3 mm Allen wrench, loosen the six small screws securing the back panel, then lift the panel up and off.
 - C. Using a small precision screwdriver, adjust the potentiometer on the power supply until voltage is in range.
 - D. Position the rear panel back on the six screws, then reinstall the two large screws at the back of the rear top deck and tighten using a 6 mm Allen wrench.
 - E. Using a 3 mm Allen wrench, tighten the six small screws securing the back panel.
4. Disconnect the voltmeter and remove the calibration P.C. board from the back of the control console.

Evolution RC Ke Calibration

Equipment required for this calibration

- 1 - Personal computer (Windows 95, 98, 2000)
- 1 - Null Modem Cable (9pin female both ends)
Kendro Part Number 73827

1. Using a 3mm Allen wrench remove the (4) socket head screws from the rear of the console assembly (1 in each corner). Remove the trim ring from the front of the control console and set aside.
2. Locate the serial interface ribbon cable hanging just above the control console. Connect a null serial modem cable between the interface cable and the serial port on the laptop computer (null modem cable Kendro #73827).
3. On centrifuges that have the Advanced Features Option (LCD Touch Screen) connect the Null Modem Interface Cable (73389) (located inside the console assembly) to the pigtail cable that is attached to the PC-104 processor. (When the Null Modem Interface Cable is connected to the centrifuge the LCD Touch Screen will be disabled.)
4. Open the Hyperterminal program that is found in Windows 95, 98, 2000, & NT set for a baud rate of 9600. If there is a copy of the Evolution software update disk available the "Evolution Diagnostic" icon can be moved to the computer desktop and utilized.
 - a. Locate and double-click on the "*Hypertrm.exe*" file (START / Programs / Accessories / HyperTerminal).
 - b. In the *Connection Description* dialog box that appears, in the *New Connection Name* field, type "**Evolution Diagnostics**" and then click "**OK**".
 - c. In the next dialog box that appears, in the *Connect Using* field, select "**Direct to Com 1**" and then click "**OK**".
 - d. In the *Com 1 Properties* dialog box that appears, select the following Port Settings:
 - In the *Bits per Second* field, select "**9600**".
 - In the *Data Bits* field, select "**8**".
 - In the *Parity* field, select "**None**".
 - In the *Stop bits* field, select "**1**".
 - In the *Flow control* field, select "**Hardware**".

- e. Click “OK when selections are complete.
 - f. The next dialog box that appears will ask “**Do you want to save session?**”. Click “**Yes**” and the currently-open “*Evolution Diagnostics.ht*” file will be saved in the HyperTerminal folder.
5. For centrifuges that use software revisions #41 and above skip steps 6 through 10.
 6. Turn the centrifuge instrument power “**ON**”. As the Evolution RC instrument boots interrupt the boot process by depressing “**CONTROL C**” on the computer just after the “**EVOL**” program starts to run. See Figure #1.

```
HOT cable detected, Serial Loader starting.  
Press ESC to abort Hard disk boot  
Booting Hard Drive  
Loading...
```

```
DR DOS Release 5.0  
Copyright © 1976,1982,1988,1990 Digital Research Inc. All rights reserved.  
Ampro Computers, Inc.
```

```
C>ECHO ON
```

```
C>evol
```

Figure #1

7. When the message displays “**Halt the Batch Process**” answer by typing “**Y**”.
8. Rename the Autoexec.bat file so that the instrument cannot be booted. (Rename the file something that will not be forgotten).

```
C>rename autoexec.bat steve
```

In this case the Autoexec was renamed “**steve**”.

9. Re-boot the Evolution RC instrument by cycling the power “**OFF**” then back “**ON**”.
10. The instrument will re-boot then ask for the date and the time. If no changes are to be made depress “**ENTER**” 2 times.

```
HOT cable detected, Serial Loader starting.  
Press ESC to abort Hard disk boot  
Booting Hard Drive  
Loading...
```

```
DR DOS Release 5.0  
Copyright © 1976,1982,1988,1990 Digital Research Inc. All rights reserved.
```

Ampro Computers, Inc.

Date: Sat 3-17-2001
Enter date (mm-dd-yy):

Time: 4:00:54.87
Enter time:

C>

Figure #2

11. On centrifuges that use software revision #37 at the “C>” start the Evolution Diagnostics by typing ‘**EVOL D**’. This will start the diagnostics program for the centrifuge and will display the menu depicted in figure #3. On centrifuges using software revisions #41 and above allow the centrifuge to boot normally then type the letter “d” on the connected computer to start the diagnostics program for the centrifuge and will display the menu depicted in figure #3.

C>evol d

MAIN MENU

c) configuration
d) diagnostic tests
s) Service Menu(s)
12) exit menus (start application)
e) exit application

your choice: s

Figure #3

12. Select “**S**” for the Service Menu

k) Read and Store Ke Value
r) Read and Store Ke Adjustment Ratio
m) Machine Temp Gain and Offset
s) Sensor Slope & Offset
a) Accelerometer menu
c) Compressor Selection
b) back to Main

13. Select “**k**” to calibrate the Ke value.

your choice: k

14. The centrifuge will display the current Ke value on the computer screen. At this point you are given the option to enter a new Ke value or “back to main menu”. To enter a new Ke value the new number can be entered by simply typing in the new value which can be found on a tag that is attached to the motor power wires near the motor plug. After the Ke is correctly programmed the centrifuge will display “completed”.
15. If there is no change to the Ke needed you can return to the Service Menu by typing “b”.

```
read and store ke value
KE value read is 9.050
Enter new value
b) back to menu
9.050
Completed
```

16. After completing the calibration return to the “C>” prompt by stepping back through the diagnostics until the “C>” prompt is reached.

```
-----
k) Read and Store Ke Value
r) Read and Store Ke Adjustment Ratio
m) Machine Temp Gain and Offset
s) Sensor Slope & Offset
a) Accelerometer menu
c) Compressor Selection
b) back to Main
-----
```

your choice: b

MAIN MENU

```
-----
c) configuration
d) diagnostic tests
s) Service Menu(s)
a) exit menus (start application)
e) exit application
-----
```

your choice: e

C:\>

Note:

On centrifuges that use software revisions #41 and above skip step #17 and continue with step #18

17. On centrifuges using software revision #37 restore the original centrifuge startup file name. At the "C:\>" prompt, type "**ren steve autoexec.bat**" ((using our "Steve" example from step 8)), then press the ".Enter" key.
18. Set the centrifuge main POWER switch to the OFF (O position, then turn it back ON (I ;the centrifuge will now start up normally. No additional calibrations are required –preexisting Ke value remains in memory.
19. Verify that the instrument operates correctly.
20. If the centrifuge operates correctly, quit Hyper Terminal. A dialog box will appear that asks if you are sure you want to disconnect now, click "YES" to quit.
21. Set the centrifuge main POWER switch to the OFF (O position and shut down the computer.
22. Disconnect the modem cable from the computer and from the centrifuge interface ribbon cable, return the ribbon cable to its original location inside the top of the control console, behind the SPEED display, positioned so that the connector pins will not contact p.c. board circuits.
23. Reinstall the bezel on the control console using the four screws removed in step G2, and tighten using a 3 mm Allen wrench.

INSTRUCTIONS

for

Evolution RC Imbalance Calibration

Tools Required

1. Allen Wrench, 3 mm.
2. Laptop Computer with serial port, running MSWindows 95 ® or later
3. Null Modem Cable, DB9 F to DB9 F (Kendro Catalog No. 73827)



Warning:

Because of the presence of high voltage, untrained personnel must not attempt to test, repair, or modify any electrical circuits or systems in this unit.



Warning:

Because of the characteristics of the samples likely to be processed in this centrifuge, biological or radioactive contamination may occur. Always be aware of this possibility, and take normal precautions. The Thermo Service Decontamination Policy states that a completed Decontamination Information Certificate is required before servicing.

Instructions

1. Set the centrifuge main POWER switch to the OFF (O) position.
2. From the behind the control console, use a 3 mm Allen wrench to remove the four screws (one from each corner) that secure the bezel in position on the control panel, and remove the bezel.
3. Locate the interface ribbon cable, marked 73389, that is stowed inside the top of the control console, behind the control panel SPEED display. Draw the loose end of the ribbon cable forward, then plug one end of the null modem cable into the ribbon cable connector.
4. On centrifuges that have the Advanced Features Option (LCD Touch Screen) connect the Null Modem Interface Cable (73389) (located inside the console assembly) to the pigtail cable that is attached to the PC-104 processor. (When the Null Modem Interface Cable is connected to the centrifuge the LCD Touch Screen will be disabled.)
5. Connect the other end of the null modem cable to the laptop computer serial port.
6. Turn the laptop computer ON, wait for the startup routine to finish so that the desktop appears. Locate and double-click on the “Evolution Diagnostics” file icon on the computer desktop – this will launch Hyper Terminal at a baud rate of 9600 and enable the computer to connect to the centrifuge software. If the “Evolution Diagnostics” icon is not on the computer desktop, one must be created; proceed as follows:

INSTRUCTIONS

for

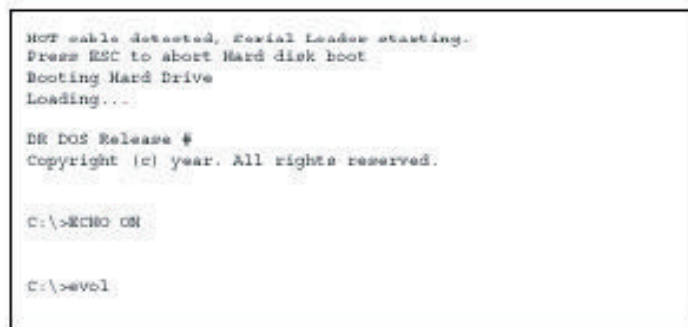
Evolution RC Imbalance Calibration

- a. Locate and double-click on the “Hypertrm.exe” file (START/Programs/Accessories/HyperTerminal).
- b. In the Connection Description dialog box that appears, in the New Connection Name field, type “Evolution Diagnostics” and then click “OK.”
- c. In the next dialog box that appears, in the Connect Using field, select “Direct to Com 1” and then click “OK.”
- d. In the Com 1 Properties dialog box that appears, select the following Port Settings:
 - In the Bits per Second field, select “9600”
 - In the Data Bits field, select “8”
 - In the Parity field, select “None”
 - In the Stop bits field, select “1”
 - In the Flow control field, select “Hardware”
- e. The next dialog box that appears will ask “Do you want to save session?” Click “Yes” and the currently-open “Evolution Diagnostics” file will be saved in the HyperTerminal folder.

Note:

On centrifuges with software revision #41 (or higher) skip steps 7 - 10 and resume at step 11.

7. Set the centrifuge main POWER switch to the ON (I) position, place your fingers in a ready position over the computer “Ctrl” and “C” keys, and watch the computer screen as the centrifuge goes into its startup routine. Text will scroll upward and, shortly after “C:\>ECHO ON” appears, “C:\>evol” will appear. Immediately after “C:\>evol” appears, interrupt the startup routine by pressing the “Ctrl” and “C” keys simultaneously.



```
NOT cable detected, Serial Loader starting.
Press ESC to abort Hard disk boot
Booting Hard Drive
Loading...

DR DOS Release #
Copyright (c) year. All rights reserved.

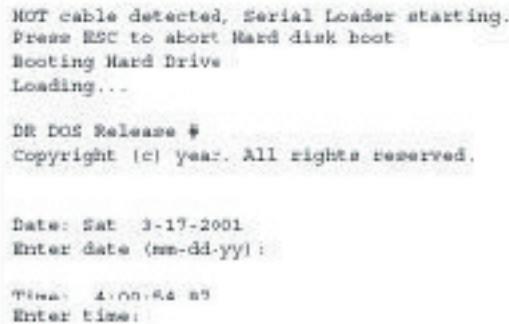
C:\>ECHO ON
C:\>evol
```


INSTRUCTIONS

for

Evolution RC Imbalance Calibration

8. “Halt batch process (Y/N) ?” will appear on the screen. Type “Y” and the “C:\>” prompt will appear. If “Halt batch process (Y/N) ?” does not appear on the computer screen and values appear in the centrifuge displays, “Ctrl” and “C” were not pressed in time to interrupt startup –set the centrifuge main POWER switch to the OFF (O) position, then go back to step 7.
9. Rename the centrifuge startup file so that the instrument cannot get through startup. At the “C:\>” prompt, type “ren autoexec.bat steve” (note: “steve” at the end of the command line is an example to show how Field Service Engineer Steve might choose to use his name. Use a file name that you are sure will not be forgotten), then press the “Enter” (return) key.
10. Set the centrifuge main POWER switch to the OFF (O) position, then turn it back ON (I); the computer will show the centrifuge startup process, then will stop scrolling and prompt to enter the date. Press the “Enter” key twice –the first time to bypass the “Enter date” prompt, then a second time to bypass the “Enter time” prompt.



```
NOT cable detected, Serial Loader starting.
Press ESC to abort Hard disk boot
Booting Hard Drive
Loading...

DR DOS Release #
Copyright (c) year. All rights reserved.

Date: Sat 3-17-2001
Enter date (mm-dd-yy) :

Time: 4:00:42 a.m.
Enter time:
```

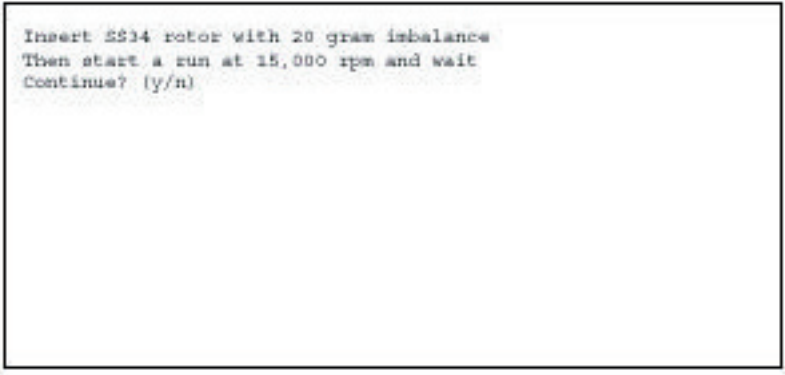
11. On centrifuges using software revision #41 (or higher) type the letter “t” on the connected PC after the centrifuge has booted. This will cause the centrifuge to change to “PLEASE WAIT” and the “c\>” will be displayed on the PC screen.
12. At the “C:\>” prompt that appears, type “evol a” and when the “Are you sure that you want to calibrate the accelerometer? (y/n)” prompt appears, type “y” to continue.

INSTRUCTIONS

for

Evolution RC Imbalance Calibration

13. The computer will prompt you to set up an imbalance calibration run:



```
Insert SS34 rotor with 20 gram imbalance  
Then start a run at 15,000 rpm and wait  
Continue? (y/n)
```

Type “y” to continue; the centrifuge will now finish booting-up and the run and set displays on the control panel will appear and become active.

14. Prepare an imbalance calibration run – even though the computer prompted for an SS-34, there are actually four different rotor setups that may be used:

Note:

Imbalance is established by completely filling sealed bottle assemblies with water and placing them in all available compartments except for one. In this compartment fill the bottle minus the appropriate imbalance as stated at the right.

- a. SS-34 loaded with (7) 50 ml sealed bottles that are filled to capacity with (1) bottle minus 20 grams of imbalance, run at 15,000 rpm
- b. SLA-1500 loaded with (5) 250 ml sealed bottles that are filled to capacity with (1) bottle minus 28 grams of imbalance, run at 10,000 rpm
- c. SLA-3000 loaded with (5) 500 ml sealed bottles that are filled to capacity with (1) bottle minus 30 grams of imbalance, run at 10,000 rpm.
- d. SLC-6000 loaded with (5) 1000 ml sealed bottles that are filled to capacity with (1) bottle minus 60 grams of imbalance, run at 8,500 rpm

INSTRUCTIONS

for

Evolution RC Imbalance Calibration

15. Load one of the four specified rotors with the imbalance specified above. Install the rotor lid and securely tighten the (larger) cover locking knob. Open the centrifuge chamber door, install the rotor on the tapered drive spindle so that it is properly seated, then securely tighten the (smaller) rotor locking knob. Close the chamber door.
16. Set the ROTOR name to indicate the installed rotor, set TIME to more than five minutes (or to hold), select RPM and set SPEED to the rpm specified above, set ACCEL and BRAKE rates to 3, set TEMP to 22, then press START.
17. The centrifuge run will begin and the rotor will accelerate to set speed. Once at set speed, the accelerometer calibration routine will run, and calibration data will appear on the computer screen (sample data follows).

```
NVRAM: knobs = 1
NVRAM: LM74 = 1
NVRAM: LCD = 0
NVRAM: KeValue = 9.210
NVRAM: KeGain = 1.240
NVRAM: Machine gain = 0.000 machine offset = 0.000
NVRAM: Sensor Slope = 0.0000000 Sensor offset = 0.0000000
KE 5 windage limit
cal_num = -381
cal_num = -381
cal_num = -379
cal_num = -382
cal_num = -382
cal_num = -382
cal_num = -381
cal_num = -380
cal_num = -380
cal_num = -380
cal_num = -381
cal_num = -381
cal_num = -380
cal_num = -380
cal_num = -383
cal_num = -385
cal_num = -387
cal_num = -388
cal_num = -386
cal_num = -387
Saving calibration data to Flash Disk
Accelerometer Calibrated at: -382

Please wait until rotor stops, then cycle power
```

INSTRUCTIONS

for

Evolution RC Imbalance Calibration

When the calibration is complete, the centrifuge run will terminate and “Imbalance Fault” will scroll across the ROTOR display. When zero speed is reached, “Error” will appear in the speed display and the chamber door will unlock. The calibration is now complete.

Note:

On centrifuges using software revision #41 (and above) skip steps 18 - 19 and resume at step #20.

18. Switch the centrifuge main POWER switch to the OFF (O) position, then turn it back ON (I); the computer will again show the centrifuge startup process, then will stop scrolling and prompt to enter the date: If the date is correct, press the “Enter” key; otherwise, type the correct date, then press the “Enter” key. The computer will prompt to enter the time. If the time is correct, press the “Enter” key; otherwise, type the correct time (using a 24 hour clock, so that 3:00 pm is input as 15:00), then press the “Enter” key.
19. Restore the original centrifuge startup file name: At the “C:\>” prompt, type “ren steve autoexec.bat” (using our “Steve” example from step 9), then press the “Enter” key.
20. Set the centrifuge main POWER switch to the OFF (O) position, then turn it back ON (I); the centrifuge will now start up normally. No additional calibrations are required.
21. Verify that the centrifuge operates correctly.
22. If the centrifuge operates correctly, quit HyperTerminal. A dialog box will appear to ask if you “are sure you want to disconnect now”; click “YES” to quit.
23. Set the centrifuge main POWER switch to the OFF (O) position and shut down the computer.
24. Disconnect the modem cable from the computer, and from the centrifuge interface ribbon cable; return the ribbon cable to its original location inside the top of the control console, behind the SPEED display, positioned so that the connector pins will not contact p.c. board circuits.

INSTRUCTIONS

for

Evolution RC Imbalance Calibration

25. On centrifuges with the Advanced Features Option (LCD Touch Screen) disconnect the Null Modem Interface cable (73389) from the pigtail that is connected to the PC-104 processor and tuck the cable into the cable clamp located inside the console assembly. (Failure to disconnect the interface cable will cause the LCD Touch Screen to be disabled.).
26. Reinstall the bezel on the control console using the four screws removed in step 2, and tighten using a 3 mm Allen wrench.

INSTRUCTIONS

for the
Evolution RC Software Upgrade Kit
(Catalog No. 73339)

Parts Included

Quantity	Part #	Description
1 ea		Evolution RC Software Update Disk
1 ea	73344	Installation Instructions



Warning:

This kit provides operating system software to be installed on the SORVALL® Evolution™ RC Centrifuge. In the process, files will be downloaded to centrifuge memory. Follow the procedure provided exactly and in its entirety. Failure to do so can cause the centrifuge to exhibit problems, or render it inoperable. These instructions assume the installer is familiar with using a computer running an MS Windows® operating system.

Note:

On centrifuges that use the Advanced Features Option (LCD Touch Screen) skip step #3 and resume on step #4.

Note:

Connecting the Null Modem Interface cable will cause the LCD Touch Screen to become inactive with no display.

Tools and Other Items Required

- 3mm Allen Wrench
- Null Modem Cable (73827)
- Computer (Windows 98 or higher)

Instructions

a. Software Installation

1. Set the centrifuge main POWER switch to the OFF (O) position.
2. From the behind the control console, use a 3 mm Allen wrench to remove the four screws (one from each corner) that secure the bezel in position on the control panel, and remove the bezel.
3. Locate the interface ribbon cable, marked 73389, that is stowed inside the top of the control console, behind the control panel SPEED display. Draw the loose end of the ribbon cable forward, then plug one end of the null modem cable into the ribbon cable connector.
4. On centrifuges that have the Advanced Features Option (LCD Touch Screen), connect the Null Modem Interface Cable (73389) (located in a cable clamp attached to the bottom interior of the control console) to the pigtail cable that is attached to the PC-104 processor.
5. Connect the other end of the null modem cable to the laptop computer serial port.

INSTRUCTIONS

for the Evolution RC Software Upgrade Kit (Catalog No. 73339)

6. Turn the laptop computer ON, wait for the start-up routine to finish so that the desktop appears, then insert the *Evolution™ RC System Software* disk (supplied) into the computer's disk drive.
7. Locate and open the disk drive on the computer desktop to access the files on the disk, then double-click on the “**Evolution Diagnostics**” file. This will launch HyperTerminal at a baud rate of 9600 and enable the computer to connect to the centrifuge.
8. If the “**Evolution Diag**” or “**Evolution Download**” Hyperterminal icons are not present on the Evolution RC software update disk open the Hyperterminal program and set the following parameters for each window.

Evolution Diag:

Bits per second: 9600
Data Bits: 8
Parity: none
Stop bits: 1
Flow control: Hardware

Note:

On centrifuges that use software revision #41 (or higher) skip steps 9 Through 12 and resume at step #13.

Evolution Download:

Bits per second: 57600
Data Bits: 8
Parity: none
Stop bits: 1
Flow control: Hardware

9. Set the centrifuge main POWER switch to the ON (I) position, place your fingers in a ready position over the computer “**Ctrl**” and “**C**” keys, and watch the computer screen as the centrifuge goes into its start-up routine. Text will scroll upward and, shortly after “**C:\>ECHO OFF**” appears, “**C:\>evol**” will appear. Immediately after “**C:\>evol**” appears, interrupt the start up routine by pressing the “**Ctrl**” and “**c**” keys simultaneously.

INSTRUCTIONS

for the
Evolution RC Software Upgrade Kit
(Catalog No. 73339)

```
HOT cable detected, Serial Loader starting.  
Press ESC to abort Hard disk boot  
Booting Hard Drive  
Loading...  
DR DOS Release #  
Copyright (c) year. All rights reserved.  
C:\>ECHO ON  
C:\>evol
```

Figure 1

10. Type “**Y**” and the “**c:\>**” prompt will appear. If this process does not work and values appear in the centrifuge displays, “**Ctrl**” and “**c**” were not pressed in time to interrupt start-up, set the centrifuge main POWER switch to the OFF (O) position, then go back to step 9.
11. Delete the Autoexec.bat file by typing “**erase autoexec.bat**”, then press the “**ENTER**” (return) key. A new autoexec.bat file will be downloaded later.
12. Set the centrifuge main POWER switch to the OFF (O) position, then turn it back ON (I); the computer will show the centrifuge start-up process, then will stop scrolling and prompt to enter the date. Press the “**ENTER**” key twice, the first time to bypass the “**Enter date**” prompt, then a second time to bypass the “**Enter time**” prompt.

```
HOT cable detected, Serial Loader starting.  
Press ESC to abort Hard disk boot  
Booting Hard Drive  
Loading...  
DR DOS Release #  
Copyright (c) year. All rights reserved.  
Date: Sat 3-17-2001  
Enter date (mm-dd-yy):  
Time: 4:00:54.87  
Enter time:
```

Figure 2

13. On centrifuges using software revision #41 (or higher) type “**T**” on the connected PC after the centrifuge has booted. This will cause the centrifuge display to change to “**PLEASE WAIT**” and the “**c:\>**” will be displayed on the PC screen.

INSTRUCTIONS

for the Evolution RC Software Upgrade Kit (Catalog No. 73339)

Note:

Deleting the remaining system files will insure that no conflicts occur when downloading the new system files.



Warning:

Erase only the files that are listed in steps #14 & #15. Erasing files other than the files that are listed can cause the file transfer process to not operate properly and will render the centrifuge inoperable.

14. Delete the Autoexec.bat file by typing “**erase autoexec.bat**”, then press the “**ENTER**” (return) key. A new autoexec.bat file will be downloaded later.

15. Delete the remaining system files following the procedure that is outlined in step 14.

evol.exe
faults.txt
rotors50
rotors60
egavga.bgi
enghflts.lng
English.lng
frchflts.lng
French.lng
German.lng
grmnflts.lng
Spanish.lng
Spnhflts.lng
Lcdfile
Password

16. At the “**C:\>**” prompt that appears, type “**msk315m**” then press the “**Enter**” key. This will run a program that is required to change the centrifuge baud rate from 9,600 to 57,600. When finished, text will stop scrolling up on the screen and garbled text/characters will be at the bottom of the screen.

17. Quit HyperTerminal. A dialog box will appear to ask if you “**are sure you want to disconnect now**”, click “**YES**” to quit.

18. Double-click on the “**Evolution Download**” file located in the “**disk drive**” window. This will connect HyperTerminal at a 57,600 baud rate.

19. Download the “**autoexec.bat**” file. From the toolbar, click “**Transfer**” then “**Send File**”. In the filename dialog box that appears, type “**D:\autoexec.bat**” and make sure the “**KERMIT**” protocol is selected in the lower box, then click “**SEND**”. The file will be downloaded from the disk to the centrifuge.

INSTRUCTIONS

for the
Evolution RC Software Upgrade Kit
(Catalog No. 73339)

20. Repeat the process for the following files.

evol.exe
faults.txt
rotors50
rotors60
egavga.bgi
enghflts.lng
English.lng
frchflts.lng
French.lng
German.lng
grmnflts.lng
Spanish.lng
Spnhflts.lng
Lcdfile
Password

Note:

The example in step #18 uses the “D:\” drive. If the software update disk is located in another drive that drive should be referenced. For example “A:\autoexec.bat”.

21. After all required files have been downloaded, quit HyperTerminal. A dialog box will appear and ask if you “are you sure that you want to disconnect now?“, click “YES” to quit.

b. System Configuration

1. Double-click on the “Evolution Diagnostics” file. This will reconnect HyperTerminal at a 9600 baud rate.
2. Set the centrifuge main POWER switch to the OFF (O) position, then turn it back ON (I); The centrifuge should boot up normally.
3. Using the connected computer type the letter “d” to enter the system diagnostics.
4. At the main diagnostic screen select “configuration” by typing the letter “c”.

INSTRUCTIONS

for the
Evolution RC Software Upgrade Kit
(Catalog No. 73339)

MAIN MENU

- c) configuration
 - d) diagnostic tests
 - s) Service Menu(s)
 - a) exit menus (start application)
 - e) exit application
-

your choice: c

Figure 3

5. At the configuration menu select “**panel**” by typing the letter “**p**”.

SYSTEM CONFIGURATION MENU

- p) panel
 - m) miscellaneous configuration
 - b) back to main menu
-

your choice: p

Figure 4

6. At the panel configuration screen select “**LCD present**” by typing the letter “**i**” if the centrifuge has a LCD Touch Screen. Select “**LCD NOT present**” by typing the letter “**n**” if the centrifuge does not have the LCD Touch Screen.

CURRENT PANEL CONFIGURATION

current state: NVRAM: knobs = 1
NVRAM: LCD = 0
NVRAM: KeBoard = 1
NVRAM: KeValue = 9.400
NVRAM: KeGain = 1.250
NVRAM: Temp. gain = 0.0000000 Temp. offset = 0.0000000
NVRAM: Sensor Slope = -0.0133040 Sensor offset = 0.6832100
NVRAM: Compressor Type = 60 Hertz
knob panel
k) knob panel
b) button panel
l) LCD present
n) LCD NOT present
e) exit panel configuration

your choice: n

Figure 5

INSTRUCTIONS

for the
Evolution RC Software Upgrade Kit
(Catalog No. 73339)

7. Select “**exit panel configuration**” by typing the letter “**e**”.

CURRENT PANEL CONFIGURATION

current state: NVRAM: knobs = 1
NVRAM: LCD = 0
NVRAM: KeBoard = 1
NVRAM: KeValue = 9.400
NVRAM: KeGain = 1.250
NVRAM: Temp. gain = 0.0000000 Temp. offset = 0.0000000
NVRAM: Sensor Slope = -0.0133040 Sensor offset = 0.6832100
NVRAM: Compressor Type = 60 Hertz
knob panel
k) knob panel
b) button panel
l) LCD present
n) LCD NOT present
e) exit panel configuration

your choice: e

Figure 6

8. Select “**back to main menu**” by typing the letter “**b**”.

SYSTEM CONFIGURATION MENU

p) panel
m) miscellaneous configuration
b) back to main menu

your choice: b

Figure 7

9. Select “**service menu(s)**” by typing the letter “**s**”.

MAIN MENU

c) configuration
d) diagnostic tests
s) Service Menu(s)
a) exit menus (start application)
e) exit application

your choice: s

Figure 8

INSTRUCTIONS

for the Evolution RC Software Upgrade Kit (Catalog No. 73339)

Note:

If you are unsure as to whether the centrifuge contains a KE Board remove the centrifuge lower front panel and look for the KE Board that should be located on the lower right side of the centrifuge frame (behind the autotransformer).

10. On centrifuges with serial numbers 10300735 and below select **“KE Board Present”** by typing the letter **“p”**. On centrifuges with serial numbers 10300736 and above or on older centrifuges that have had the motor upgraded to the Servo Magnetics motor select **“KE Board Not Present”** by typing the letter **“n”**.

SERVICE MENU
Ke-Board is installed

- p) KE Board Present
 - n) KE Board not Present
 - k) Read and Store Ke Value
 - r) Read and Store Ke Adjustment Ratio
 - m) Machine Temp Gain and Offset
 - d) Display Temp Sensor Data
 - a) Accelerometer menu
 - c) Compressor Selection
 - l) Calibrate LCD Touch Panel
 - b) back to Main
-

your choice: p

Figure 9

11. Select **“Read and Store Ke Adjustment Ratio”** by typing the letter **“r”**. The computer will display the current adjustment ratio (1.325 for software revision #37 or 1.250 for software revision #41 or higher). Enter the value **“1.250”** to correspond with the new software revision. Entering the wrong Ke adjustment ratio will result in poor centrifuge performance.

INSTRUCTIONS

for the
Evolution RC Software Upgrade Kit
(Catalog No. 73339)

SERVICE MENU
Ke-Board is installed

- p) KE Board Present
 - n) KE Board not Present
 - k) Read and Store Ke Value
 - r) Read and Store Ke Adjustment Ratio
 - m) Machine Temp Gain and Offset
 - d) Display Temp Sensor Data
 - a) Accelerometer menu
 - c) Compressor Selection
 - l) Calibrate LCD Touch Panel
 - b) back to Main
-

your choice: r
read and store Adjustment Ratio value
KE Adjustment Ratio value read is 1.250
Enter new value
b) back to menu
1.250
Completed

Figure 10

12. Select **“Compressor Selection”** by typing the letter **“c”**.

SERVICE MENU
Ke-Board is installed

- p) KE Board Present
 - n) KE Board not Present
 - k) Read and Store Ke Value
 - r) Read and Store Ke Adjustment Ratio
 - m) Machine Temp Gain and Offset
 - d) Display Temp Sensor Data
 - a) Accelerometer menu
 - c) Compressor Selection
 - l) Calibrate LCD Touch Panel
 - b) back to Main
-

your choice: c

Figure 11

13. Select **“60 Hertz”** by typing numeral **“1”** if the line power of the installed centrifuge is 60 Hz. Select **“50 Hertz”** by typing the numeral **“2”** if the line power of the installed centrifuge is 50 Hz.

INSTRUCTIONS

for the
Evolution RC Software Upgrade Kit
(Catalog No. 73339)

CURRENT Compressor CONFIGURATION

60 Hertz

- 1) 60 Hertz
 - 2) 50 Hertz
 - 3) 50 Hertz single phase
 - 4) 50 Hertz polyphase
 - b) back to menu
-

your choice: 1

Figure 12

14. Select “**back to menu**” by typing the letter “**b**” to return to the main menu.

SERVICE MENU

Ke-Board is installed

- p) KE Board Present
 - n) KE Board not Present
 - k) Read and Store Ke Value
 - r) Read and Store Ke Adjustment Ratio
 - m) Machine Temp Gain and Offset
 - d) Display Temp Sensor Data
 - a) Accelerometer menu
 - c) Compressor Selection
 - l) Calibrate LCD Touch Panel
 - b) back to Main
-

your choice: b

Figure 13

15. Set the centrifuge main POWER switch to the OFF (O) position, then turn it back ON (I); the centrifuge will now start up normally (during start-up, the new software revision (**REL**) number will momentarily appear in the Temperature display). No calibrations are required the preexisting Ke value and imbalance calibration remain in memory.
16. Open the chamber door, install a rotor, then verify that the instrument operates correctly.
17. If the centrifuge operates correctly, quit HyperTerminal. A dialog box will appear to ask “**you are sure you want to disconnect now**”; click “**YES**” to quit.

INSTRUCTIONS

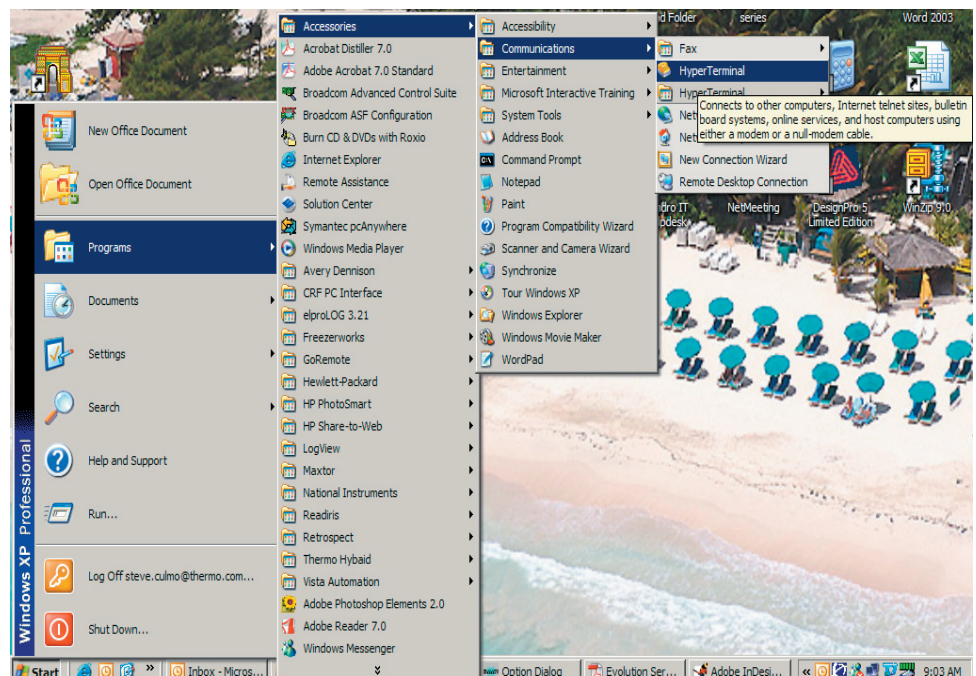
for the
Evolution RC Software Upgrade Kit
(Catalog No. 73339)

18. Set the centrifuge main POWER switch to the OFF (O) position, remove the system software disk from the computer, and shut down the computer.
19. Disconnect the modem cable from the computer, and from the centrifuge interface ribbon cable, return the ribbon cable to its original location inside the top of the control console, behind the SPEED display, positioned so that the connector pins will not contact p.c. board circuits.
20. On centrifuges with the Advanced Features Option (LCD Touch Screen) disconnect the Null Modem Interface Cable (73389) from the pigtail that is connected to the PC-104 processor and tuck the cable into the cable clamp located inside the console assembly. (Failure to disconnect the interface cable will cause the LCD Touch Screen to be disabled.)
21. Reinstall the bezel on the control console using the four screws removed in step 2, and tighten using a 3 mm Allen wrench.

INSTRUCTIONS for Faultlog & Runlog Retrieval Sorvall Evolution RC Centrifuge

1. Using a 3mm Allen wrench remove the (4) screws at the rear of the control console and remove the trim ring from around the display panel.
2. Locate the interface ribbon cable hanging just above the control console. Connect a nulling serial cable (Thermo part #73827) between the interface cable and the serial port on the laptop computer.
3. On centrifuges that have the Advanced Features Option (LCD Touch Screen) connect the Null Modem Interface Cable (73389) (located inside the console assembly) to the pigtail cable that is attached to the PC-104 processor.
4. The Evolution RC uses the Hyperterminal communications program that is included with all versions of Microsoft Windows.
 - a. Open Hyperterminal by selecting:

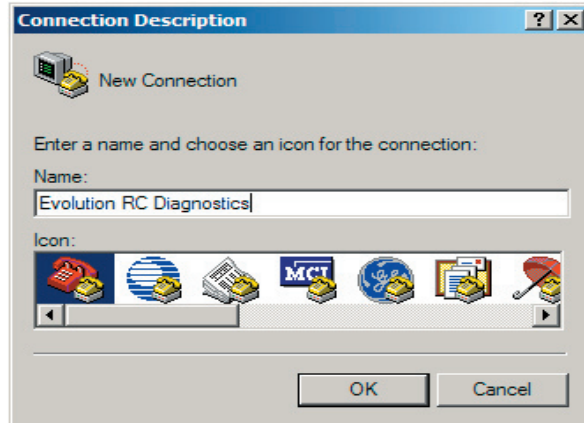
“Start”
“Programs”
“Accessories”
“Communications”
“Hyperterminal”



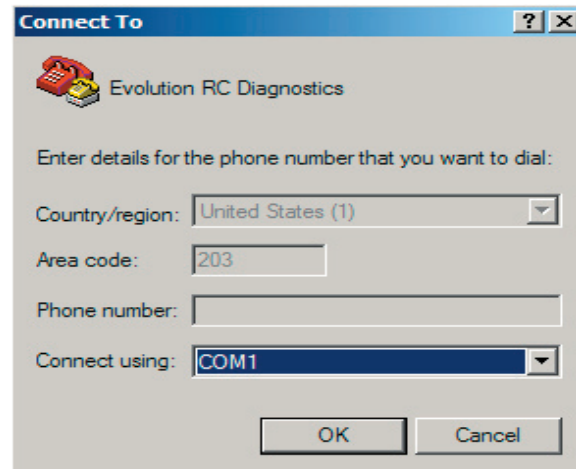
INSTRUCTIONS

for
Faultlog & Runlog Retrieval
Sorvall Evolution RC Centrifuge

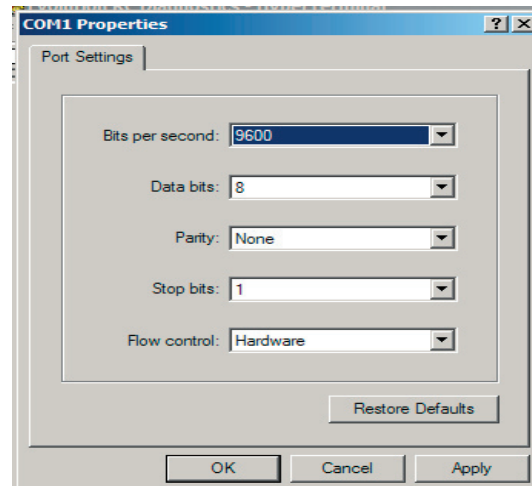
- b. Give the new connection a name “Evolution RC Diagnostics”.



- c. Select “COM1” for the connection.



- d. Select the following properties then select “OK”



INSTRUCTIONS
for
Faultlog & Runlog Retrieval
Sorvall Evolution RC Centrifuge

The computer is now ready to communicate with the Evolution RC centrifuge.

5. Re-boot the Evolution RC instrument by cycling the power “OFF” then “ON”.
6. On centrifuges using software revision #41 (or higher) type the letter “t” on the connected PC after the centrifuge has booted. This will cause the centrifuge to change to “PLEASE WAIT” and the “c\>” will be displayed on the PC screen.
7. On the Hyperterminal tool bar select “TRANSFER” then “CAPTURE TEXT”. Hyperterminal will then ask for a location and filename for the captured text. When naming the file use the centrifuge’s serial number and indicate whether the file contains the run log or the fault log. For example “1234 runlog” where the first 4 digits are the last 4 digits of the instrument serial number and the word runlog indicates the contents of the file. After naming the file select “OPEN”. Hyperterminal will now save the text file in the location that was selected.
8. Access the run log by typing “type runlog”. The run log will now be displayed in the hyperterminal window.
9. After the run log is displayed select “TRANSFER” on the Hyperterminal toolbar, then “CAPTURE TEXT” and then “STOP”. This will close the text file that was just created.
10. Repeat the above steps for recording the fault log.
11. Cycle the Evolution RC power “OFF” then back “ON”. The instrument will now boot up normally
12. Disconnect the computer and tuck the interface ribbon cable into the control console. Install the trim ring using the 3mm Allen Wrench.

Note:

On centrifuges with the Advanced Features Option (LCD Touch Screen) disconnect the Null Modem Interface cable (73389) from the pigtail that is connected to the PC-104 processor and tuck the cable into the cable clamp located inside the console assembly. Failure to disconnect the interface cable will cause the LCD Touch Screen to be **disabled.**)

Evolution RC LCD Contrast Calibration

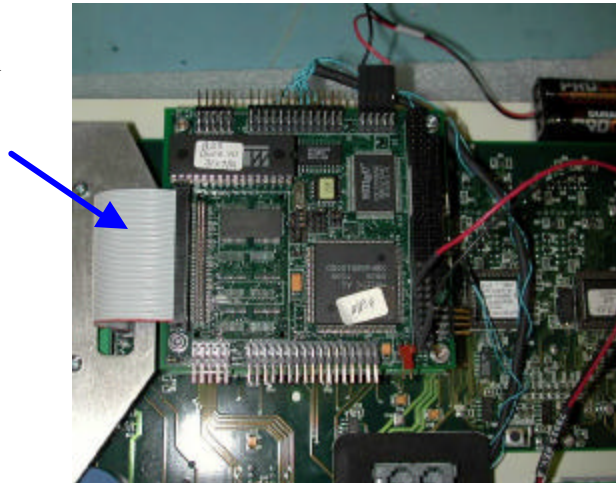
Caution:

The printed circuit boards contained in the control console assembly are static sensitive and must be handled with the appropriate static control procedures. Always use an anti static wrist-strap and workstation (Kendro part #73369).

Hazardous voltages exist in the console assembly when the Evolution RC AF LCD module is installed.

- 1 Turn off the centrifuge power and disconnect the instrument power cord from the mains supply.
- 2 Disconnect the Power supply cable (red plug) and the IIC cable (data cable) from the back of the control console.
- 3 Using a 3mm Allen wrench, remove the 4 socket head screws located behind the control console and remove the console trim ring.
- 4 Using a 3mm Allen wrench, remove the 4 socket head screws that hold the Control Panel to the Console assembly.
- 5 Carefully remove the Compact Flash Memory ribbon cable from the PC104 microprocessor board. This will enable easier access to the LCD contrast adjustment potentiometer.

Compact Flash
Memory
Ribbon Cable



- 6 Connect a DVM across CR-1 on the LCD Transition board located on top of the LCD assembly.
- 7 Connect the display panel to the red power supply cable on the centrifuge. No other connections are required since the only voltage being adjusted is for the LCD contrast.

- 8 Turn the main centrifuge power “ON”. Adjust the potentiometer on the VGA module located under the PC-104 Processor for a reading of 19.6 volts DC on the DMM.
- 9 Turn off the centrifuge power and reconnect the Compact Flash Memory Inrerface cable to the PC-104 Processor.
- 10 Turn the main centrifuge power back on and allow the centrifuge to boot up. (the centrifuge will display faults due to the I2C cable being disconnected) Look at the LCD screen and fine tune the contrast as needed by adjusting the potentiometer located on the VGA Module.
- 11 Turn the main centrifuge power off and reinstall the Control Panel into the Console assembly. Connect the Power Supply cable (red connector) and the I2C connector to the rear of the console assembly.
- 12 Reinstall the Console Trim ring.

Evolution RC LCD Touch Screen Calibration

Caution:

The printed circuit boards contained in the control console assembly are static sensitive and must be handled with the appropriate static control procedures. Always use an anti static wrist-strap and workstation (Kendro part #73369).

Hazardous voltages exist in the console assembly when the Evolution RC AF LCD module is installed.

1. Using a 3mm Allen wrench remove the 4 socket head screws located behind the control console and remove the console trim ring.
2. Locate the null modem cable interface (73389) and connect it to the PC-104 processor on the pigtail cable that is attached to the PC-104 processor. (The PC-104 processor is the small board located in the console farthest to the rear of the console assembly).

Note:

When the null modem cable is attached to the PC-104 processor the LCD touch screen will be inactive and the display will be blank.

3. Connect a Null Modem cable to the centrifuge null modem interface cable and to the serial port on the PC to be used.
4. Open the Hyperterminal program that is found in Windows 95, 98, 2000, & NT set for a baud rate of 9600. If there is a copy of the Evolution software update disk available the "Evolution Diagnostic" icon can be moved to the computer desktop and utilized.
5. If the "Evolution Diagnostics" icon is not available locate and double-click on the "*Hypertrm.exe*" file (START / Programs /Accessories / HyperTerminal).
6. In the *Connection Description* dialog box that appears, in the *New Connection Name* field, type "**Evolution Diagnostics. ht**" and then click "**OK**".
7. In the next dialog box that appears, in the *Connect Using* field, select "**Direct to Com 1**" and then click "**OK**".
8. In the *Com 1 Properties* dialog box that appears, select the following Port Settings:

In the *Bits per Second* field, select "**9600**".

In the *Data Bits* field, select "**8**".

In the *Parity* field, select "**None**".

In the *Stop bits* field, select “**1**”.
In the *Flow control* field, select “**Hardware**”.

9. Click “OK when selections are complete.
10. The next dialog box that appears will ask “**Do you want to save session?**”. Click “**Yes**” and the currently-open “*Evolution Diagnostics.ht*” file will be saved in the HyperTerminal folder.
11. Connect the centrifuge to the mains supply and turn the centrifuge power ON. The centrifuge will boot up normally (the LCD screen will be blank). After the boot process is complete the Hyperterminal screen will also appear blank with a flashing cursor in the lower left corner of the computer screen.
12. On the computer type the letter “D” which will start the Evolution Diagnostics program. The computer screen should display the menu shown below.

```
d
C:\>IF ERRORLEVEL 4 GOTO XFER
C:\>IF ERRORLEVEL 3 GOTO DIAG
C:\>echo..... Start diagnostic
..... Start diagnostic
C:\>evol d
MAIN MENU
-----
c) configuration
d) diagnostic tests
s) Service Menu(s)
a) exit menus (start application)
e) exit application
-----
your choice: s
```

13. When the Service Menu is displayed, select “Calibrate LCD Touch Panel: by entering “1”.

SERVICE MENU
Ke-Board is installed

p) **KE Board Present**
n) **KE Board not Present**
k) **Read and Store Ke Value**
r) **Read and Store Ke Adjustment Ratio**
m) **Machine Temp Gain and Offset**
d) **Display Temp Sensor Data**
a) **Accelerometer menu**
c) **Compressor Selection**
l) **Calibrate LCD Touch Panel**
b) **back to Main**

your choice: l

14. The centrifuge will prompt you with the following instructions in the Hyperterminal window.

Calibrate LCD Touch Panel

Disconnect RS-232.
Power down and power up the centrifuge.
Select Miscellaneous in the Lcd Main Menu.
Select Calibrate Lcd in the Miscellaneous Menu.
Follow the procedure for Lcd calibration.
Power down and power up the centrifuge.

15. Disconnect the null modem cable at the PC-104 processor (73389 ribbon cable).
16. Cycle the centrifuge power “OFF then “ON”.
17. After the centrifuge boots up the LCD screen will be active. Select “MISCELLANOUS” in the main LCD menu.
18. At the next screen select “CALIBRATE LCD”.
19. The centrifuge will prompt you to touch the target in the lower left corner of the touch screen. GENTLY touch the target with a stylus (a small Allen wrench will do).
20. The centrifuge will then prompt you to touch the target in the upper right corner of the touch screen. GENTLY touch the target with a stylus (a small Allen wrench will do). The centrifuge will indicate that the calibration is complete.
21. Close the Hyperterminal window on the PC.

Evolution RC

Table of Contents

8.0 Schematic Diagrams

- 8.1 System Schematic**
- 8.2 Refrigeration Interface Layout**
- 8.3 Refrigeration Interface Schematic Diagram**
- 8.4 Display Board Layout**
- 8.5 Display Board Schematic Diagram**
- 8.6 Drive Interface Layout**
- 8.7 Drive Interface Schematic Diagram**
- 8.8 Door Interface Layout**
- 8.9 Door Interface Schematic Diagram**
- 8.10 Ke Board Layout**
- 8.11 Ke Board Schematic Diagram**
- 8.12 Door Sensor Layout**
- 8.13 Door Sensor Schematic Diagram**
- 8.14 Accelerometer (Imbalance Sensor) Schematic**
- 8.15 Door System Block Diagram**
- 8.16 Drive System Block Diagram**
- 8.17 Refrigeration System Block Diagram**

Schematics & P.C. Boards

System Schematics

Major System (oversize)

Drive System

Refrigeration System

Polyphase System

Door System

P.C. Board Schematics & Component Locations

Drive Interface Board Schematic (oversize)

Drive Interface Board Component Location

Control Panel Display Board Schematic (1 of 5)

Control Panel Display Board Schematic (2 of 5)

Control Panel Display Board Schematic (3 of 5)

Control Panel Display Board Schematic (4 of 5)

Control Panel Display Board Schematic (5 of 5)

Control Panel Display Board Component Location (front)

Control Panel Display Board Component Location (back)

Ke Board Schematic (1 of 2)

Ke Board Schematic (2 of 2)

Ke Board Component Location

Fan Control and Power Supply Schematic

Fan Control Board Component Location

Refrigeration Interface Board Schematic

Refrigeration Interface Board Component Location

Door Interface Board Schematic

Door Interface Board Component Location

Door & Latch Sensor Board Schematic

Door & Latch Sensor Board Component Location

Accelerometer Board Schematic

Precautions for Handling Printed Circuit Boards

W A R N I N G

Hazardous voltages may exist whenever power is connected and circuits are energized. To eliminate potential for serious electrical shock or component damage, turn the main power switch OFF, unplug the centrifuge, then wait four minutes before proceeding. Never remove or install a printed circuit board while the centrifuge power cord is plugged in and the centrifuge power is ON.

C A U T I O N

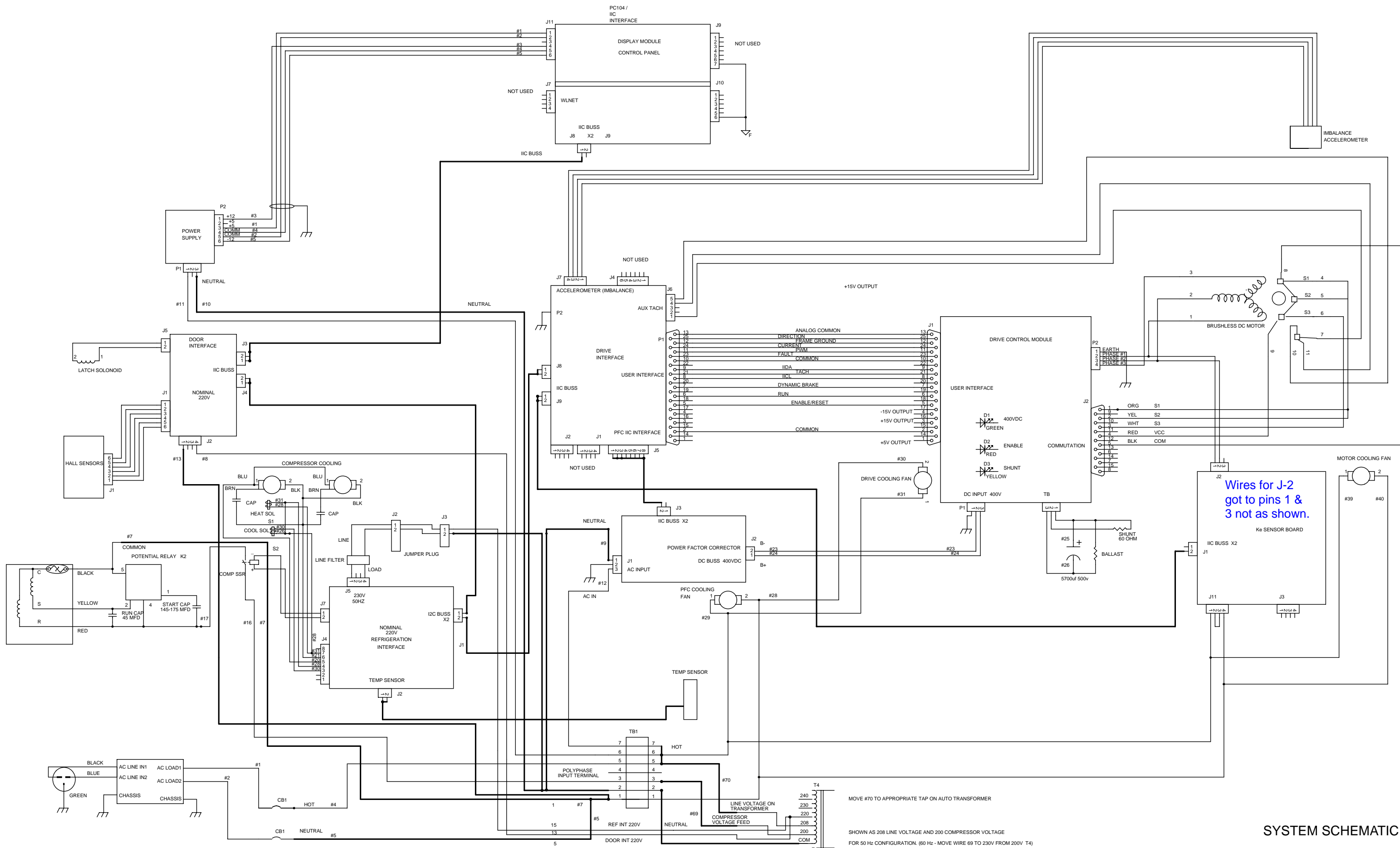
Printed circuit board components can be damaged by static voltage; therefore, it is important to use the following precautions when handling printed circuit boards. An electrostatic discharge control product (such as a Kendro Service-issued Anti-Static Workstation, Catalog No. 73369) is required in order to handle Evolution™ RC printed circuit boards.

Always observe all of the following precautions when handling printed circuit boards:

1. You must be grounded when handling printed circuit boards, especially if working in a carpeted area. Use of an electrostatic discharge control product will protect against static voltages that can destroy some printed circuit board components.
2. Always handle the printed circuit board by its corners only.
3. Wrap the printed circuit board in a conductive plastic packing material, such as Velostat® by 3M Company, whenever the board is to be shipped or stored.
4. Whenever a printed circuit board is out of the centrifuge, cover all connectors with conductive plastic.

W A R N I N G

If it is necessary to replace printed circuit components, make sure the soldering iron used is properly grounded.

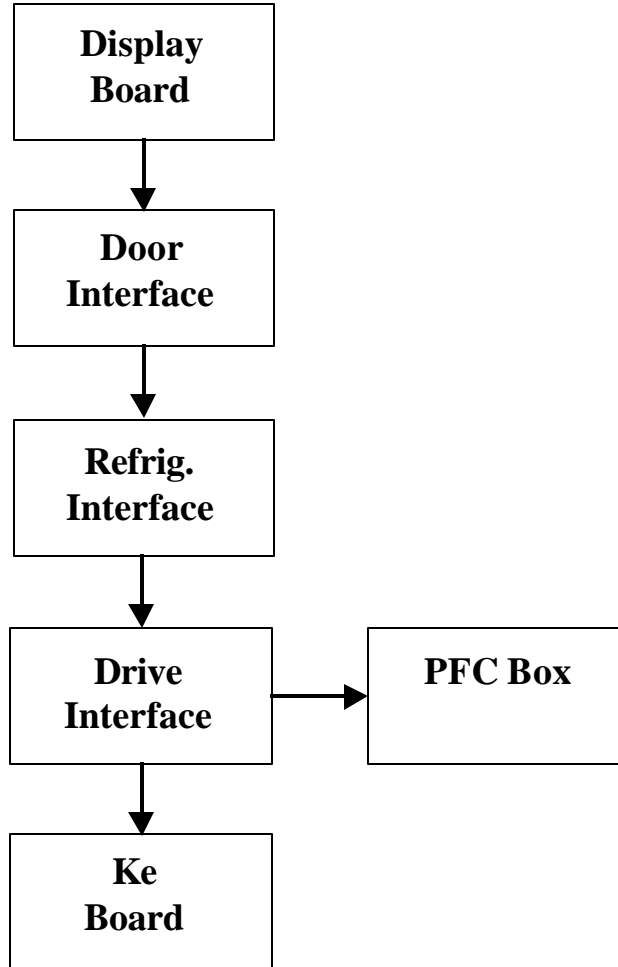


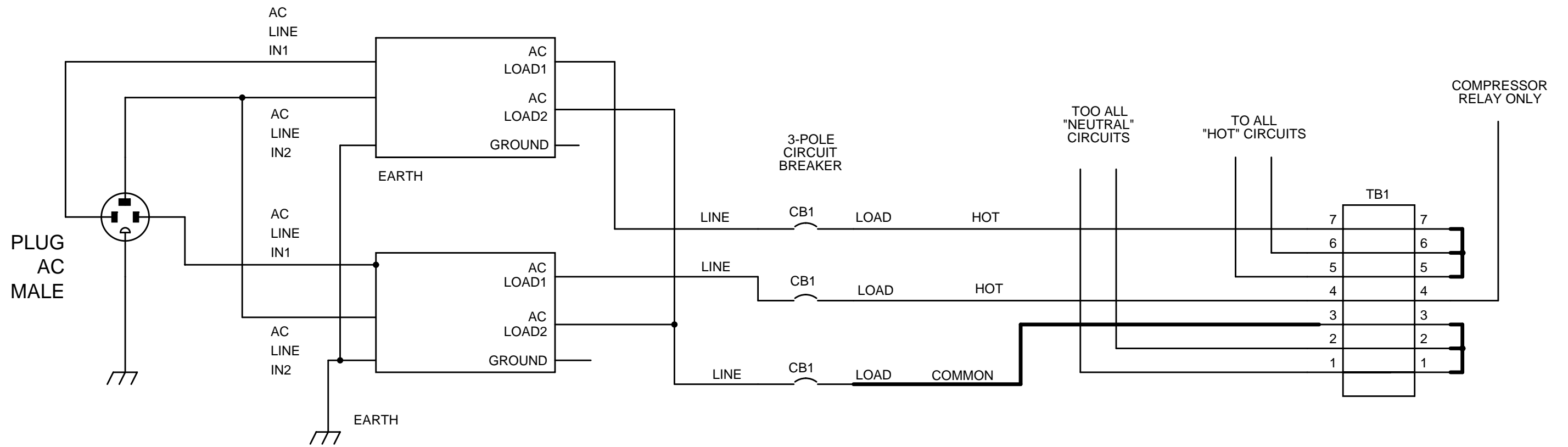
Wires for J-2
got to pins 1 &
3 not as shown.

MOVE #70 TO APPROPRIATE TAP ON AUTO TRANSFORMER
SHOWN AS 208 LINE VOLTAGE AND 200 COMPRESSOR VOLTAGE
FOR 50 Hz CONFIGURATION. (60 Hz - MOVE WIRE 69 TO 230V FROM 200V T4)

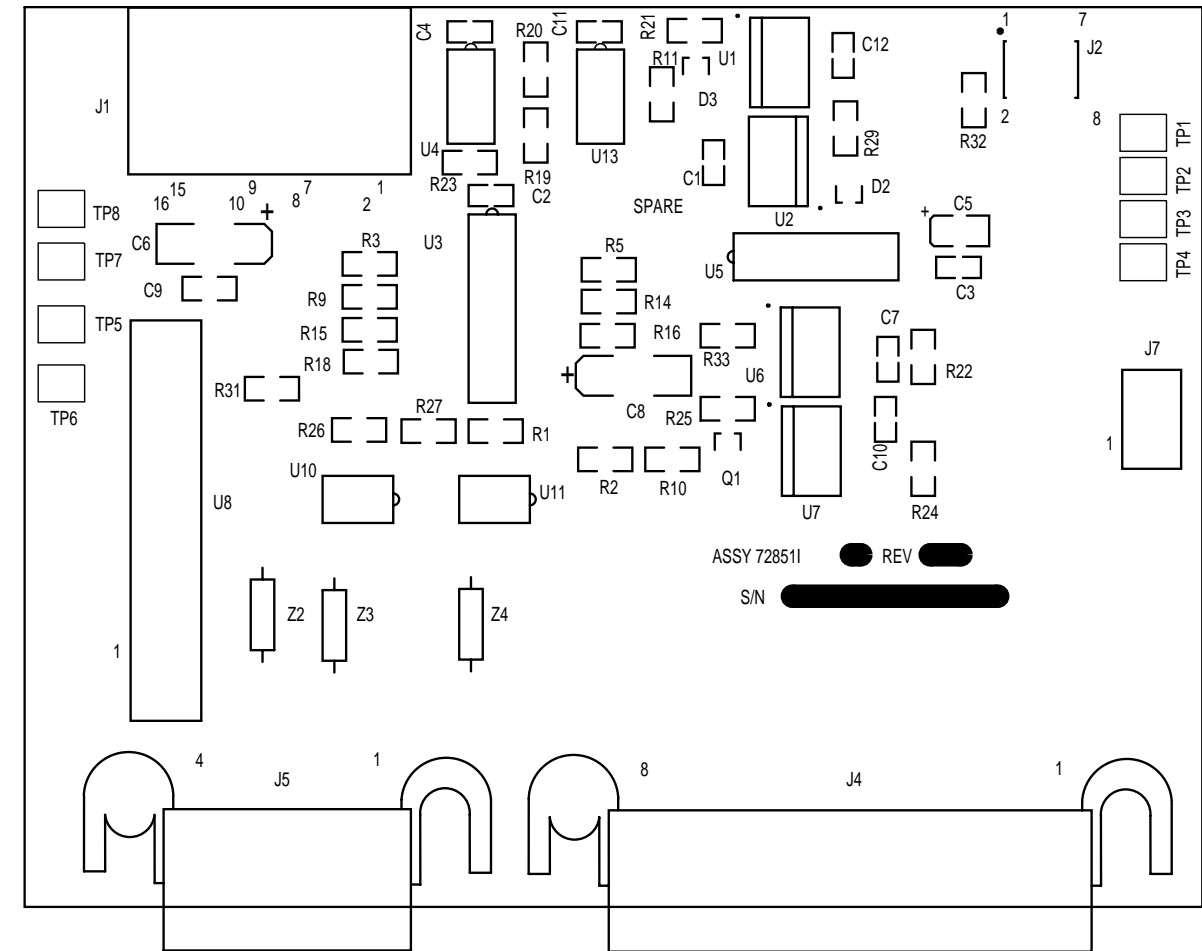
SYSTEM SCHEMATIC

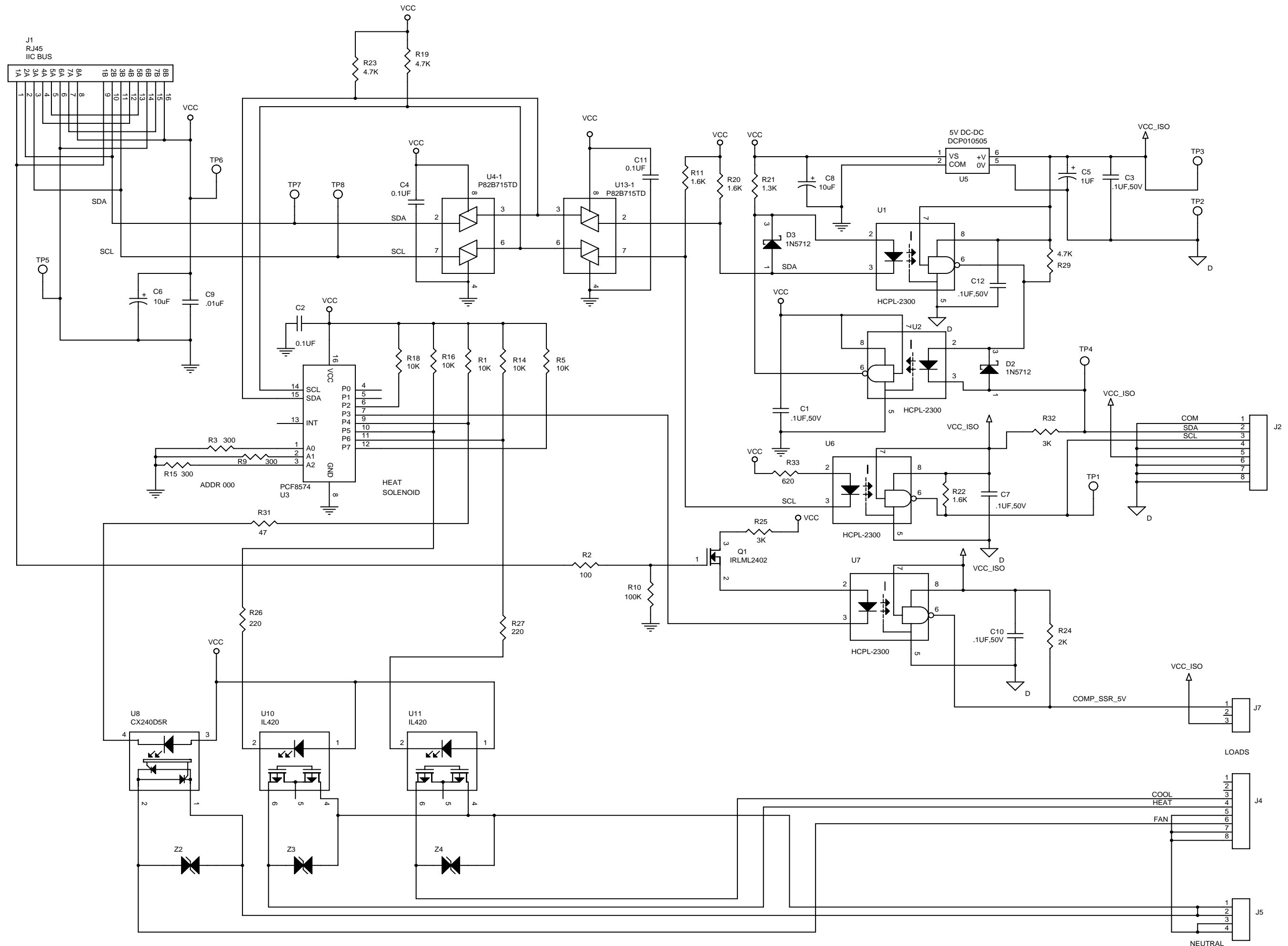
Evolution RC I2C Bus Routing

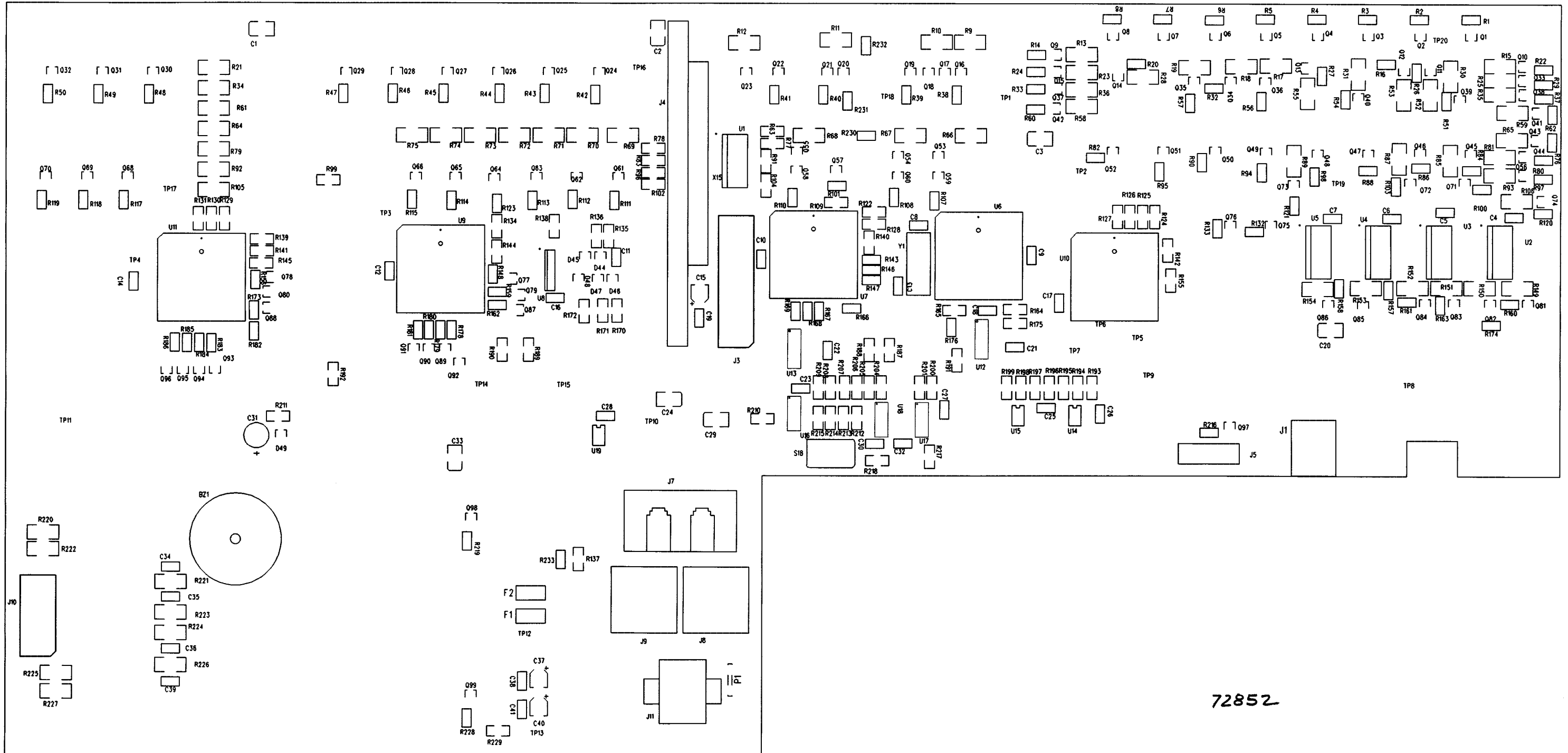




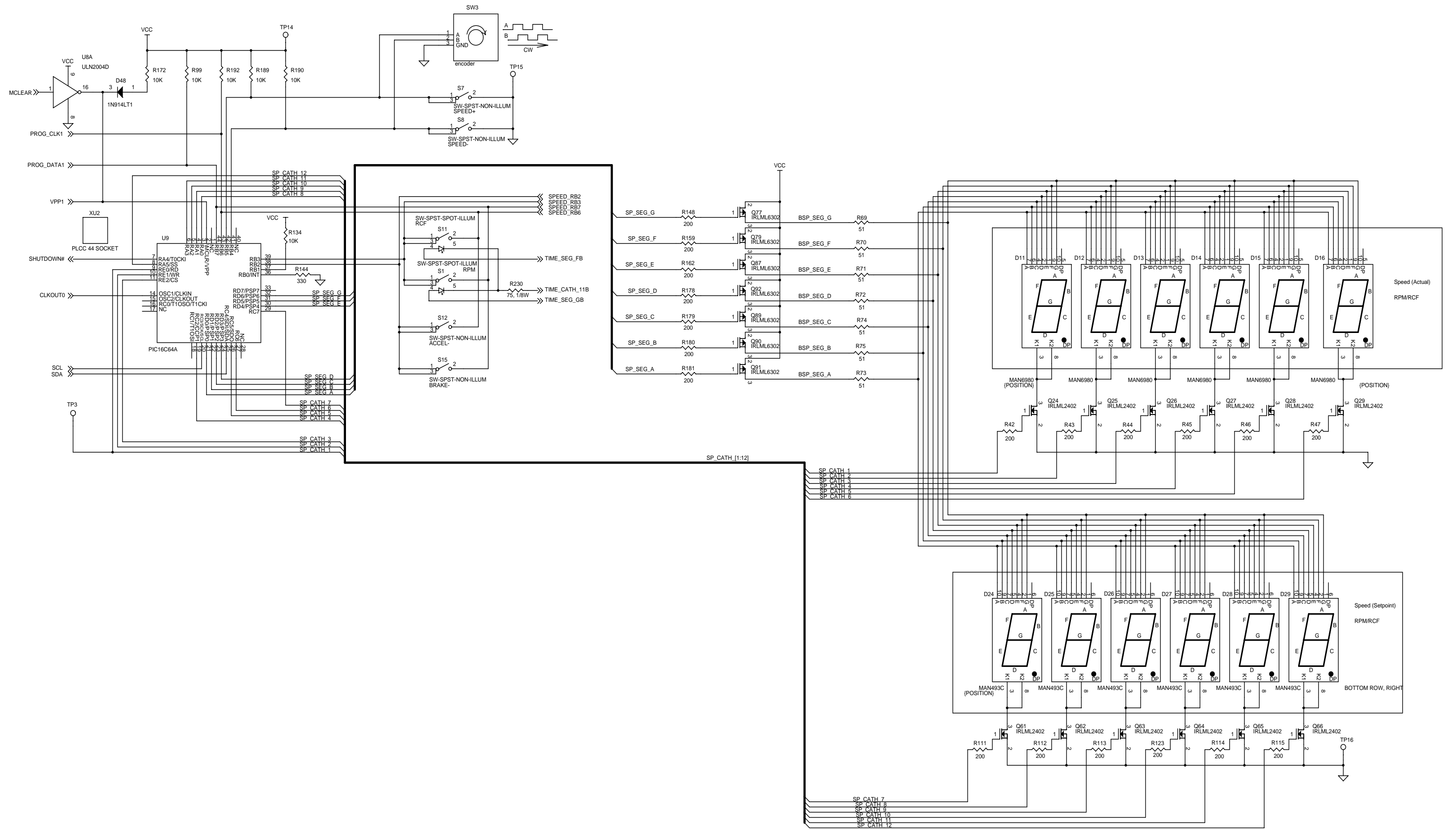
POLYPHASE SYSTEM



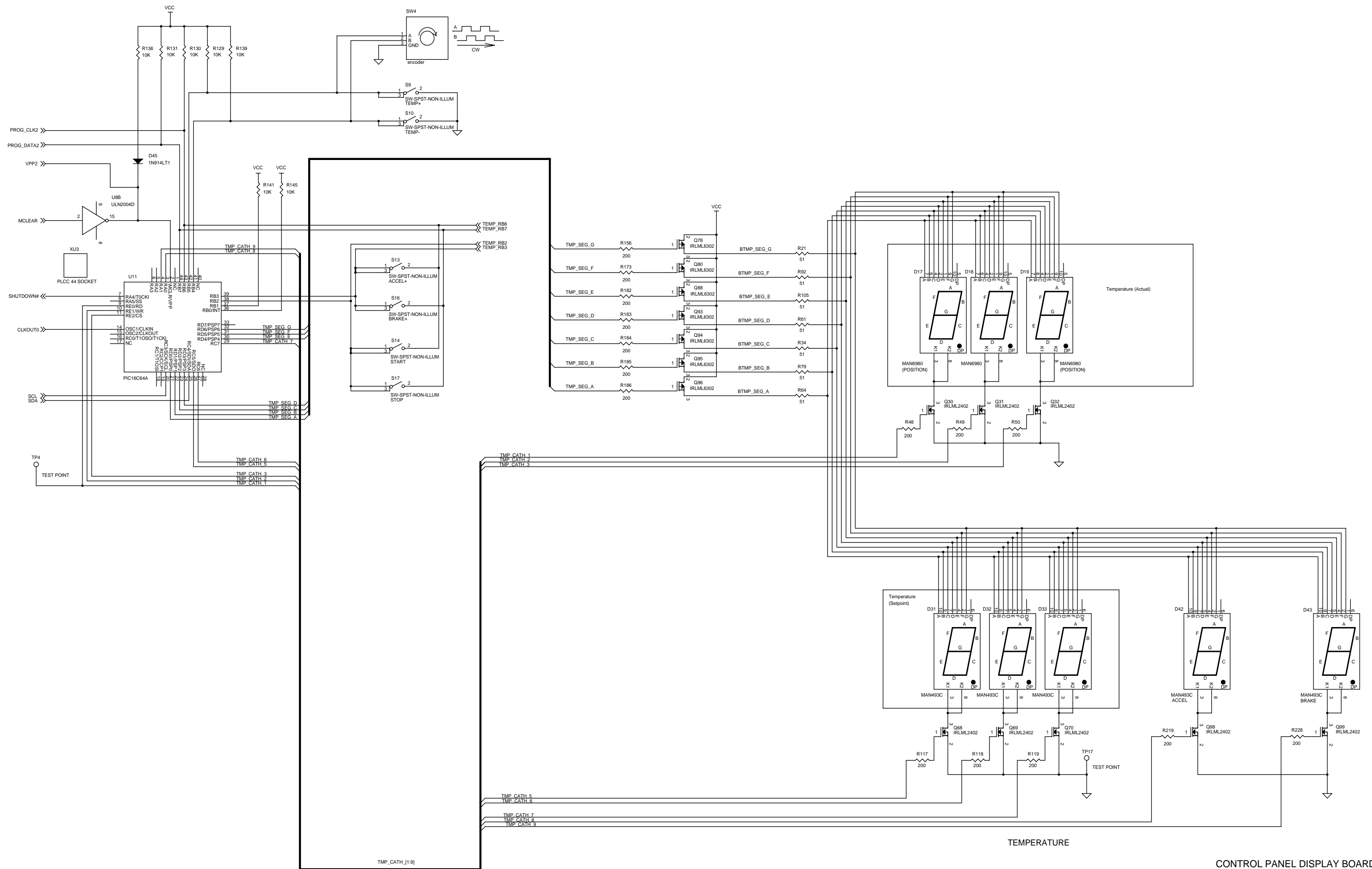


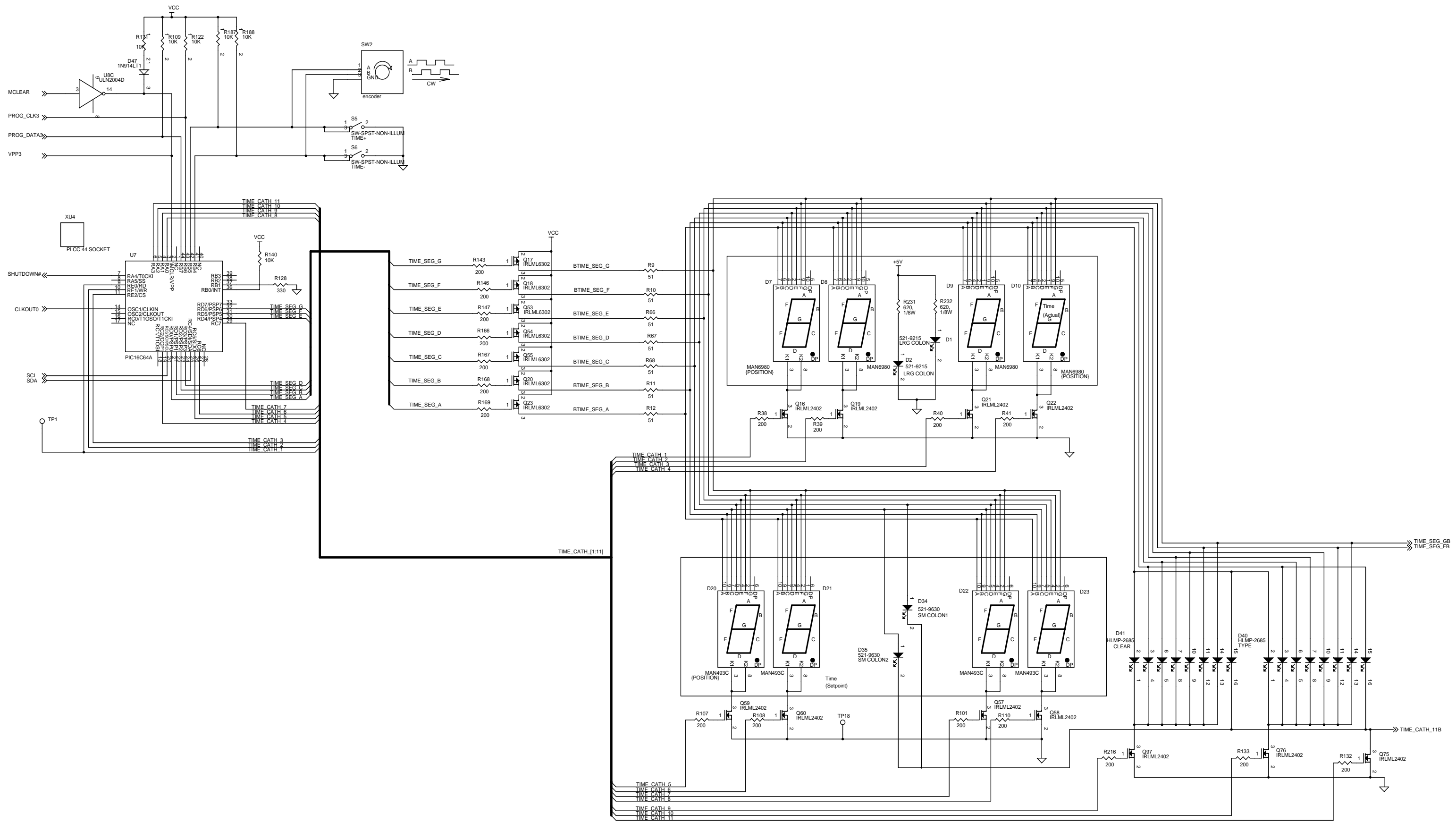


72852

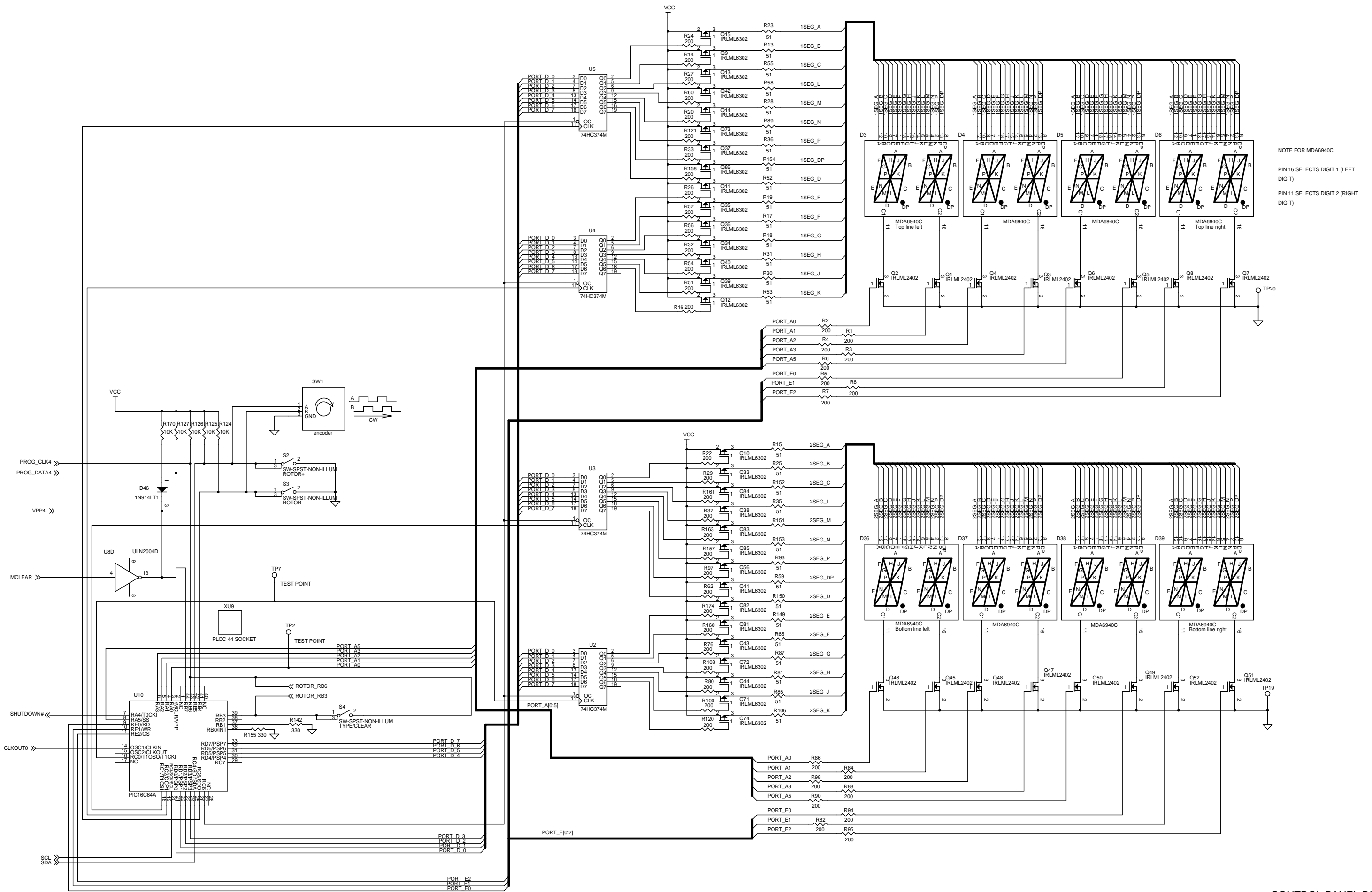


SPEED

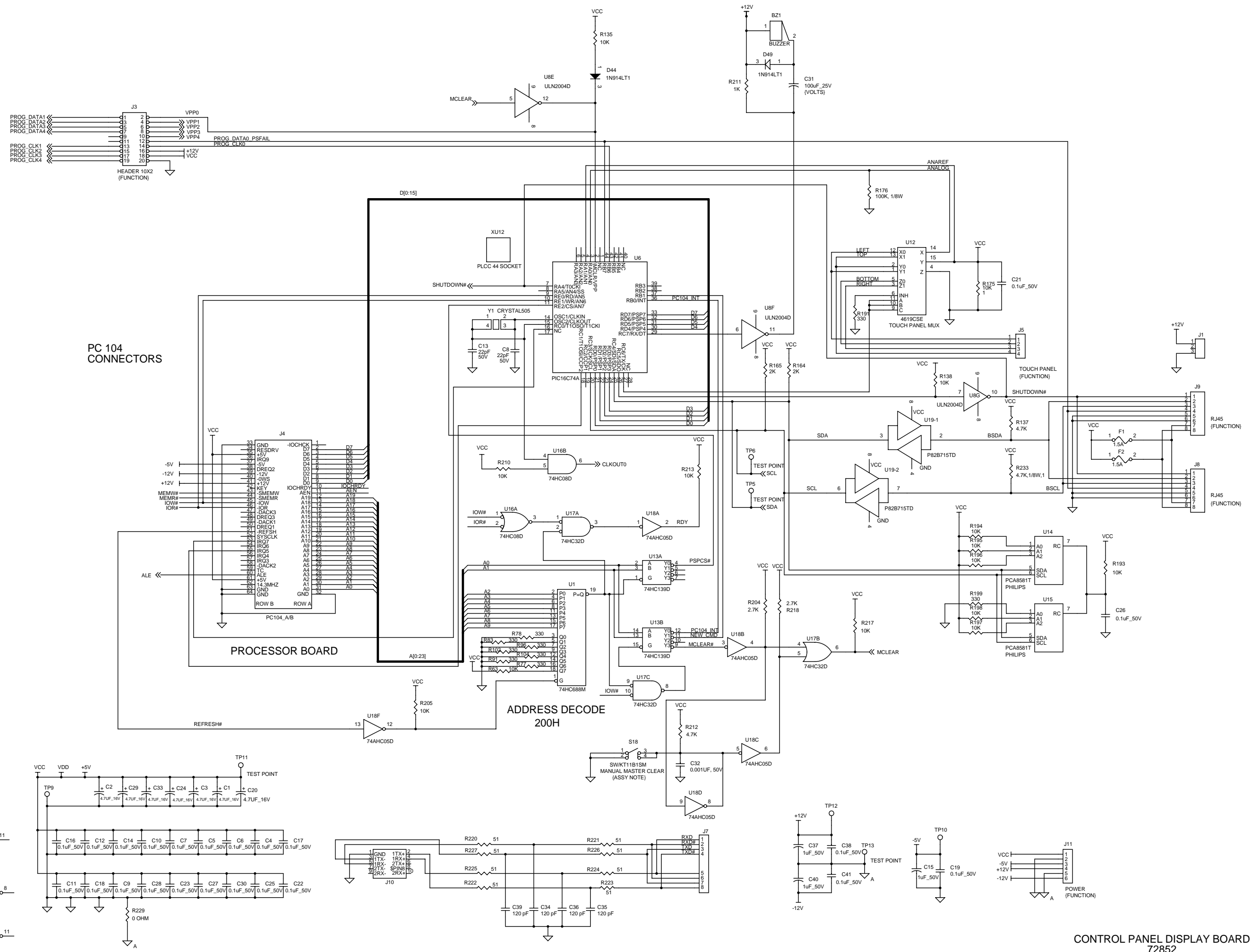




TIME

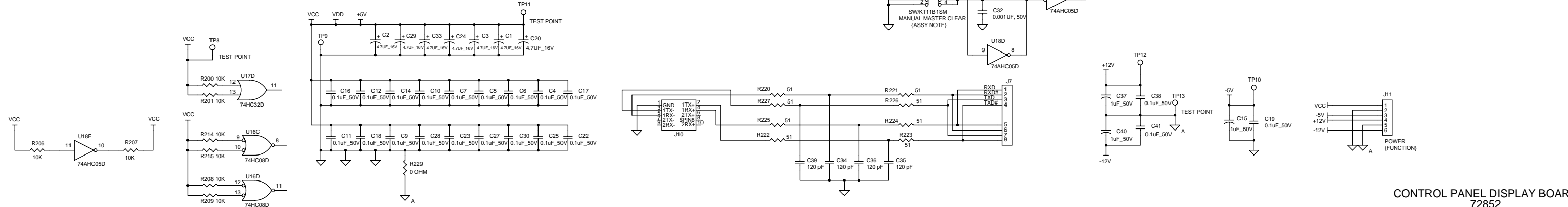


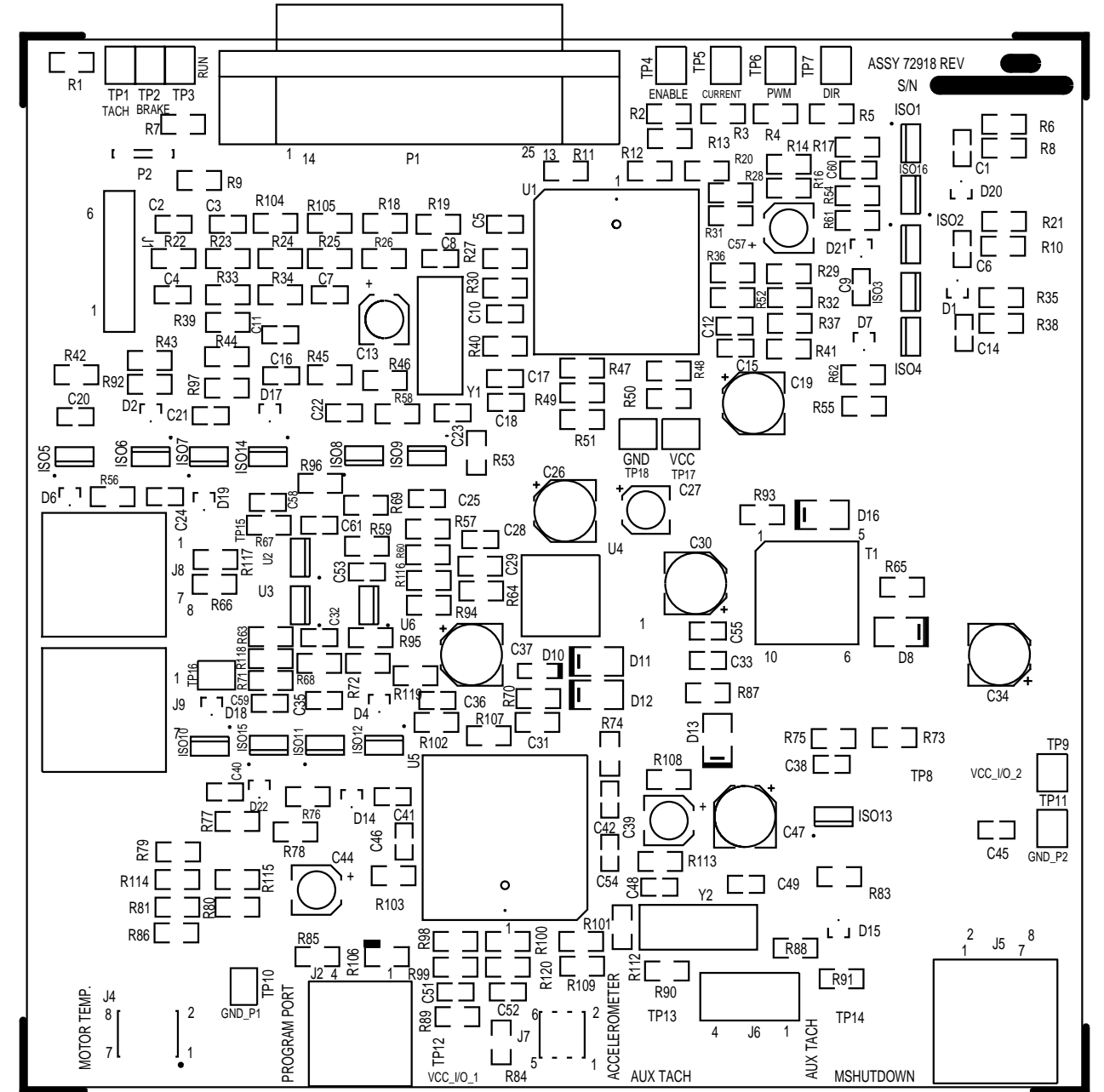
NOTE FOR MDA6940C:
 PIN 16 SELECTS DIGIT 1 (LEFT DIGIT)
 PIN 11 SELECTS DIGIT 2 (RIGHT DIGIT)

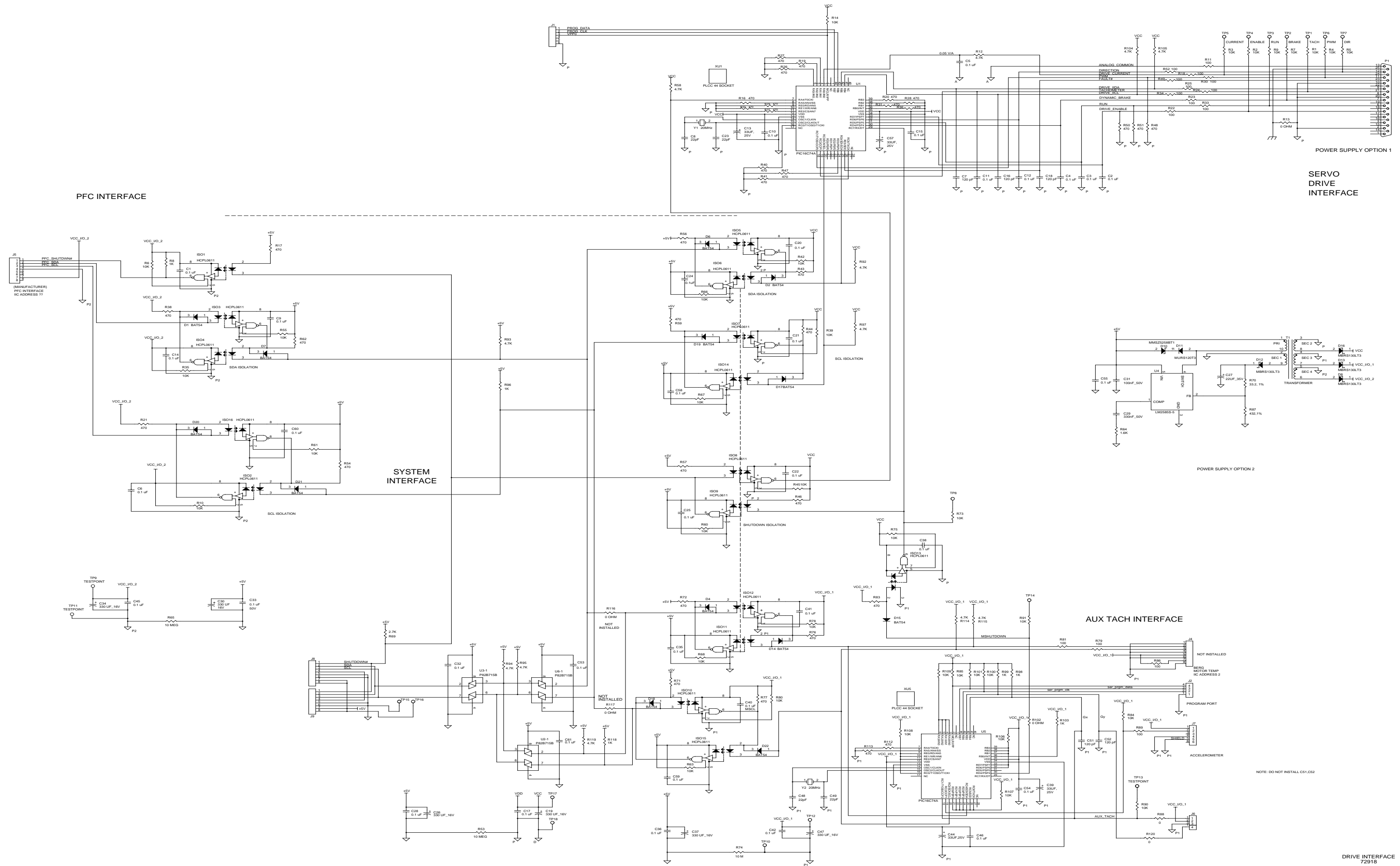


- LAST USED REFERENCES
- J13
 - TP13
 - U20
 - Z6
 - Y1
 - S18
 - R237
 - C41
 - BZ1
 - D53
 - Q101

SPARES







PFC INTERFACE

POWER SUPPLY OPTION 1

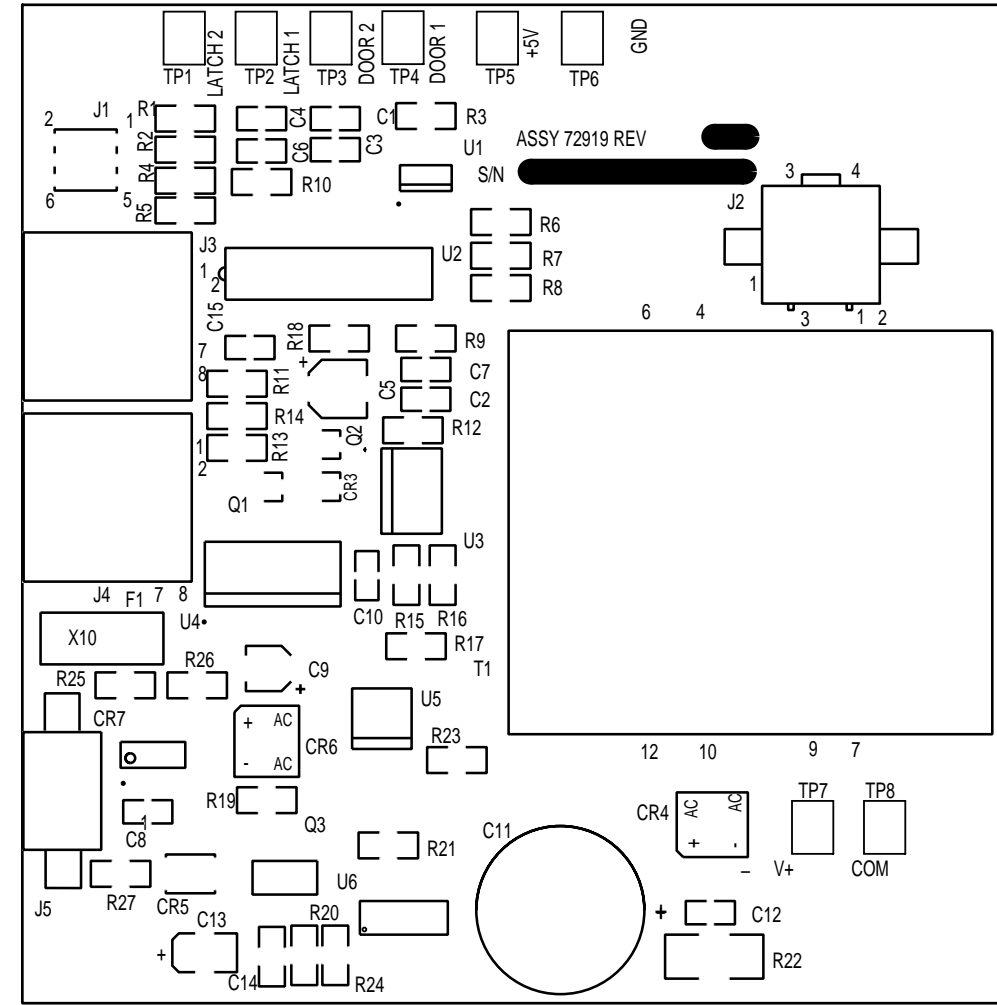
SERVO DRIVE INTERFACE

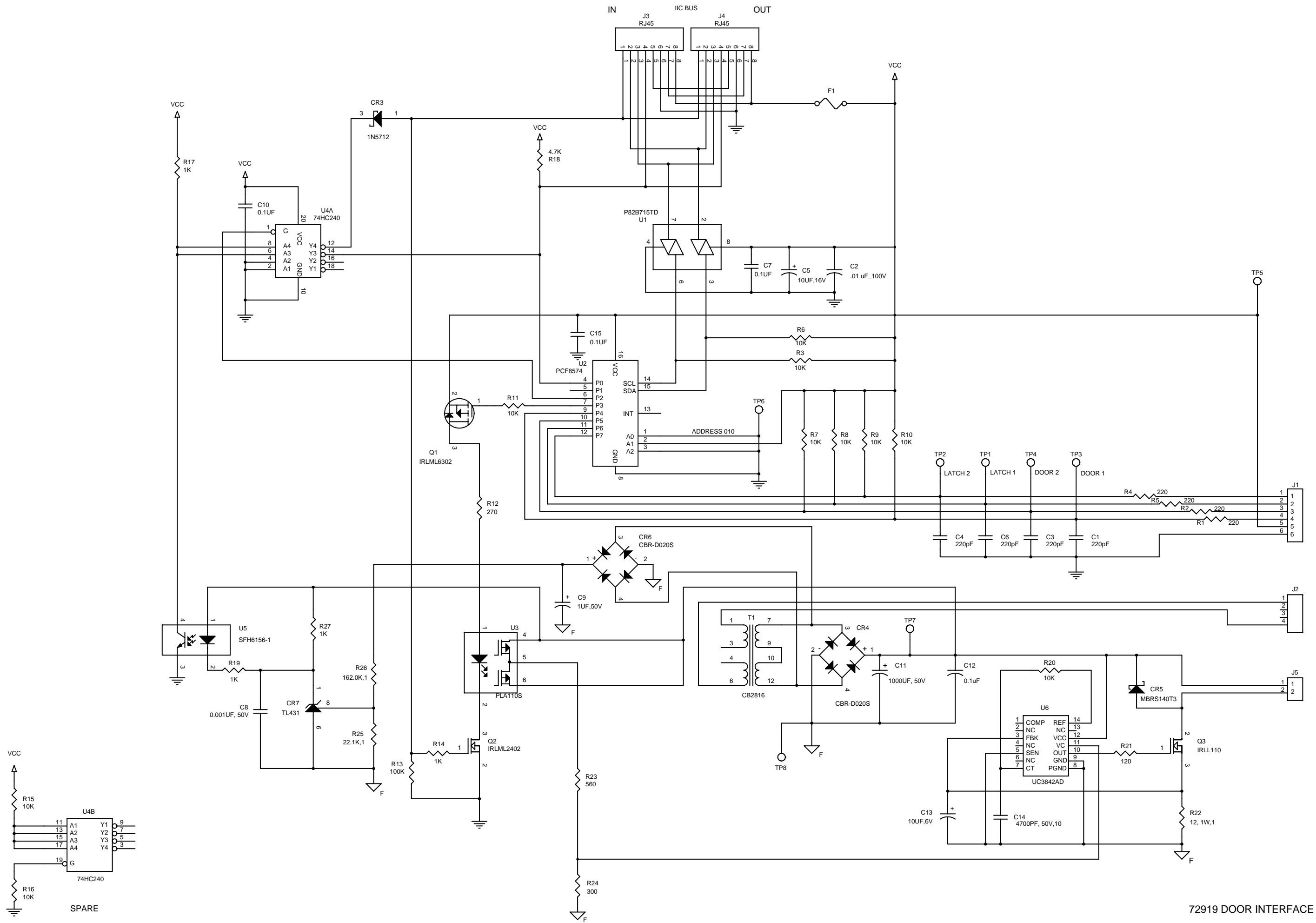
SYSTEM INTERFACE

POWER SUPPLY OPTION 2

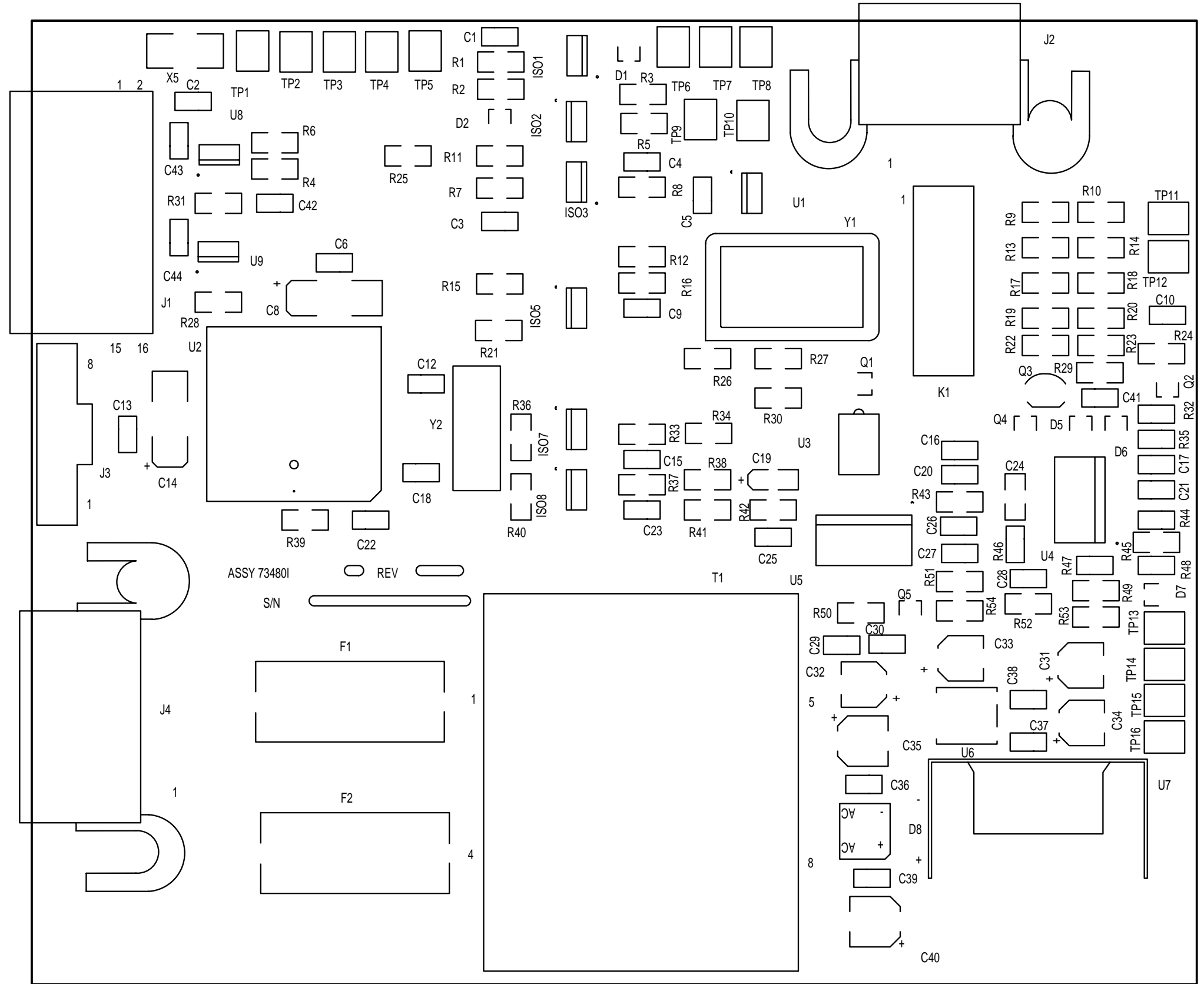
AUX TACH INTERFACE

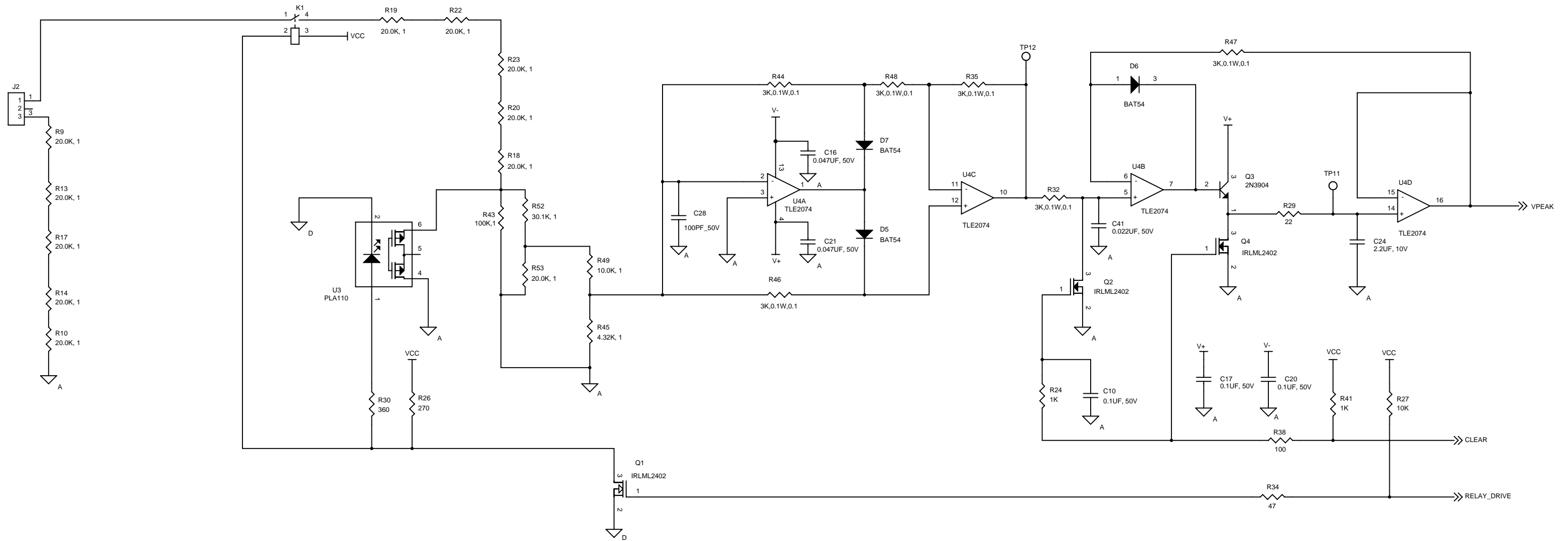
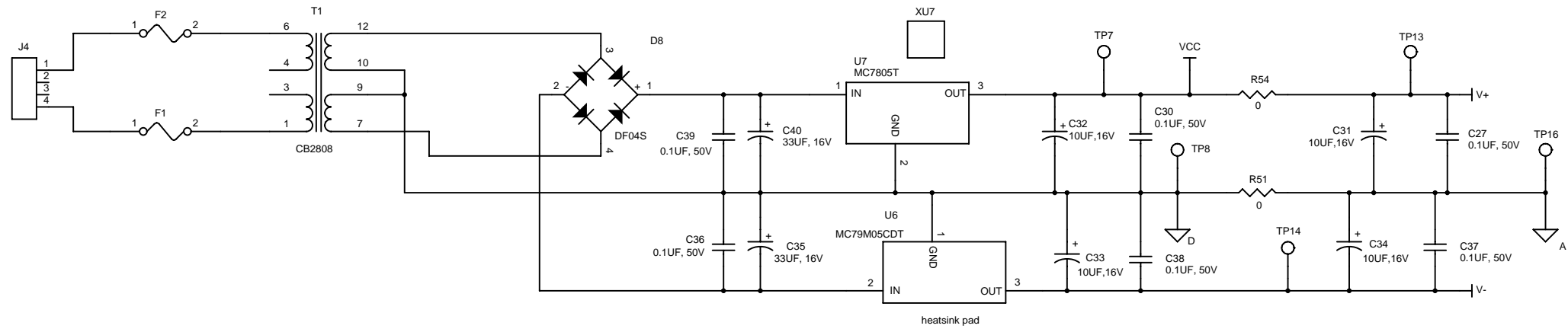
NOTE: DO NOT INSTALL C51-C52

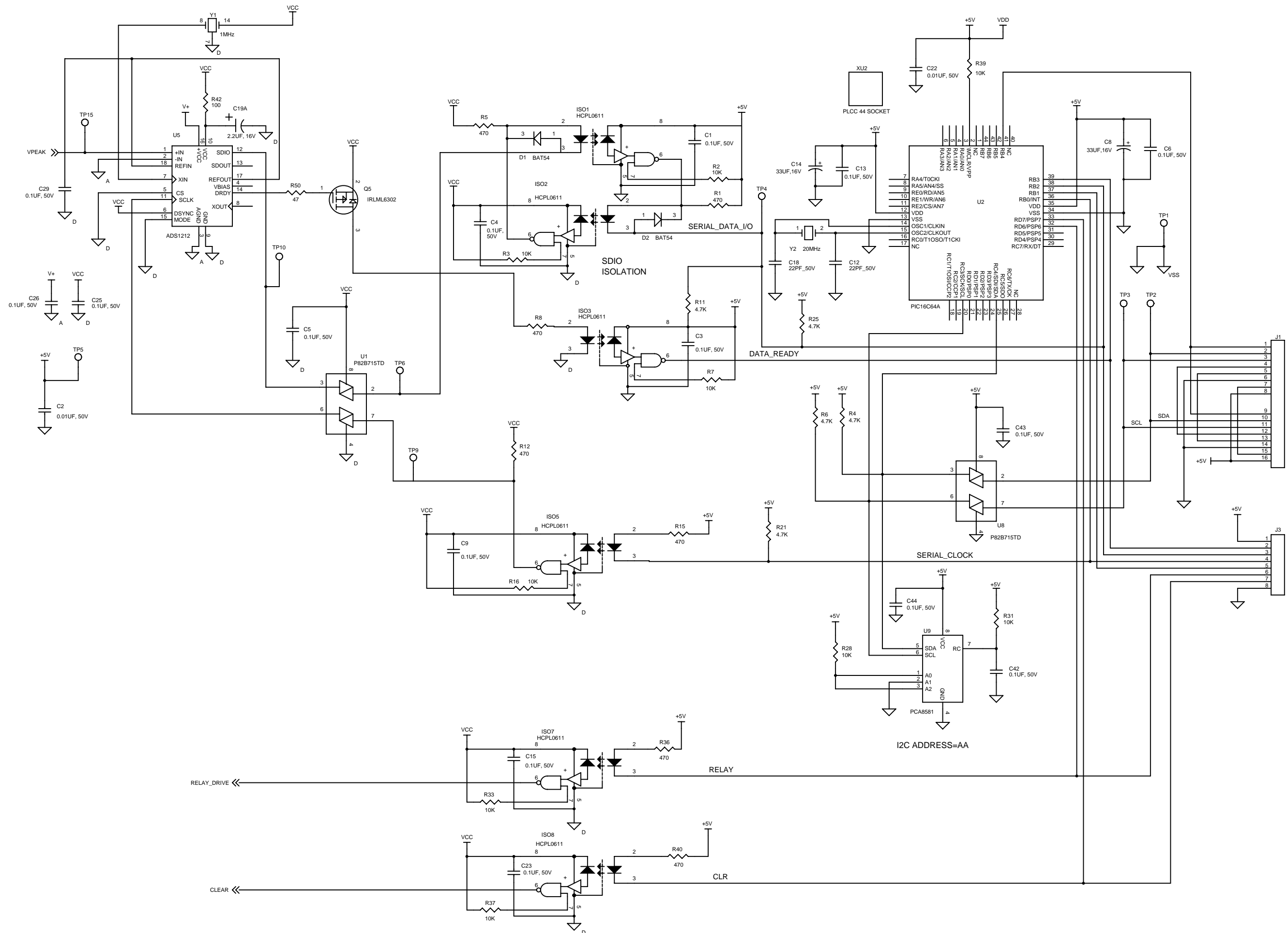


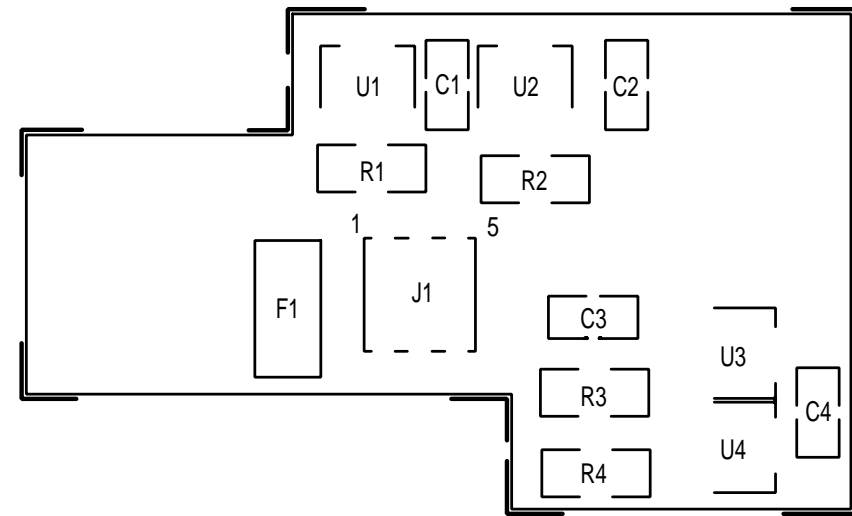


72919 DOOR INTERFACE

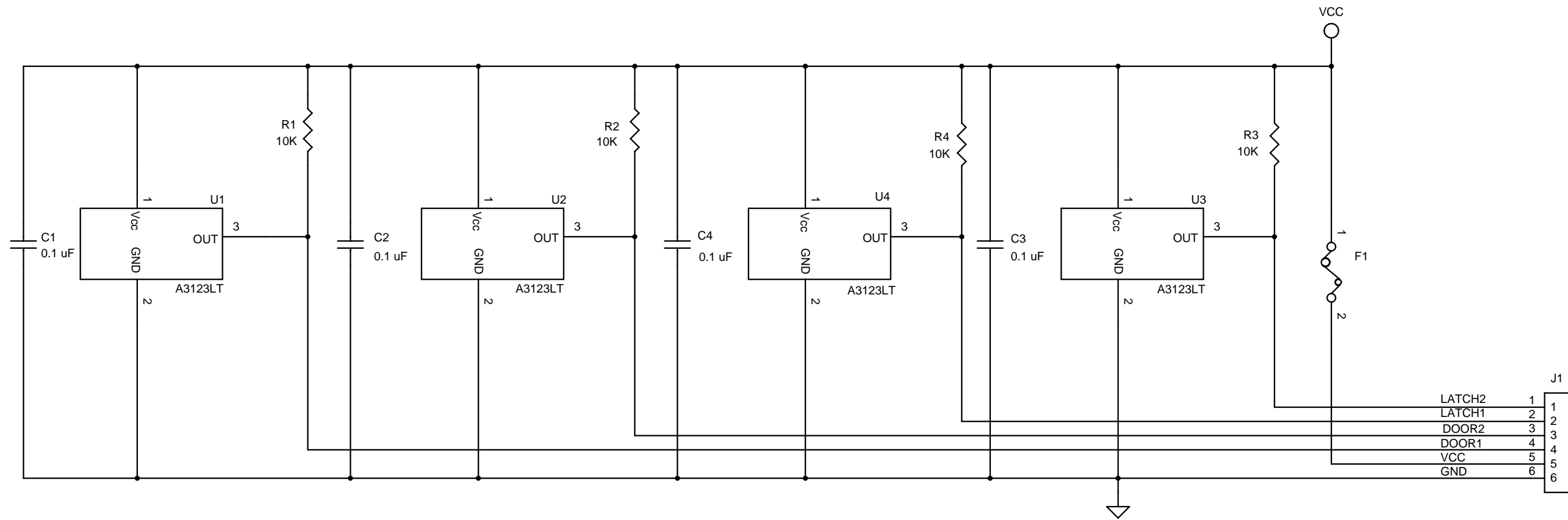


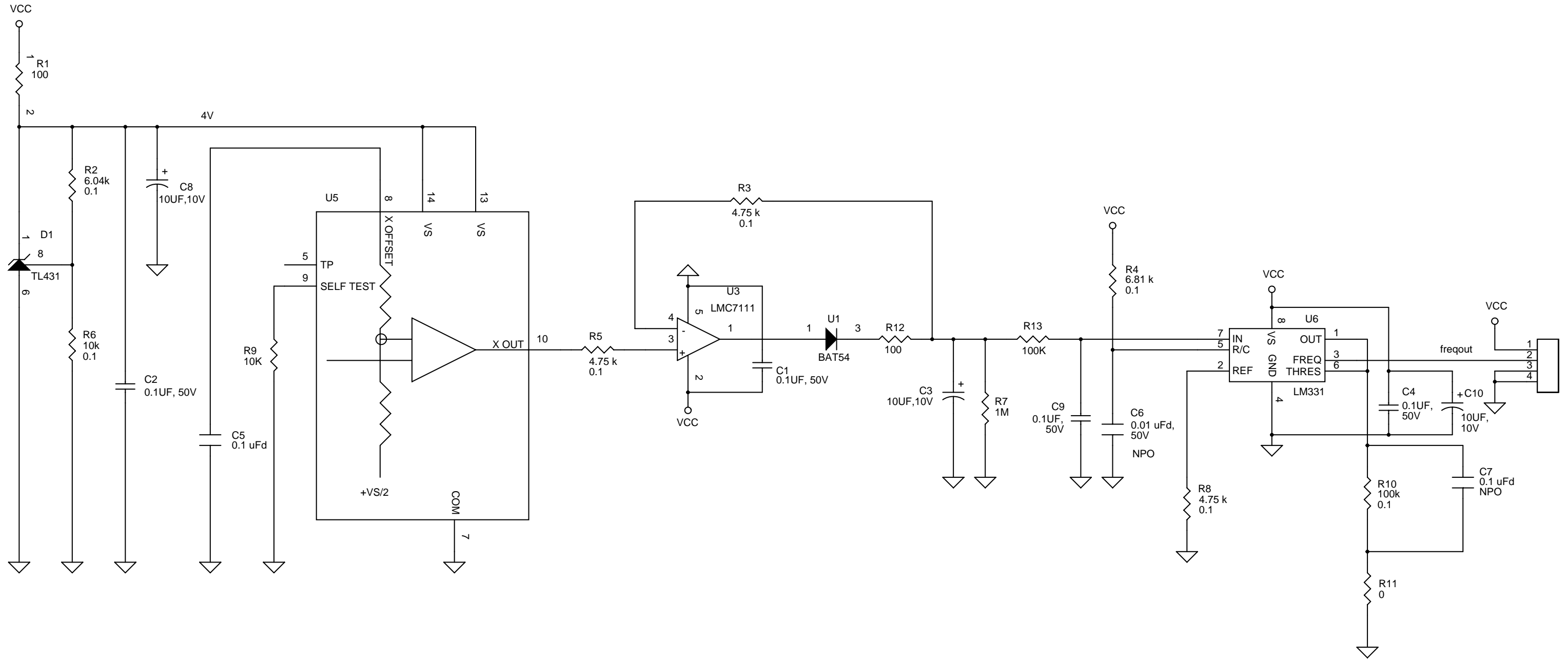


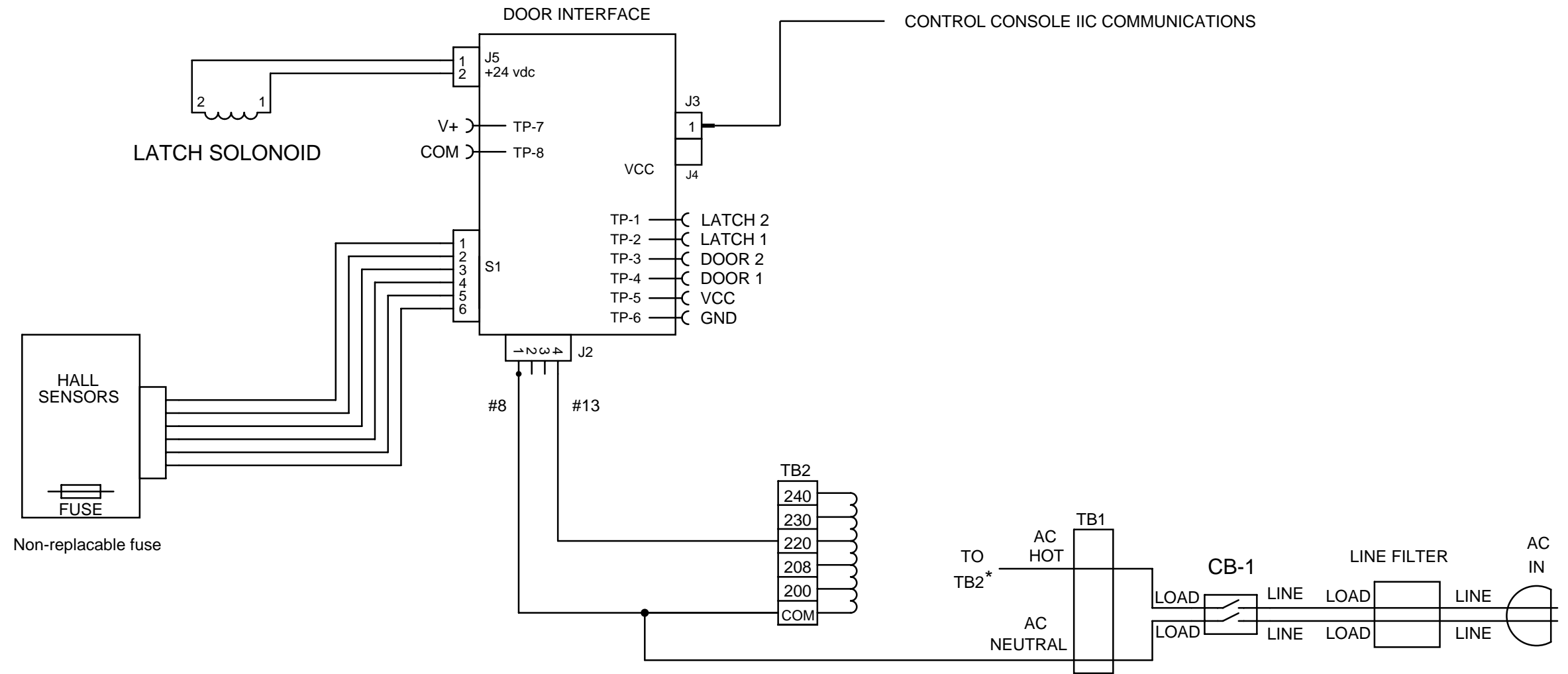




72822 DOOR SENSOR

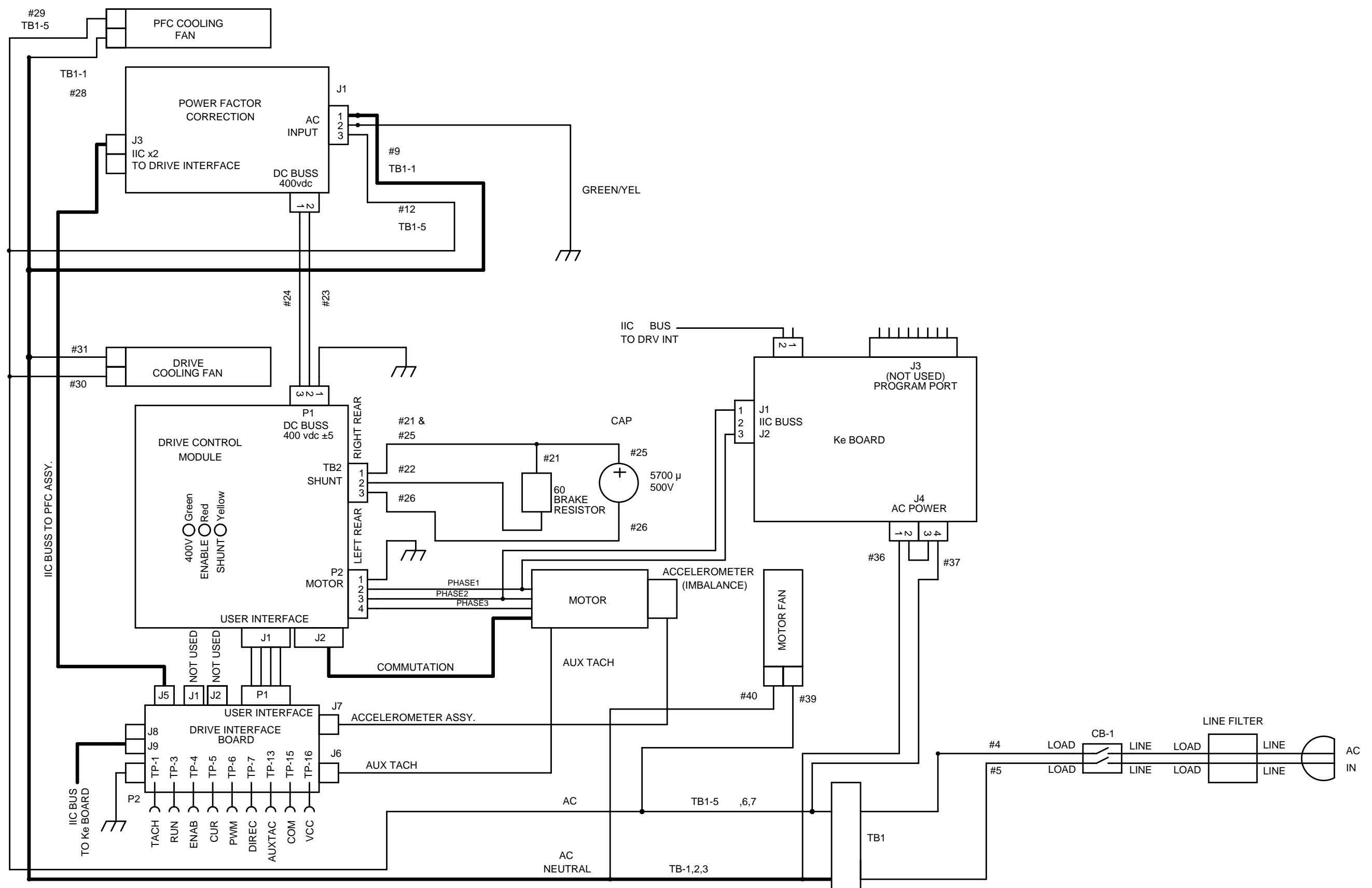






LINE TO APPROPRIATE TAP ON TRANSFORMER:
 IF AC INPUT VOLTAGE < 240V DOOR TO 220V TAP
 IF AC INPUT VOLTAGE > 240V DOOR TO 208V TAP

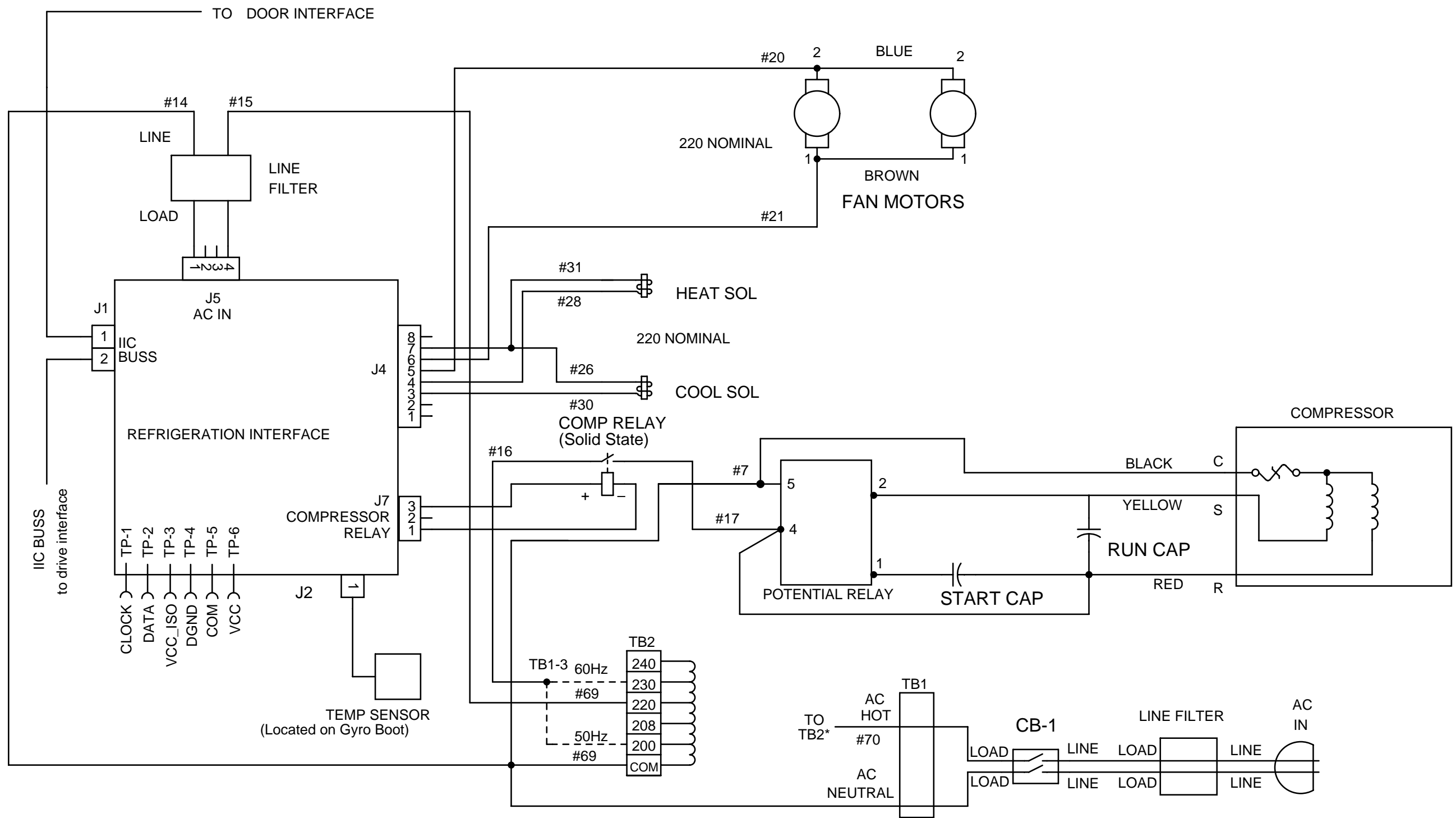
* AC HOT CONNECTS TO THE TB2 TAP THAT MATCHES LINE VOLTAGE.



Main Tach Between
 TP-1 & TP-18
 Speed = Freq. x 10

AUX Tach Between
 TP-13 & TP-10
 Speed = Freq. x 30

NOTE: POSITION 4 IS POLY-PHASE ONLY (COMPRESSOR)



* AC HOT CONNECTS TO THE TB2 TAP THAT MATCHES LINE VOLTAGE.

Section 9: *ILLUSTRATED PARTS*

Replacement Parts List

Figure 9-1 Control Console

Figure 9-2 Top Deck & Door Assemblies

Figure 9-3 Main Assembly

Figure 9-4 Door Rail Detail

Figure 9-5 Rear View

Figure 9-6 Front View

Figure 9-7 Drive Control Chassis

Figure 9-8 Condensing Assembly

Figure 9-9 Motor / Gyro Assembly

Section 9: *ILLUSTRATED PARTS*

This section provides illustrations of Evolution RC assemblies and each illustration is keyed by item numbers to an accompanying parts list. The parts lists provide the part numbers and descriptions of each item that is called out on the illustrations. When ordering replacement parts, specify the part number and description, and the serial number of the centrifuge.

NOTE:

Tables throughout this section contain part numbers valid at the time of printing. All part numbers are subject to change without notice. Part numbers in **BOLD BLACK** type are currently stocked at our parts depot and are routinely available. Other parts listed in **RED** will be provided on a best effort basis.

Replacement Parts List Evolution RC

Figure 9-1. Evolution RC Control Console

Item	Description	Part #
1	KNOB, CONTROL	72970
2	BATTERY BACKUP PC104 (4940BM)	73300
3	KIT PC-104/COMPACT FLASH	73340
4	CABLE RIBBON, IDE	73826
5	CONSOLE ASSY, REAR	72971
6	KNOB, CONSOLE PIVOT	92793
7	PLATE MOUNTING HARD DRIVE	73824
8	COMPACT FLASH MEMORY use KIT PC-104/COMPACT FLASH	73340
9	KIT, BUTTON DISPLAY BOARD	73337
9	KIT, KNOB DISPLAY BOARD	73338
10	OVERLAY ASSY, BUTTON	73443
10	OVERLAY ASSY, KNOB	73439
11	CONSOLE FRONT	72907
	Kit, Upgrade Knob Evolution RC AFM (LCD Module)	73889
	Kit, Upgrade Button Evolution RC AFM (LCD Module)	73891
	KIT, LCD ASSEMBLY	73341
	KIT, LCD TRANSITION BOARD	73343
	Low Voltage Power Supply Harness	72924

Figure 9-2. Evolution RC Top Deck & Door Assemblies

Item	Description	Part #
1	DECK, TOP FRONT ASSEMBLY	73408
2	DECK, TOP REAR	72904
3	DOOR HANDLE ASSEMBLY, EVOLUTION	73825
4	DOOR PLATE ASSEMBLY (Steel plate & top panel only)	72880
5	Kit, Roller Replacement	73869
	DOOR LATCH RAMP (does not include door magnets which must be ordered separately)	72943
	MAGNET, 0.250" DIAMETER, (4 Magnets needed for door latch ramp)	67653

Replacement Parts List Evolution RC

Figure 9-3. Evolution RC Main Assembly

Item No.	Description	Part No.
1	PANEL, FRONT, ASSEMBLY (Does not include decals)	72900
1	DECAL, EVOLUTION	72972
1	DECAL, KENDRO, LARGE	72973
2	GASKET, KSB PORT, EVOLUTION	72983
3	COVER, KSB, EXTERNAL	72899
4	PLUG, KSB, INTERNAL	72823
	HOLDER ASSEMBLY, TUBING (Tubing holder for TZ-28 rotor)	73486
5	SLIDER, EVAPORATOR SEAL, EVOLUTION (Beneathe Seal)	72963
6	SEAL, EVAPORATOR	72845
7	PANEL, BACK	72912
8	CORD ASSEMBLY, POWER, EVOLUTION RC (208 volt 60 Hz Centrifuges)	76178
8	CORD, POWER, BLACK, 4 CONDUCTOR (4940T) (Single Phase 50 Hz Centrifuges)	50585
8	CORD, POWER, 5 CONDUCTOR (2844) (Poly Phase 50 Hz Centrifuges)	50543

Figure 9-4. Evolution RC Door Rail Detail

Item No.	Description	Part No.
1	Kit, Door Repair (S/N 10200647 & Below)	73870
1	DOOR RAIL, LEFT (S/N 10200648 & Above)	73863
2	PULLEY, IDLER (Obsolete starting with 10200648, Use #73870 on machines S/N 10200647 & Below)	72962
3	DOOR STOP BUMPER	73861
4	REEL, RETRACTOR (Use on S/N 10200648 & below only)	72890
5	RAIL, DOOR, RIGHT (Obsolete use #72870 for S/N 10200647 & Below)	72876
5	RAIL, DOOR, RIGHT (Use on S/N 10200647 & above only)	73862
6	KIT, DOOR LATCH, EVOLUTION	73452
7	CABLE ASSEMBLY, DOOR SENSOR, INST	71719
8	KIT, DOOR LATCH SENSOR	73362

Figure 9-5. Evolution RC Rear View

Item No.	Description	Part No.
1	KIT, POWER SUPPLY	74777
2	RELAY SOLID STATE #1 CRYDOM #H (Refrigeration Relay)	68794
3	FAN, CONDENSER, EVOLUTION	72831
4	KIT, REFRIGERATION BOARD	73334
5	FILTER EMI 250/30A KK-1151	92005

Replacement Parts List
Evolution RC

Figure 9-6. Evolution RC Front View

Item No.	Description	Part No.
1	BREAKER, CIRCUIT (Single phase 30 amp)	92794
1	BREAKER, CIRCUIT 3 POLE (Poly Phase 30 amp)	92824
2	GASKET, CIRCUIT BREAKER	73409
3	PLENUM SUPPORT, MOTOR COOLING	72988
4	KIT, PCB MOTOR SENSOR, KE (S/N 10300735 & Below)	73333
5	TRANSFORMER ASSEMBLY, EVOLUTION	73467
6	FAN, 230V AXIAL COOLING (Motor cooling fan)	92921
6	Finger Guard, Fan	90392
7	LEVELING FOOT	72979

Figure 9-7. Evolution RC Drive Control Chassis

Item No.	Description	Part No.
1	CAPACITOR, PFC, 5700MFD 500VAC	72850
2	PFC / BRAKE FAN	69380
3	DRIVE CONTROL MODULE FAN	92921
4	KIT, DRIVE INTERFACE BOARD	73332
5	DRIVE CONTROL MODULE	72913
5	RECONDITIONED DRIVE CONTROL MODULE	R72913
6	PFC ASSEMBLY	72886
6	RECONDITIONED PFC ASSEMBLY	R72886
7	CALROD BRAKE RESISTOR	91046

**Replacement Parts List
Evolution RC**

Figure 9-8. Evolution RC Condenser Assembly

Item No.	Description	Part No.
1	KIT, FILTER DRIER, EVOLUTION	73328
2	KIT, EXPANSION VALVE, EVOLUTION	73458
3	COIL, SOLENOID, LIQUID LINE	92773
4	TRANSORB ASSEMBLY, SOLENOID (Surge Suppressor)	71704
5	CAPACITOR, RUN	92733
6	CAPACITOR, START (60 Hz centrifuges)	92734
6	CAPACITOR, START (50 Hz centrifuges)	91922
7	VARISTOR, POTENTIAL RELAY (4940BB)	71730
8	RELAY, POTENTIAL	92732
9	KIT, CONDENSER, EVOLUTION 60HZ	73326
9	KIT, CONDENSER, 50HZ EVOLUTION	73832
10	KIT, SUCTION LINE, EVOLUTION	73456
11	SEAL,TEFLON 5/8" X 3/4"	66952
12	SEAL,TEFLON FBR 7/8" ID X	61768
13	COIL, SOLENOID, HOT GAS	92774
14	TRANSORB ASSEMBLY, SOLENOID (Surge Suppressor)	71704

Figure 9-9. Evolution RC Motor / Gyro Assembly

Item No.	Description	Part No.
1	SPINDLE, ASSEMBLY EVOLUTION RC	59194
2	SCREW, SET, CUP PT M4 X 6MM	92815
3	SLINGER, GYRO, 26K	72863
4	KIT, TEMP SENSOR / GYRO BOOT	73360
5	INSULATION, GYRO BOOT	73430
6	INSULATION, BOOT, GYRO, LOWER	73316
7	RING, SPRING, CLAMP, OUTER	72871
8	KIT, IMBALANCE SENSOR	73358
9	KIT, GYRO, EVOLUTION	73446
10	KIT, GYRO SPRING, EVOLUTION	73833
11	KIT, VIBRATION DAMPING	73881
12	MOUNT, SHOCK	92786
13	Plate, Backing, Motor/Gyro	73853
14	RING, DAMPER, MOTOR	72839
15	BRACKET, MOUNT, MOTOR	72838
16	KIT, MOTOR COUPLING, EVOLUTION	73450
17	KIT, MOTOR, EVOLUTION	73448

Replacement Parts List
Evolution RC**Other Items (Not Illustrated)**

Item No.	Description	Part No.
	KIT, SOFTWARE UPGRADE, EVOLUTION	73339
	SERIAL CABLE, EVOLUTION (Null Modem Cable)	73827
	KIT ,ANTI STATIC, SERVICE	73369
	WRIST STRAP, ANTI STATIC	73370
	TEST BOARD, EVOLUTION (I2C Test board / calibration)	73373
	TEST CABLE, BUSS VOLT, EVOLUTION (PFC Test Cable)	73391
	GAUGE, GAP, EVOLUTION (Motor Coupling / Door Latch)	73492
	MANUAL, OPERATOR, EVOLUTION	72975
	MANUAL, EURO OPERATOR, EVOLUTION RC	73483
	KIT, BUTTON CONVERSION, EVOLUTION	73841
	KNOB CONVERSION KIT, EVOLUTION	73839
	ASSY CABLE I2C 39"	72986

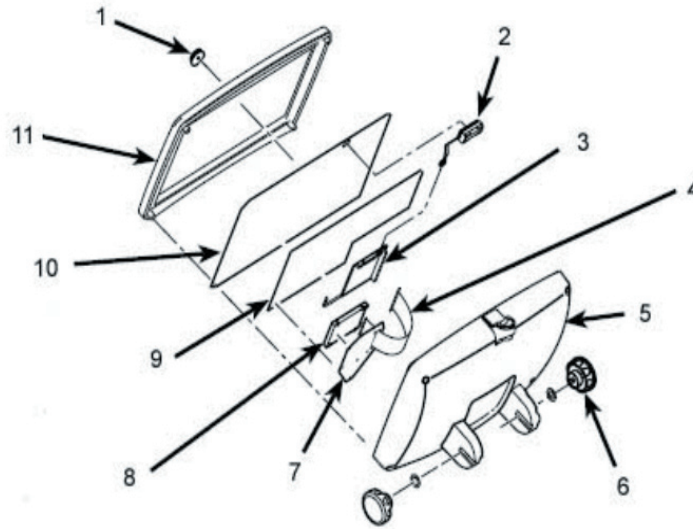


Figure 9-1. Evolution RC Control Console

Item	Description	Part #
1	KNOB, CONTROL	72970
2	BATTERY BACKUP PC104 (4940BM)	73300
3	KIT PC-104/COMPACT FLASH	73340
4	CABLE RIBBON, IDE	73826
5	CONSOLE ASSY, REAR	72971
6	KNOB, CONSOLE PIVOT	92793
7	PLATE MOUNTING HARD DRIVE	73824
8	COMPACT FLASH MEMORY use KIT PC-104/COMPACT FLASH	73340
9	KIT, BUTTON DISPLAY BOARD	73337
9	KIT, KNOB DISPLAY BOARD	73338
10	OVERLAY ASSY, BUTTON	73443
10	OVERLAY ASSY, KNOB	73439
11	CONSOLE FRONT	72907
	Kit, Upgrade Knob Evolution RC AFM (LCD Module)	73889
	Kit, Upgrade Button Evolution RC AFM (LCD Module)	73891
	KIT, LCD ASSEMBLY	73341
	KIT, LCD TRANSITION BOARD	73343
	Low Voltage Power Supply Harness	72924

Table 9-1. Evolution RC Control Console

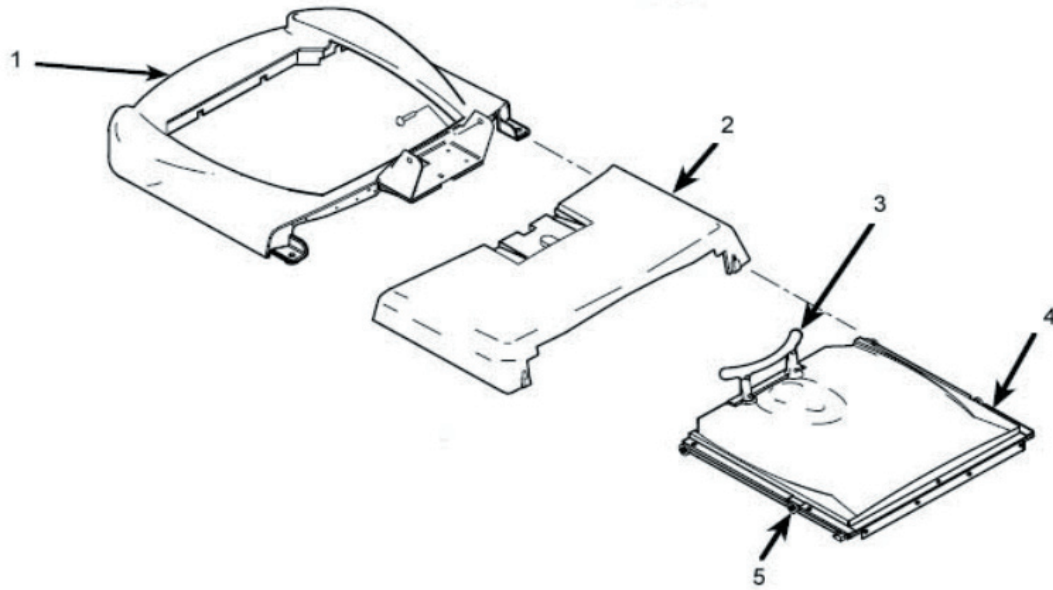


Figure 9-2. Evolution RC Top Deck & Door Assemblies

Item	Description	Part #
1	DECK, TOP FRONT ASSEMBLY	73408
2	DECK, TOP REAR	72904
3	DOOR HANDLE ASSEMBLY, EVOLUTION	73825
4	DOOR PLATE ASSEMBLY (Steel plate & top panel only)	72880
5	Kit, Roller Replacement	73869
	DOOR LATCH RAMP (does not include door magnets which must be ordered separately)	72943
	MAGNET, 0.250" DIAMETER, (4 Magnets needed for door latch ramp)	67653
	Kit, Door Repair (Door Upgrade Kit. Use on S/N 10200647 and below)	73870

Table 9-2. Evolution RC Top Deck & Door Assemblies

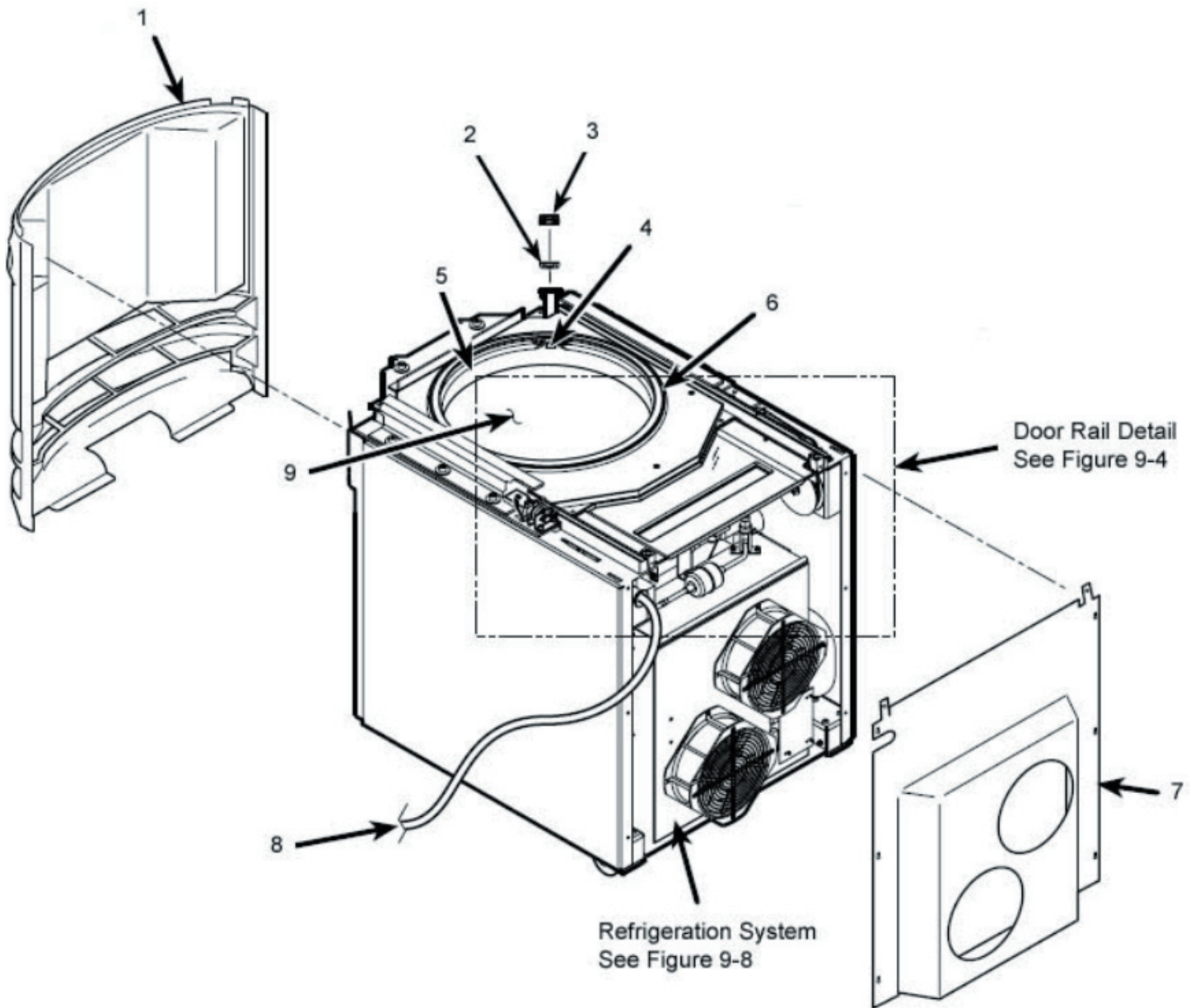


Figure 9-3. Evolution RC Main Assembly

Item No.	Description	Part No.
1	PANEL, FRONT, ASSEMBLY (Does not include decals)	72900
1	DECAL, EVOLUTION	72972
1	DECAL, KENDRO, LARGE	72973
2	GASKET, KSB PORT, EVOLUTION	72983
3	COVER, KSB, EXTERNAL	72899
4	PLUG, KSB, INTERNAL	72823
	HOLDER ASSEMBLY, TUBING (Tubing holder for TZ-28 rotor)	73486
5	SLIDER, EVAPORATOR SEAL, EVOLUTION (Beneathe Seal)	72963
6	SEAL, EVAPORATOR	72845
7	PANEL, BACK	72912
8	CORD ASSEMBLY, POWER, EVOLUTION RC (208 volt 60 Hz Centrifuges)	76178
8	CORD, POWER, BLACK, 4 CONDUCTOR (4940T) (Single Phase 50 Hz Centrifuges)	50585
8	CORD, POWER, 5 CONDUCTOR (2844) (Poly Phase 50 Hz Centrifuges)	50543
9	KIT, EVAPORATOR, EVOLUTION	73461

Table 9-3. Evolution RC Main Assembly

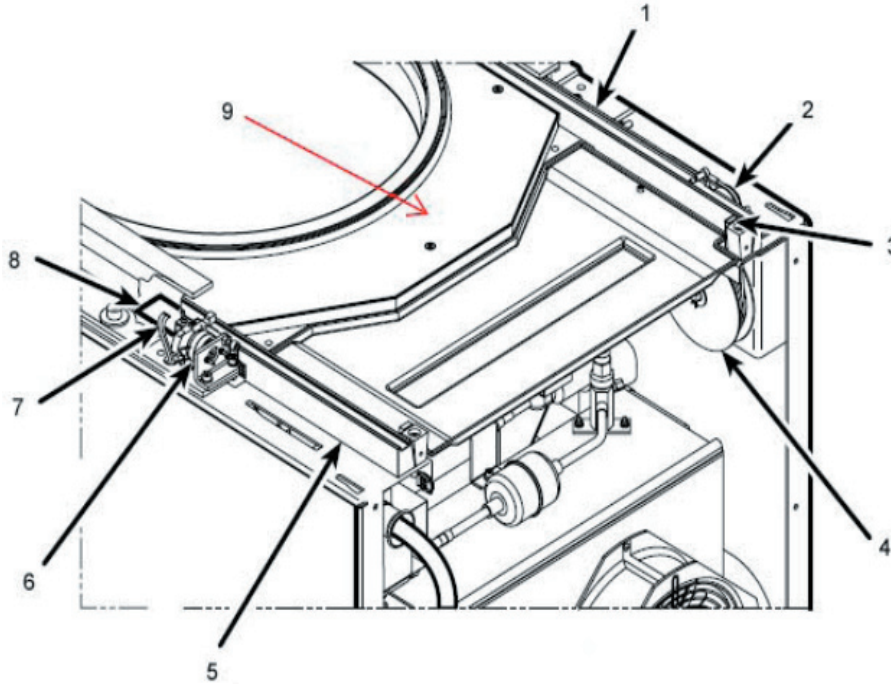


Figure 9-4. Evolution RC Door Rail Detail

Item No.	Description	Part No.
1	Kit, Door Repair (S/N 10200647 & Below)	73870
1	DOOR RAIL, LEFT (S/N 10200648 & Above)	73863
2	PULLEY, IDLER (Obsolete starting with 10200648, Use #73870 on machines S/N 10200647 & Below)	72962
3	DOOR STOP BUMPER	73861
4	REEL, RETRACTOR (Use on S/N 10200648 & below only)	72890
5	RAIL, DOOR, RIGHT (Obsolete use #72870 for S/N 10200647 & Below)	72876
5	RAIL, DOOR, RIGHT (Use on S/N 10200647 & above only)	73862
6	KIT, DOOR LATCH, EVOLUTION	73452
7	CABLE ASSEMBLY, DOOR SENSOR, INST	71719
8	KIT, DOOR LATCH SENSOR	73362
9	SUB DECK ASSEMBLY	72911

Table 9-4. Evolution RC Door Rail Detail

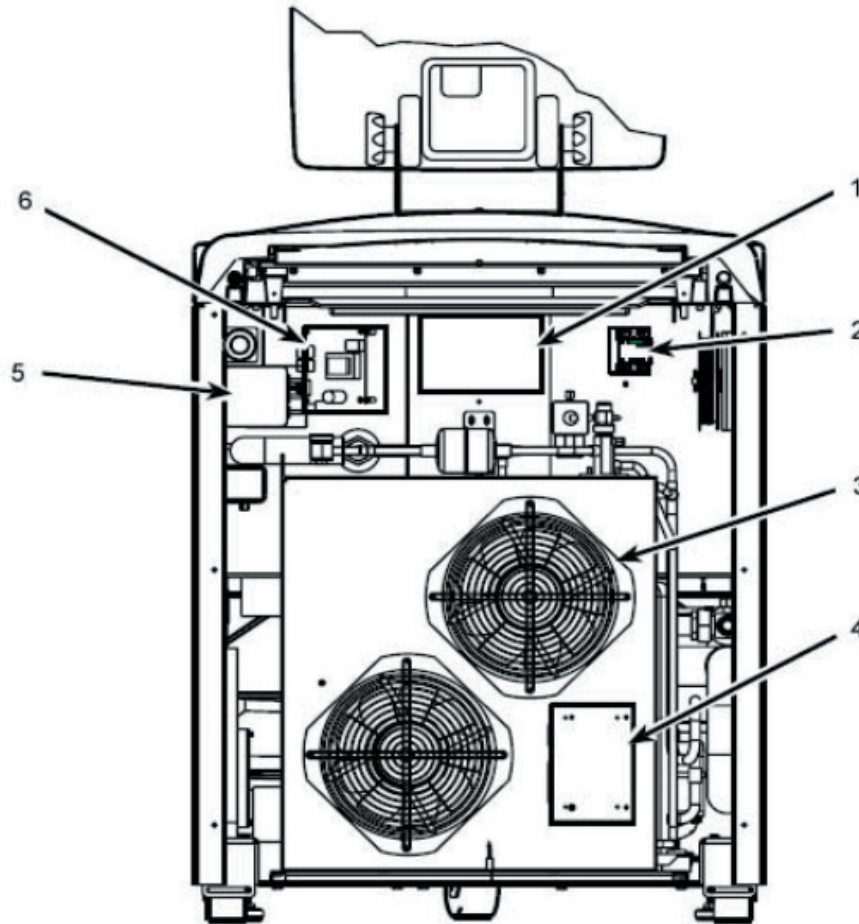


Figure 9-5. Evolution RC Rear View

Item No.	Description	Part No.
1	KIT, POWER SUPPLY	74777
2	RELAY SOLID STATE #1 CRYDOM #H (Refrigeration Relay)	68794
3	FAN, CONDENSER, EVOLUTION	72831
4	KIT, REFRIGERATION BOARD	73334
5	FILTER EMI 250/30A KK-1151	92005
6	KIT DOOR INTERLOCK BOARD, EVOLUTION	73336

Table 9-5. Evolution RC Rear View

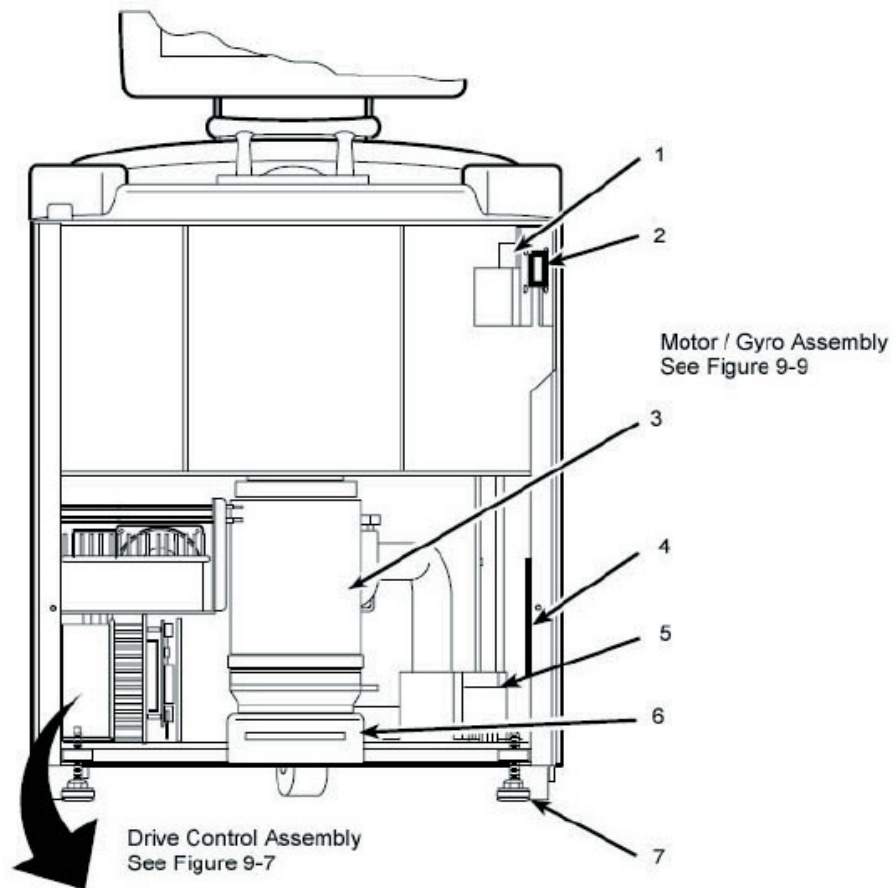


Figure 9-6. Evolution RC Front View

Item No.	Description	Part No.
1	BREAKER, CIRCUIT (Single phase 30 amp)	92794
1	BREAKER, CIRCUIT 3 POLE (Poly Phase 30 amp)	92824
2	GASKET, CIRCUIT BREAKER	73409
3	PLENUM SUPPORT, MOTOR COOLING	72988
4	KIT, PCB MOTOR SENSOR, KE (S/N 10300735 & Below)	73333
5	TRANSFORMER ASSEMBLY, EVOLUTION	73467
6	FAN, 230V AXIAL COOLING (Motor cooling fan)	92921
6	Finger Guard, Fan	90392
7	LEVELING FOOT	72979

Table 9-6. Evolution RC Front View

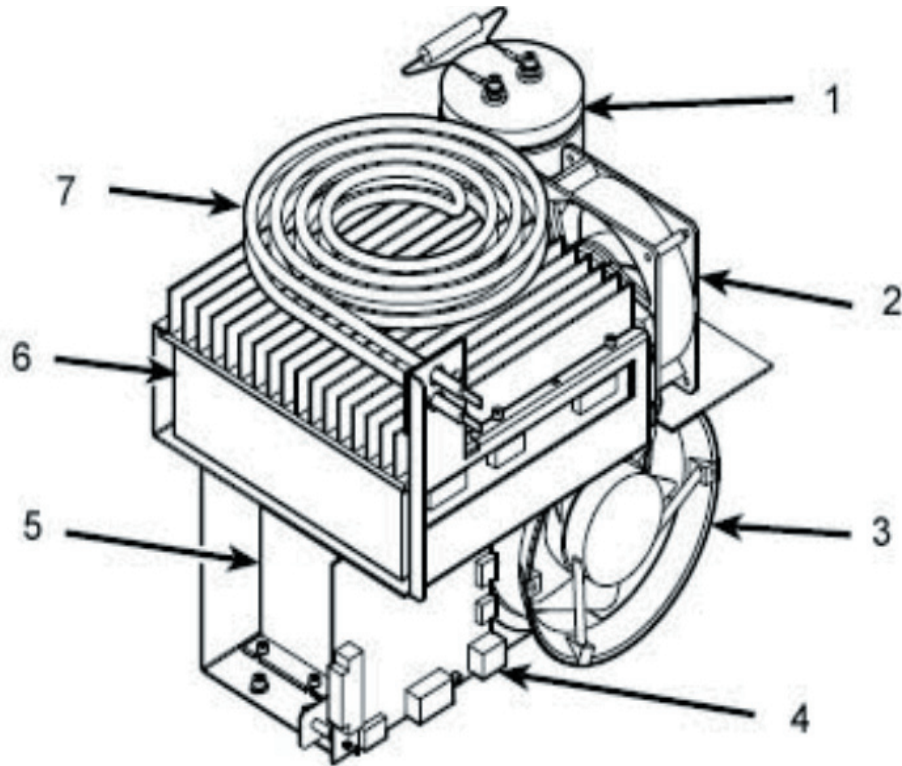


Figure 9-7. Evolution RC Drive Control Chassis

Item No.	Description	Part No.
1	CAPACITOR, PFC, 5700MFD 500VAC	72850
2	PFC / BRAKE FAN	69380
3	DRIVE CONTROL MODULE FAN	92921
4	KIT, DRIVE INTERFACE BOARD	73332
5	DRIVE CONTROL MODULE	72913
5	RECONDITIONED DRIVE CONTROL MODULE	R72913
6	PFC ASSEMBLY	72886
6	RECONDITIONED PFC ASSEMBLY	R72886
7	CALROD BRAKE RESISTOR	91046

Table 9-7. Evolution RC Drive Control Chassis

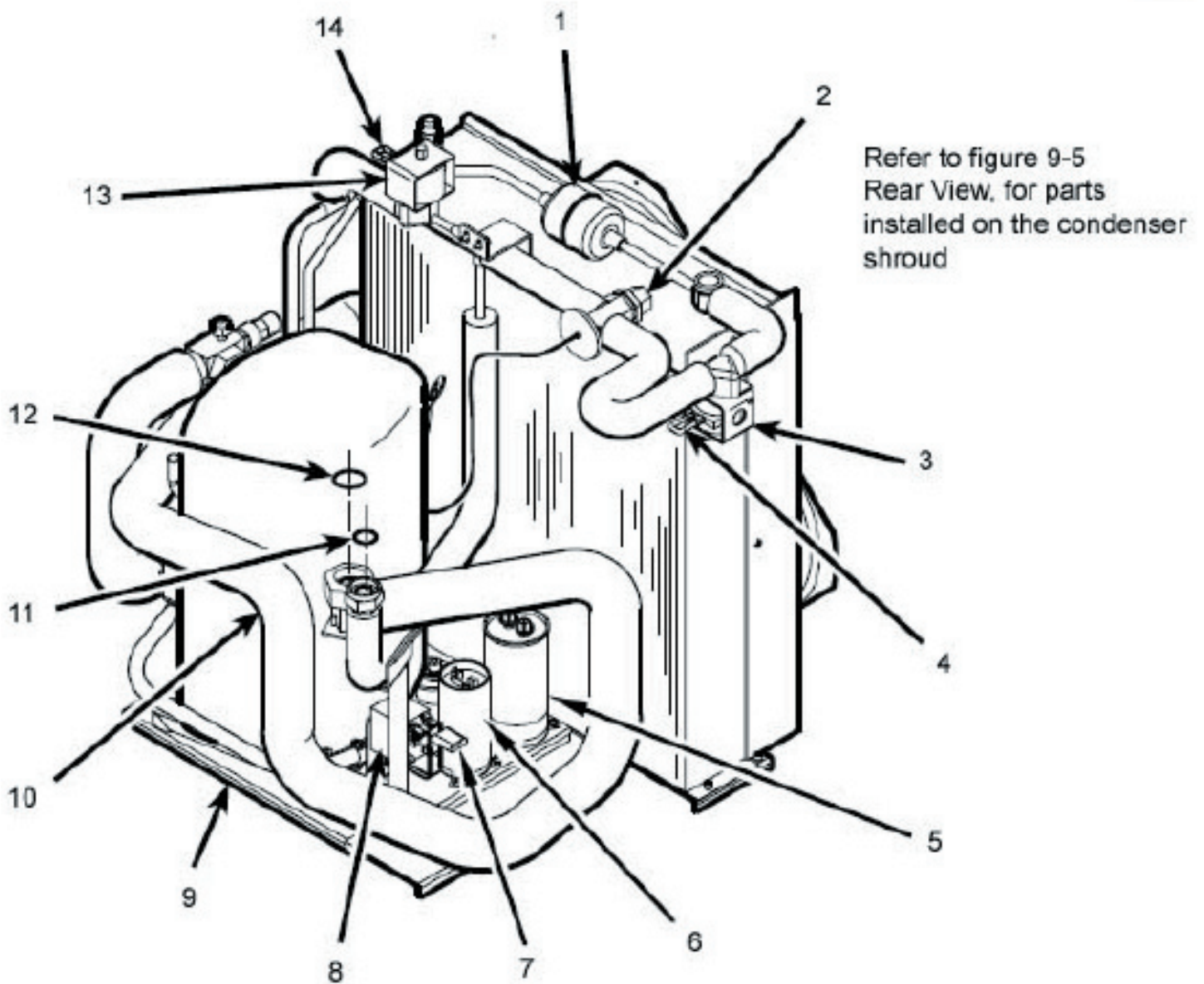


Figure 9-8. Evolution RC Condenser Assembly

NOTE: When replacing high side refrigeration components part number 72945 can be used. Cut the appropriate component from the assembly and connect to the system using Swagelock unions #67555.

Item No.	Description	Part No.
1	KIT, FILTER DRIER, EVOLUTION	73328
2	KIT, EXPANSION VALVE, EVOLUTION	73458
3	COIL, SOLENOID, LIQUID LINE	92773
4	TRANSORB ASSEMBLY, SOLENOID (Surge Suppressor)	71704
5	CAPACITOR, RUN	92733
6	CAPACITOR, START (60 Hz centrifuges)	92734
6	CAPACITOR, START (50 Hz centrifuges)	91922
7	VARISTOR, POTENTIAL RELAY (4940BB)	71730
8	RELAY, POTENTIAL	92732
9	KIT, CONDENSER, EVOLUTION 60HZ	73326
9	KIT, CONDENSER, 50HZ EVOLUTION	73832
10	KIT, SUCTION LINE, EVOLUTION	73456
11	SEAL,TEFLON 5/8" X 3/4"	66952
12	SEAL,TEFLON FBR 7/8" ID X	61768
13	COIL, SOLENOID, HOT GAS	92774
14	TRANSORB ASSEMBLY, SOLENOID (Surge Suppressor)	71704

Table 9-8. Evolution RC Condenser Assembly

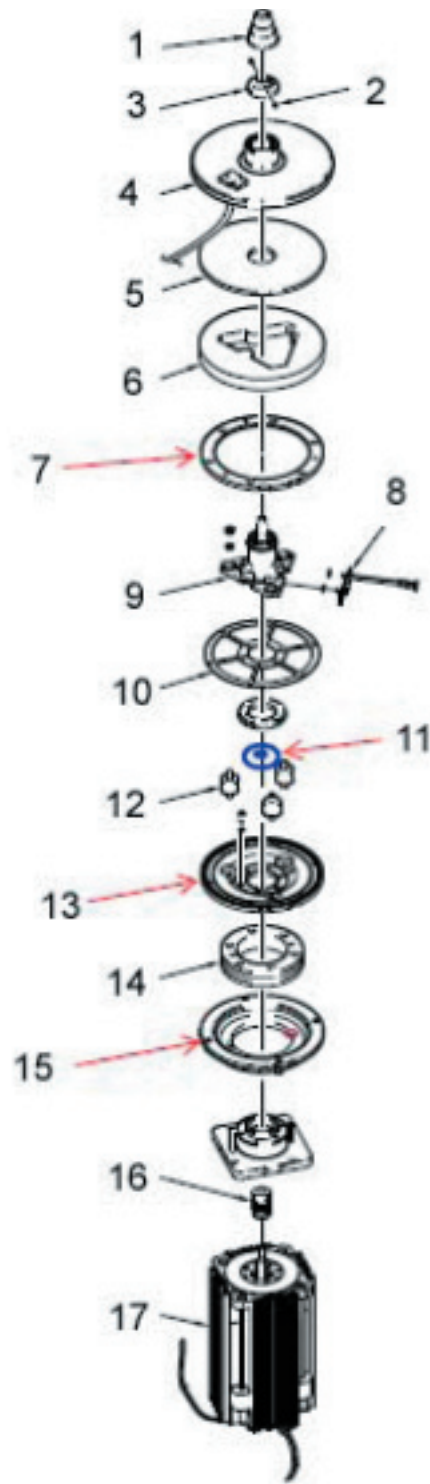


Figure 9-9. Evolution RC Motor / Gyro Assembly

Item No.	Description	Part No.
1	SPINDLE, ASSEMBLY EVOLUTION RC	59194
2	SCREW, SET, CUP PT M4 X 6MM	92815
3	SLINGER, GYRO, 26K	72863
4	KIT, TEMP SENSOR / GYRO BOOT	73360
5	INSULATION, GYRO BOOT	73430
6	INSULATION, BOOT, GYRO, LOWER	73316
7	RING, SPRING, CLAMP, OUTER	72871
8	KIT, IMBALANCE SENSOR	73358
9	KIT, GYRO, EVOLUTION	73446
10	KIT, GYRO SPRING, EVOLUTION	73833
11	KIT, VIBRATION DAMPING	73881
12	MOUNT, SHOCK	92786
13	Plate, Backing, Motor/Gyro	73853
14	RING, DAMPER, MOTOR	72839
15	BRACKET, MOUNT, MOTOR	72838
16	KIT, MOTOR COUPLING, EVOLUTION	73450
17	KIT, MOTOR, EVOLUTION	73448

Table 9-9. Evolution RC Motor / Gyro Assembly