UltraCW

Automatic Cell Washing System

Operation Manual

Version A

S/N _____

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Section 1 - Installation

1.1 Unpacking and Inspection

- The UltraCW weighs 51.5 lbs. Unpacking and installation may require two people.
- Inspect contents to ensure no damage from shipment. Immediately report damage to the freight company and then contact Helmer.
- **IMPORTANT** - Remove the transportation bolts from the bottom of the unit.
- Find the serial number, located on the specification label on the side of the unit, and write it on the front page of this manual in the blank provided.

1.2 Location

Place the unit on a sturdy, level surface with access to a waste container or drain suitable to receive decanted saline and human blood product waste. Allow a minimum of 5-in. (12 cm) of clearance on all sides of the unit for proper air cooling circulation. A minimum of 13-in. (33 cm) clearance should be allowed above the unit for opening the lid.

1.3 Power Configuration

Attach the power cord to the power entry receptacle on lower right side of the unit. Connect to a grounded AC power supply as listed on the specification label on the unit. Arrange for proper grounding if your facility does not have properly grounded power outlets.

1.4 Tubing Installation

Included with the cell washing system are both the saline supply tubing and the larger diameter drain tubing. Firmly press each tube onto its corresponding sized fitting located on the back of the unit. Use the saline supply adapter to connect the free end of the saline supply tubing to a saline supply container.

CAUTION: The UltraCW has a gravity drain. Therefore be sure the drain tubing flows downward and that it is not restricted in any way. If the drain line becomes kinked or restricted, drained liquid can back up the drain hose and into the motor compartment causing motor failure.

WARNING: Some saline solution contains a sodium azide preservative which may react with the drain plumbing to form dangerous explosive azide salts. Check with the saline solution supplier before discharging waste solutions directly into normal drains.

CAUTION: Long-term exposure to certain preservatives found in azide-free saline solutions may adversely effect certain plastic components within the cell washer. Routine housekeeping and cleaning practices will help to remove salt deposits in, and prolong the life of, these components.

Section 2 - Features

2.1 Main Power

The power switch is located at the lower right side of the cabinet.

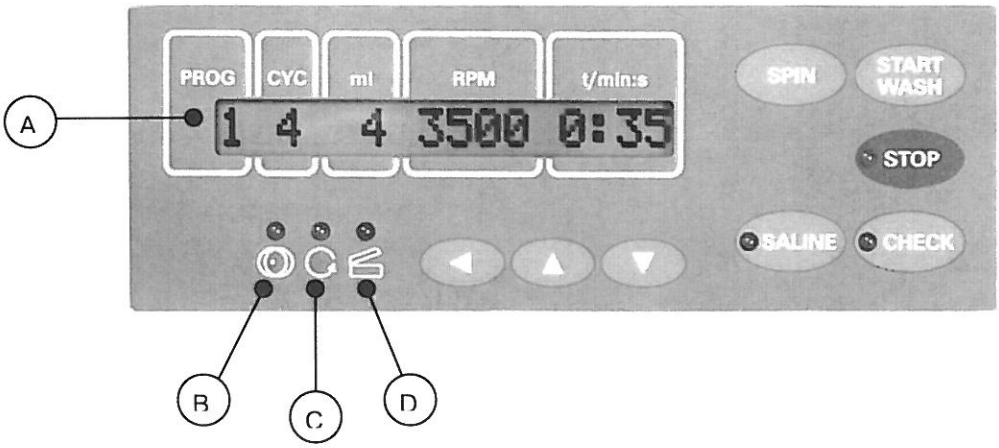


Figure 1 Control Panel

2.2 Control Panel Touch Key Functions (reference figure 1)

SPIN

Starts the spin (centrifugation for agglutination) cycle (see section 3.3).

START WASH

- Starts the washing cycles in "WASH" mode (see section 3.1).
- Saves parameter values while in "PROG" and "VOLUME ADJUST" mode.

STOP

- Immediately stops and resets the spin and wash cycles.
- Immediately stops the flow of saline during a volume calibration.

SALINE

- Enabled only when lid is open.
- Starts the saline volume calibration mode (see section 3.6).

CHECK

- Interrupts current operation of the wash cycle.
- Starts to pump the saline in the "CALIBRATE SALINE" mode.

2.3 Control Panel Visual Indicators (reference Figure 1)

A. Message screen - Displays process information, programming prompts, and error messages to the user.
B. Unit is out of balance
C. Unit is spinning
D. Lid is ready to be opened

2.4 Lid Interlock Bypass

The UltraCW is equipped with an electronically controlled interlock mechanism that prevents the lid from being opened during the wash cycle. To bypass the interlock in the event that it will not disengage, make sure the unit unplugged and locate the access hole in the upper right hand corner of the front bezel assembly. Place the bypass tool (long metal wire supplied with unit) into the hole until it stops. Gently press downward on the wire tool until the lid latch is disengaged.

2.5 Wash Mode

The UltraCW can be programmed to run up to nine wash cycles in succession (see 3.1 Programming an Automatic Wash Cycle).

Each wash cycle consists of four steps (reference figure 2):

1. FILL

   Saline wash solution is drawn from the reservoir by the peristaltic pump up through the flow control valve, the flow switch and the saline-dispensing nozzle. The nozzle feeds the saline into the inlet porthole in the rotor distributor where the filler tubes feed the saline into the test tubes in a directed stream for maximum resuspension of cells.

2. SPIN

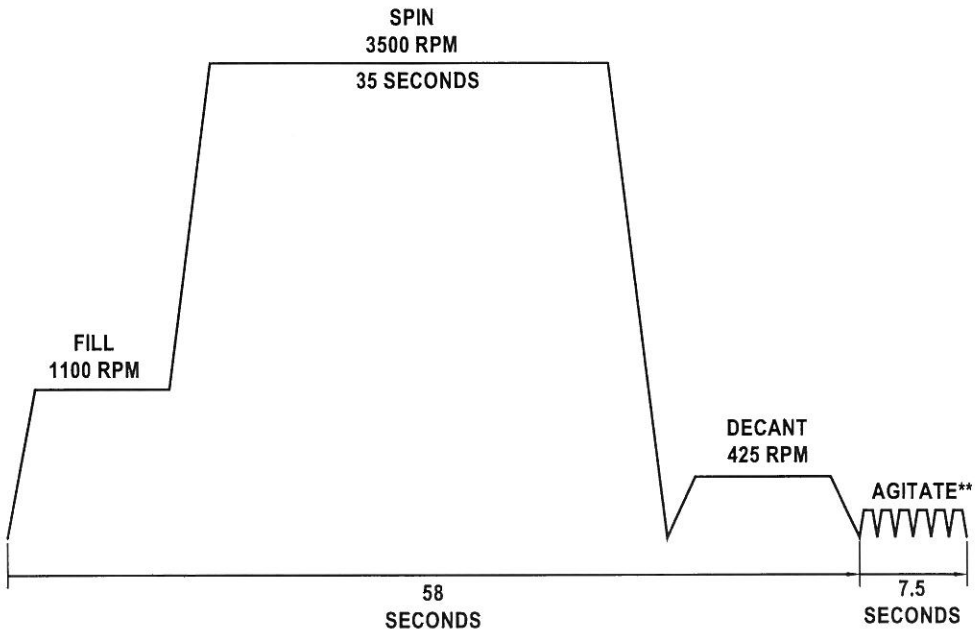
   The system rapidly accelerates to full speed to create a button of red blood cells. Automatic dynamic braking at the end of this step provides rapid deceleration to prevent resuspension or dislodging of the cell button.

3. DECANT

   The rotor holds the tubes at a slight negative angle and spent saline is expelled from the test tubes by low centrifugal force. This action retains virtually all cells in the tubes while effectively removing almost all residual saline. Decanted waste solution is directed, by the splash guard in the cover, through the drain-hole in the chamber bowl and into the drain tubing which carries waste out of the cell washer and into a waste container or drain.

4. AGITATE (except in a single or final wash cycle)

   By a rapid "stepping" motion of the rotor, cell buttons are disrupted (broken apart) for resuspension of the cells during subsequent wash cycles. This Agitation step is automatically eliminated during single-cycle operation and during the final wash cycle of a multi-cycle program to ensure that a well-defined, clean button remains at the completion of the run.



** Agitation occurs only between successive programmed cycles.

Figure 2 - Typical Wash Cycle

2.6 Spin Mode

In this mode the UltraCW can be operated at high speed in a timed run up to 9 minutes and 59 seconds at up to 3500 RPM using 10 x 75 or 12 x 75 tubes.

Section 3 - Operation

3.1 Programming an Automatic Wash Cycle

Note: If no buttons are pressed after sixteen seconds while in the program mode the unit will switch back to the default display mode. All selected program values will be lost.

Wash parameters can be stored in up to four distinct programs for repeated use. Set program parameters using the following procedure:

1. Select the Number of Wash Cycles

   Press ◀ repeatedly until the display shows **"#CYC/WASH =".** Use ▲ ▼ to select up to nine successive wash cycles.

2. Select the Saline Volume

   For best results each tube should be filled between 75% to 80% of its capacity with saline. The table below provides approximated settings to help achieve this volume. Actual settings will vary from unit to unit. Make sure the unit has been calibrated for the day before setting this parameter.

Tube Size / Rotor	ml Setting (per tube)	Volume dispensed for calibration check (+/- 5%)
10 x 75 /12 place	3.2 ml	38.4 ml
10 x 75 / 24 place	3.2 ml	76.8 ml
12 x 75 / 12 place	4.7 ml	56.4 ml
12 x 75 / 24 place	4.7 ml	112.8 ml

   Press ◀ repeatedly until the display shows **"SALINE (ml) =".** Use ▲ ▼ to select the desired saline volume (per tube). If no saline fill is required, ie for a step cycle, set the ml at "0".

   The volume is programmable to tenths of a ml but the display will not show the decimal place after the program is finished. A "+" will indicate settings between whole numbers. For example: If the amount selected is 2 the display will show 2. If the amount selected is 2.2 the display will show 2+.

3. Select the Wash Speed

   Press ◀ repeatedly until the display shows **"WASH(rpm) =".** Select the desired speed using the ▲ ▼. It is recommended to set the wash speed at 3500 RPM.

4. Select the Wash Time

   Press ◀ repeatedly until the display shows **"TWASH (min) =" or "TWASH (sec) =".** Use ▲ ▼ to select the desired wash time. It is recommended set the wash time for 35 seconds.

5. Assign the Program Number

   Press ◀ repeatedly until the display shows **"PROG =".** Use ▲ ▼ to select program 1,2,3 or 4. Press **START WASH** to store the program. The display will show **"***ok****"** to confirm the selection has been stored and then return to the default display mode.

3.2 Running an Automatic Wash Cycle

1. Make sure that the saline volume check has been performed for the day. See 3.4 Saline Volume Calibration.
2. Install and load the rotor per 3.5. **Caution: Never run the UltraCW without a rotor installed.**
3. Press ▲ or ▼ to select the program number you wish to use.
4. Close the cover and press **START WASH**. The Spin LED will light, and the remaining run time and number of cycles will be displayed.
5. The run may be stopped immediately by pressing **STOP.** The program will be reset and can be started from the beginning by opening and closing the lid and pressing **START WASH**.
6. Pressing **CHECK** will pause the wash cycle after the current step (Fill, Spin, Decant or Agitate). The run will continue when the cover is closed and **START WASH** is pressed.
7. At the end of the run the **"SERUM"** message will be displayed and an alert will sound. Lift the latch handle and raise the lid to retrieve samples.

3.3 Programming a Spin Cycle

1. Press ◀ repeatedly until the display shows **"SPIN (rpm) ="**
   - Select desired spin RPM using the ▲ ▼ keys
   - For reagent spin, recommended spin RPM is 3500.
2. Press ◀ and hold until the display shows **"SPIN (min) ="** or **"SPIN (sec) ="**
   - Select desired number of minutes and seconds for spin cycle using the ▲ ▼ keys
   - Recommended spin time for reagent is 20 seconds.
3. After setting all spin parameters, press **START WASH** to save changes. The display will show **"***ok****"** to confirm the selection has been stored and then return to the default display mode.

3.4 Running a Spin Cycle

1. Install and load rotor per section 3.5.
2. Once programmed, simply press the **SPIN** key to initiate spin cycle.
   - Centrifugation will commence after automatic agitation cycle. The remaining cycle time will be displayed as well as the RPM.
   - To halt spin cycle press **STOP**.
   - Process is not interruptible pressing **CHECK.**
   - Process stops automatically after programmed spin time expires.

3.5 Rotor Selection, Installation and Loading

Note: If no buttons are pressed after sixteen seconds while in the program mode the unit will switch back to the default display mode. All selected program values will be lost.

Caution: Never run the UltraCW without a rotor installed.

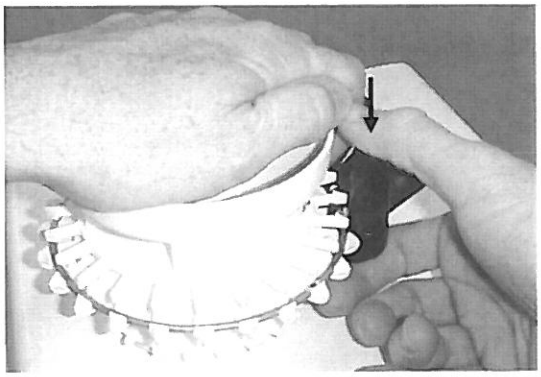
Programming the rotor type

1. Press ◀ and hold until the display shows : **"VOLUME ADJUST xx".**
2. Repeat pressing ◀ until the display shows **"Rotor: 12place "** or **"Rotor: 24place"**
3. Toggle between rotor types using the ▲ ▼ keys.
4. Store the correct rotor type by pressing **START WASH.** The display will show **"***ok****"** to confirm the selection has been stored and then return to the default display mode.

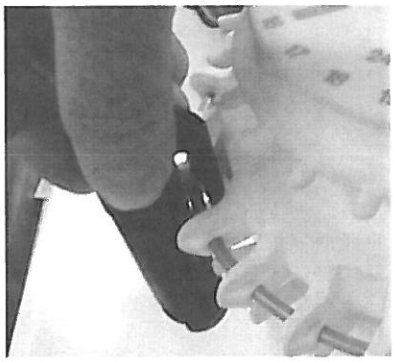
Setting up the Rotor

1. The rotor comes assembled with 12 x 75 tube holders. If 10 x 75 tubes will be used you must replace the 12 x 75 tube holders with the 10 x 75 tubes holders that are supplied with the unit.

   CAUTION: Using 10 x 75 tubes in 12 x 75 tube holders could result in tube breakage or imbalance problems.



Tube holder removal:
Turn the rotor assembly upside down. Hold each tube holder vertically and firmly push down from the bottom until it snaps out of place.



Tube holder replacement:
With the rotor assembly right side up. Align the tube holder clip over the metal ring and firmly push down from the top until it snaps into place.

Installing the rotor

1. Make sure the unit is programmed for the rotor you are about to install.
2. Push the main power switch to the ON position.
3. Wait for the screen to display **"OPEN LID"**, lift the latch handle and raise lid.
4. Orient the rotor assembly so that the alignment marks on the top are aligned with the grooves on the rotor shaft and then lower it on to the shaft.

5. Close the lid and run a short spin cycle without tubes. If an imbalance error occurs check each tube holder to make sure it is completely snapped down on the metal ring and that it moves freely.

6. If no imbalance error occurs, insert tubes into the tube holders. If using less than a full rotor load of tubes, make sure to distribute them evenly around the rotor.

   For example, if centrifuging three evenly filled tubes in a 12-place rotor, one proper loading configuration would be to install tubes in the 1, 5, and 9 positions.

   CAUTION: Damage to the rotor and instrument can occur if the rotor is unevenly loaded.

7. Close lid and press down on handle to latch.

3.6 Saline Volume Calibration

Note: If no buttons are pressed after sixteen seconds while in the program mode the unit will switch back to the default display mode. All selected program values will be lost.

Calibration is performed with the lid open. Make sure to hold a container in front of the nozzle before pressing **CHECK** to avoid accidental spraying/spillage of saline solution.

1. Press **SALINE** for 4 seconds. The display will show **"CALIBRATE xxx ml"**

   Note: xxx is the product of the preset "ml" with 12 or 24-place rotor.

   Example: the set volume for ONE tube is 4 ml. The dispensing (testing) volume with the 12-place rotor is (12x4) 48 ml, with the 24-place rotor the volume is (24x4) 96 ml.

2. Press **CHECK** to dispense saline into a volumetric measuring device, such as a calibrated 100ml graduated cylinder.

3. If the volume is not correct, perform the following adjustment procedure:
   - Press ◀ and hold for approximately 8 sec until **"VOLUME ADJUST xx"** appears on the display.
   - Use the ▲ ▼ keys to adjust volume within the range 20 and –20. A change of 1 increment corresponds to approximately 0.5 % difference in measured volume.

$$\textbf{Adjustment} = \textbf{Difference (in ml)} \times \frac{200}{\textbf{Measured volume (in ml)}}$$

$$\textbf{Difference} = \textbf{set volume} - \textbf{measured volume}$$

Store the value by pressing **START WASH.** . The display will show **"***ok****"** to confirm the selection has been stored and then return to the default display mode.

Section 4 – Cleaning and Maintenance

CAUTION - It is a safe practice to wear gloves and a breathing mask whenever cleaning blood bank equipment. Follow established laboratory procedures.

4.1 Daily

1. Inspect the tubing and connections.

   Make sure that all tubing is securely connected and free from obstructions. Make sure that the drain tube is not restricted and that saline waste can flow through freely.

2. Inspect interior bowl.

   Make certain that the bowl is clean and free of dried saline crystals and other debris. Wipe out the bowl daily with a damp cloth or sponge. It is not necessary to remove or clean under bowl.

   Caution: In the event of glass tube breakage, make sure to remove all fragments from the bowl. Glass fragments could cause damage to the rotor and bowl or cause imbalance errors.

3. Check saline fill volume.

   Refer to 3.6 Saline Volume Calibration

4.2 Weekly

Clean Rotor and Tubing

It is important that the rotor and tubing be kept clean and free of dried saline crystals and other debris. Here are some options and suggestions for cleaning.

Based on usage, it is recommended that the rotor be cleaned at least once per week. More frequent cleanings may be required if you allow the rotor to dry between wash cycles. Please adjust cleanings based on your individual usage.

System Flush

1. Prepare a fresh solution of 10% household bleach (0.5% Sodium Hypochlorite). Approximately 200 – 300 ml is needed for a 12 place rotor and 300 – 400 ml for a 24 place rotor.
2. Remove the saline supply tube from the saline reservoir. Run the calibration check (see 3.6) until all of the saline has been flushed from the line.
3. Connect the saline supply line to the bleach solution and program the unit to wash 4 (four) times.
4. With a rotor in place, close the lid and run the 4 wash cycles.
5. Remove the saline supply line from the bleach and again flush the line with the calibration check.
6. Connect the saline supply line to at least one-liter of distilled water. Run the unit through enough wash cycles to use all of the distilled water. Again clear the line with the calibration check.
7. Reconnect the saline supply line to the saline reservoir. Make sure that the inner bowl is wiped out to remove any excess moisture before resuming use of the cell washer.

Rotor Cleaning

Note: Cleaning the rotor using methods other than what is described here could alter the results and/or void your warranty.

1. Soak the rotor in clean warm water or directly run warm water into the top of the rotor for several minutes and make sure water is flowing freely out of all the filler ports.
2. If the ports are blocked, gently slide the cleaning tool into the fill port from the outside toward the center of the rotor. Gently slide the cleaning tool in and out several times to clean port.

4.3 As Needed

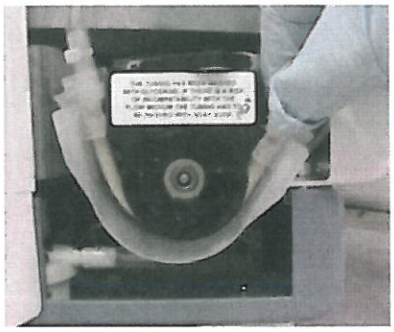
Replace Tubing

Frequency of tubing replacement depends upon the usage of the unit, internal policies, etc. but should be replaced at least once a year. Tubing kits are available for purchase through Helmer. Please refer to Section 6: Parts List.

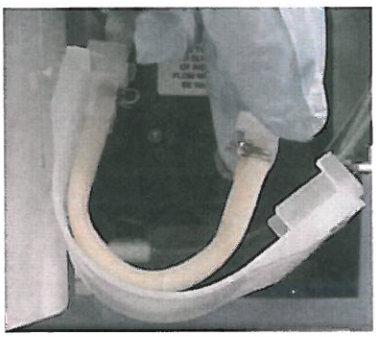
Saline Pump Tubing Replacement.

1. Disconnect the unit from its power source before reaching in the access door.

2. Turn the locking lever, located on the top of the pump, clockwise.

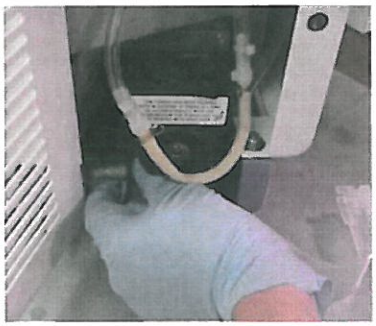


3. Free the tubing and holder from around the pump.

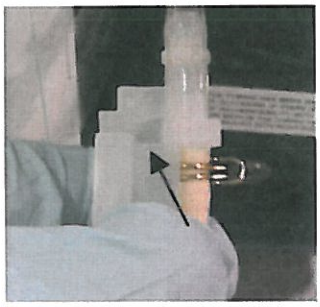


4. Remove the tubing from the holder.

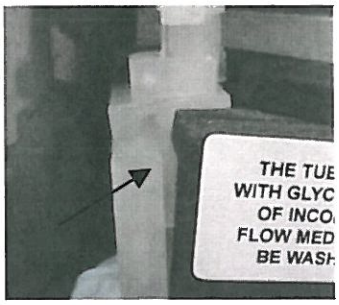
5. Disconnect the tubing at both ends.



6. Pull the tubing through the grommet and remove from the unit.

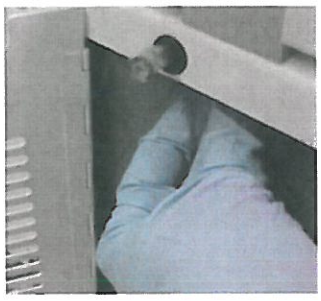


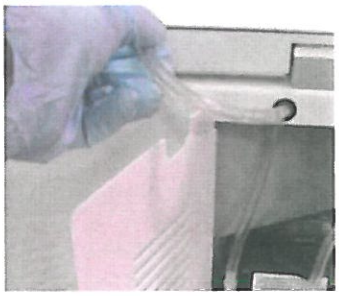
7. Orient the new tubing so that the rounded edge of the fitting will slide into the rectangular slot in the holder. Repeat for other side.



8. Work the tubing and holder around the pump so that the squared edges meet. Squeeze the holder so that it is snug against the pump.

9. Turn the locking lever counterclockwise to secure tubing.





10. Thread the left side of the tubing through the grommet in the top of the access door and reconnect it to the fitting on the back of the unit

11. Reconnect right side of tubing to the fitting located on the bottom left inside the access door.

12. Perform the Saline Volume Calibration and check for leaks around all fitting locations.

Verify rotor speed.

The UltraCW is equipped with a sight window in the lid and an optical reference on the rotor. Reference 28 and 36 in the Section 7 - View for Parts Identification and Location section. This enables the operator to verify the rotor speed with a NIST traceable tachometer.

Section 5 - Troubleshooting

5.1 Performance Problems

The following are problems that could occur as a result of the operation of the cell washing system. It is assumed that the user has verified that proper materials and laboratory procedures have been implemented.

Problem	Probable Cause	Action
Insufficient Wash	• Using 24-place rotor but programmed for 12-place. • Clog in fill port • Low saline • Insufficient saline amount	• Verify programming of rotor type. See section 3.5 • Clean fill port • See Section 5.2 • Check programmed saline volume, Check saline calibration
Streaking	• Decant speed too high • Spin speed too low • Tube holder stuck in decant position.	• Contact Helmer Technical Service
No button or small button	• Using 12-place rotor but programmed for 24-place. • Decant speed too high.	• Verify programming of rotor type. See section 3.5 • Contact Helmer Technical Service
Too much residual saline left after wash	• Decant speed too low	• Contact Helmer Technical Service
Did not decant	• Rotor lock did not engage	• Contact Helmer Technical Service

5.2 Error Messages

🛠 - A qualified service technician should perform actions marked with this symbol.

POWER RESET – Turn main power switch off for 10 seconds. Turn back on.

Message	Probable Cause	Action	Message Reset
LOW SALINE	• Saline supply empty • Kinked or worn saline supply or pump tubing • Clogged saline supply or pump tubing, adapter, or connector • Pump failure • Saline flow sensor defective	• Replace saline supply • Straighten or replace (ref. 3.6) • Clean or replace 🛠 Replace 🛠 Replace	Open and close lid
IMBALANCE	• Uneven loading of tubes • Clogged fill port(s) caused under fill of one or more tubes. • Imbalance switch not connected or defective • Loose contact in cable or plug. • Control cable to control panel is defective. • Control panel or supply board is defective.	• Redistribute (ref. 3.5) • Clean fill ports 🛠 Check connection or replace. 🛠 Check 🛠 Replace 🛠 Replace	Power Reset
POWER INTERRUPT	• AC power interrupted during operation	• Check power cord connection 🛠 Check facility supply voltage 🛠 Control cable to control panel is defective	Open lid and press Start Wash key.
TACHO – ERROR 01	• Speed sensor (speedometer) defective or loose contact on plug. • Control cable to control panel, or to frequency converter is defective. • Supply board, control panel or frequency converter is defective.	🛠 Check connection or replace 🛠 Replace 🛠 Replace	Open the lid. Spin the rotor clockwise by hand and perform power reset while the rotor is turning.
TACHO – ERROR 02	• See Tacho Error 01 • Startup took place without the rotor. • Motor not connected or defective.	• See Tacho Error 01 • Install rotor 🛠 Check connection or replace	Open the lid. Spin the rotor clockwise by hand and perform power reset while the rotor is turning.
CONTROL - ERROR 04	• Lid latch defective. • Control cable to control panel is defective. • Supply board or control panel is defective.	🛠 Replace 🛠 Replace 🛠 Replace	Power Reset

Message	Probable Cause	Action	Message Reset
N > MAX 05	• Insulation of speed sensor (speedometer) cable is defective. • Loose contact on speed sensor (speedometer) cable. • Speed sensor (speedometer) is defective. • Control cable to control panel is defective. • Control panel, frequency converter or supply board is defective.	🛠 Replace 🛠 Check 🛠 Replace 🛠 Replace 🛠 Replace	Power Reset
ROTOR CODE 10	• Speed sensor is defective. • Loose contact on speed sensor plug.	🛠 Replace 🛠 Check	Power Reset with lid open.
N < MIN 13	• Motor defective • Frequency converter defective	🛠 Replace 🛠 Replace	Power Reset with lid open.
CONTROL – ERROR 21 – 26	• Control panel is defective.	🛠 Replace	Power Reset
SER I/O – ERROR 30 and ERROR 31	• Control cable to frequency converter is defective. • Control panel or frequency converter is defective. • Cable on plug S102 is loose. • Overflow of saline	🛠 Replace 🛠 Replace 🛠 Reseat 🛠 Check clog in drain or kink in tubing. Make sure drain tube is lower than cell washer.	Power Reset
SER I/O – ERROR 33 **SER I/O – ERROR 34** **SER I/O – ERROR 36**	• Control cable to frequency converter is defective. • Control panel or frequency converter is defective	🛠 Replace 🛠 Replace	Power Reset
FU / CCI – ERROR 60	• Control cable to frequency converter is defective. • Control panel or frequency converter is defective • Supply board is defective	🛠 Replace 🛠 Replace 🛠 Replace	Power Reset
FU / CCI – ERROR 61 **FU / CCI – ERROR 62** **FU / CCI – ERROR 68** **FU / CCI – ERROR 69** **FU / CCI – ERROR 84** **FU / CCI – ERROR 85**	• Control cable is defective. • Frequency converter is defective	🛠 Replace 🛠 Replace	Power Reset
FU / CCI – ERROR 63	• Motor defective • Frequency converter defective • Control cable is defective.	🛠 Replace 🛠 Replace 🛠 Replace	Power Reset with lid open.

Message	Probable Cause	Action	Message Reset
FU / CCI – ERROR 64	• Break resistor is defective. • Control cable is defective. • Frequency converter is defective.	🛠 Replace 🛠 Replace 🛠 Replace	Power Reset
FU / CCI – ERROR 67	• Motor defective • Frequency converter defective. • Control cable is defective.	🛠 Replace 🛠 Replace 🛠 Replace	Power Reset
KEYBOARD ERROR	• Front panel button stuck • Button held down during testing.	🛠 Replace • Release	Power Reset

Section 6 – Parts List

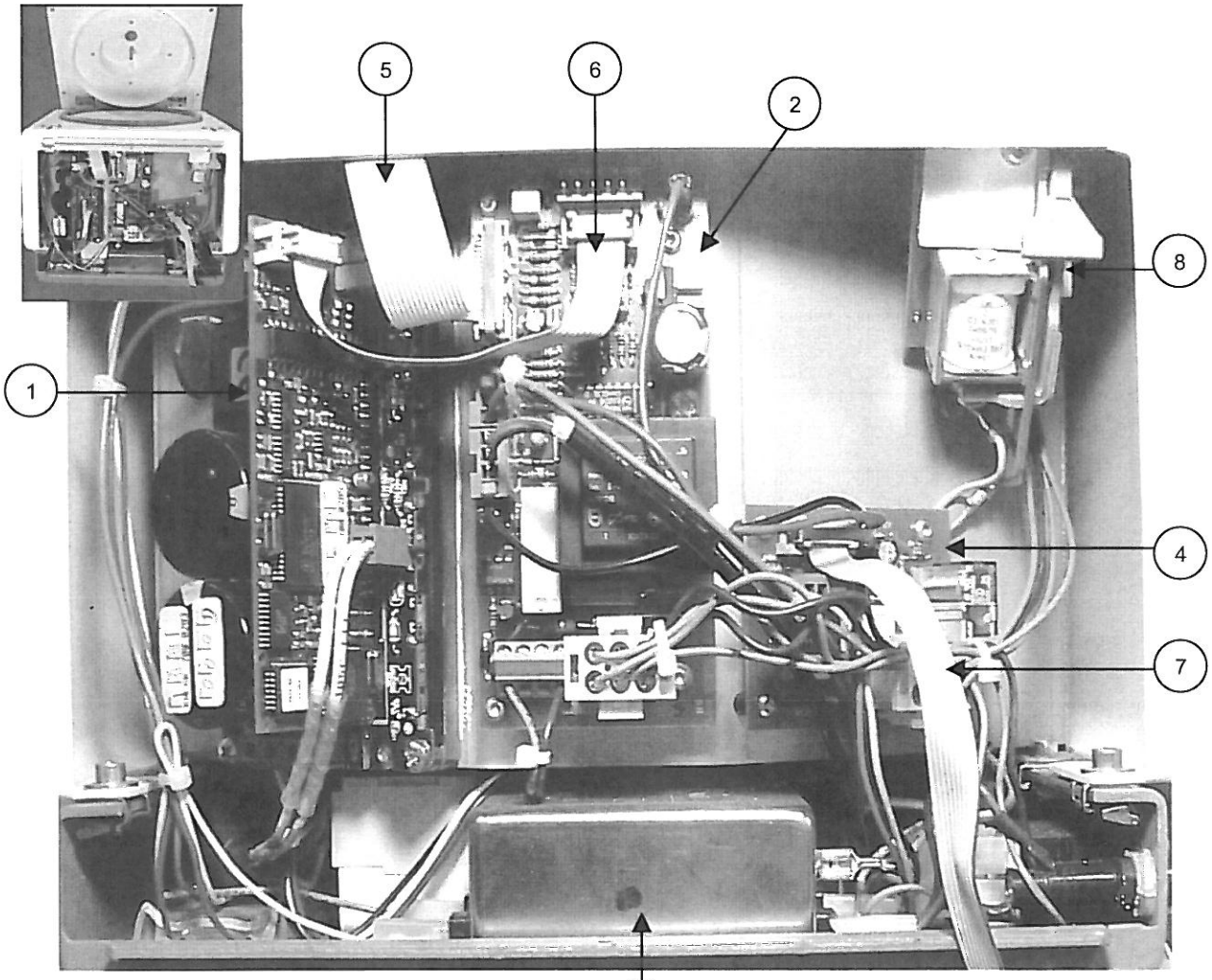
Reference exploded views pictures for location of parts. NS = Not Shown

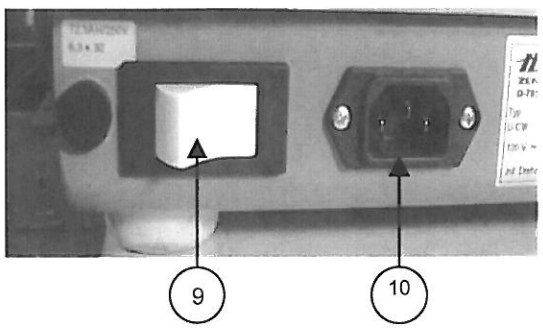
ID	DESCRIPTION	PART#	ID	DESCRIPTION	PART#
1	PCB, Frequency converter	E1184	26	Hinge, Lid	E1563
2	PCB, Power Supply	E1888	27	Spring, Lid	E1565
3	RFI filter	E1284	28	Glass, Sight w/gluing ring	E1323
4	PCB, Liquid Handling	E2130	29	Lid, Painted	E2186
5	Ribbon cable 140/16p	E1332	30	Handle	E2189
6	Ribbon cable 130/10p	E1333	31	Gasket	E2105
7	Ribbon cable 250/10p	E1327	32	Bowl, Asmb UltraCW	450004-1
8	Lock, Lid	E1478	33	Panel, Front	E2188
9	Switch, Main Power	E1009	34	Panel, Rear	E2107
10	Power Entry Module	E507	35	Foot	E3680
11	Pump, Saline	E2096	36	Rotor, 12-place	450001-1
12	PCB, Varistor	E1463	NS	Rotor, 24-place	450002-1
13	Resistor, Breaking	E1461	NS	Fuse	E2268
14	Relay, Motor	E2193	NS	Tube holder 10 x 75	E2196
15	Transformer, Isolation	E2195	NS	Tube holder 12 x 75	E2197
16	Flowmeter	E2103	NS	Power Cord	6083
17	Microswitch, Imbalance	2378	NS	Tool, Transportation Bolt Removal	E613
18	Speed Sensor	E730	NS	Tool, Interlock bypass	E003
19	Hood, Motor	E2191	NS	Tool, Rotor Cleaning	
20	Motor, Drive	E823	NS	Pump Tubing Assembly*	450005-1
21	Mount, Motor	E343	NS	Drain/Fill Tubing Assembly**	450006-1
22	PCB, Control/Display	E2148			
23	Cover, Splash	E2187			
24	Lid, Assembly	E2184			
25	Lid, Inner	E2185			

*Pump tubing assembly contains assembled pump tubing.

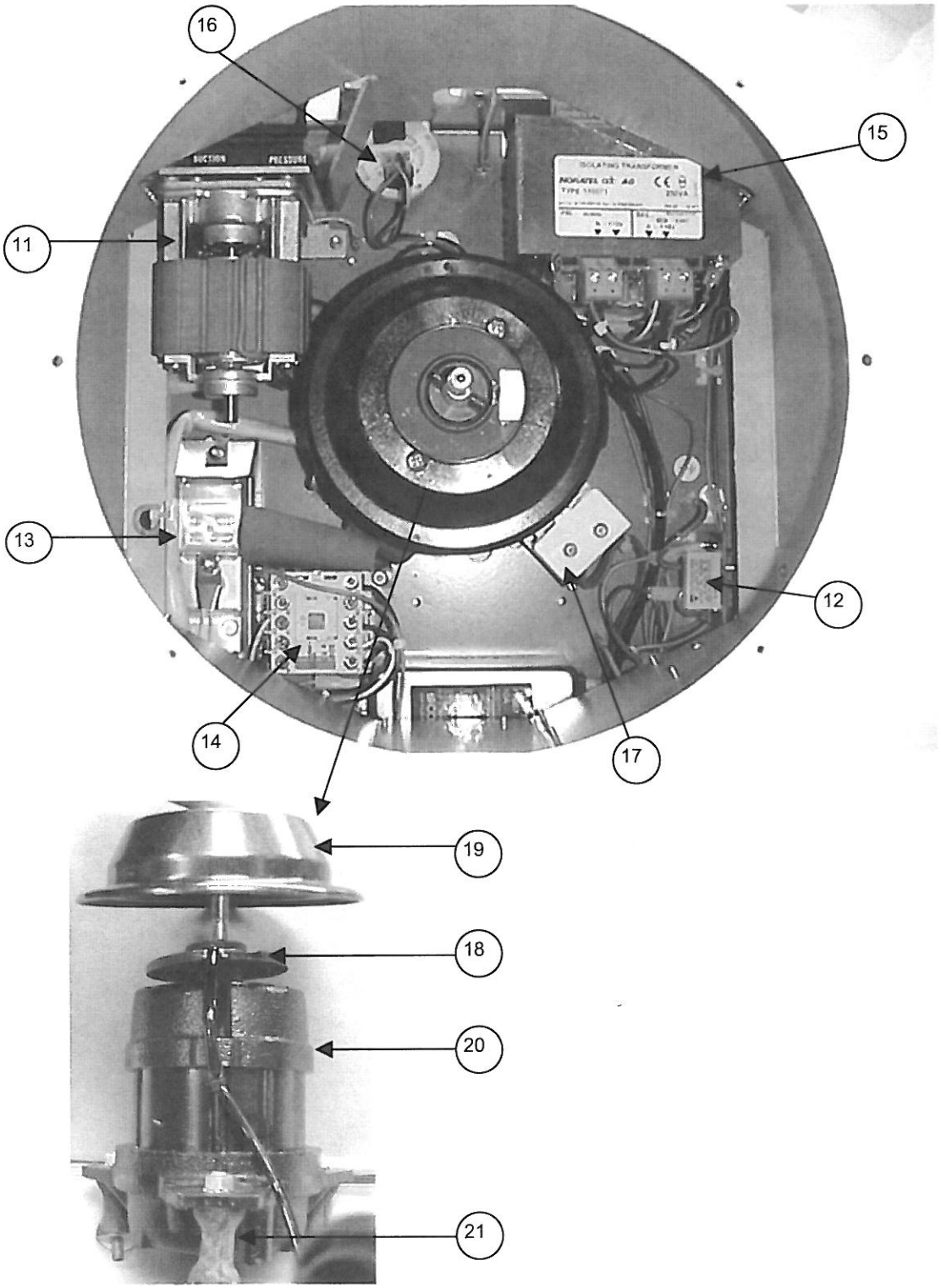
**Drain/fill tubing assembly with adaptor contains drain tubing and inlet tubing ready to attach to standard boxed saline.

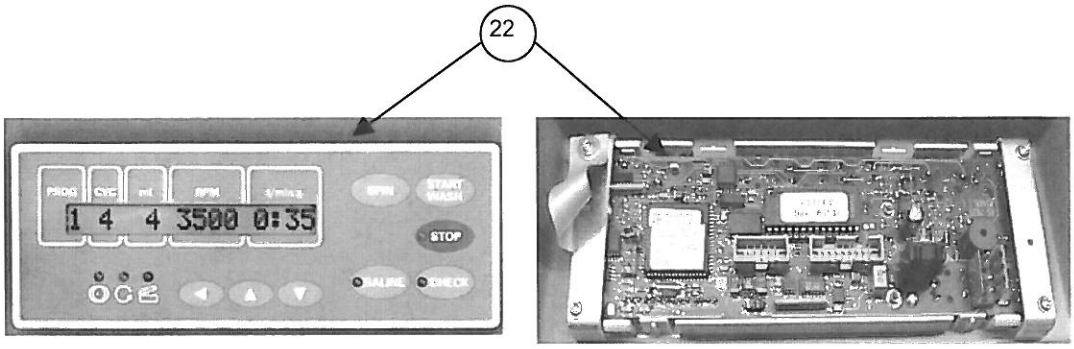
Section 7 - Views for Part Identification and Location



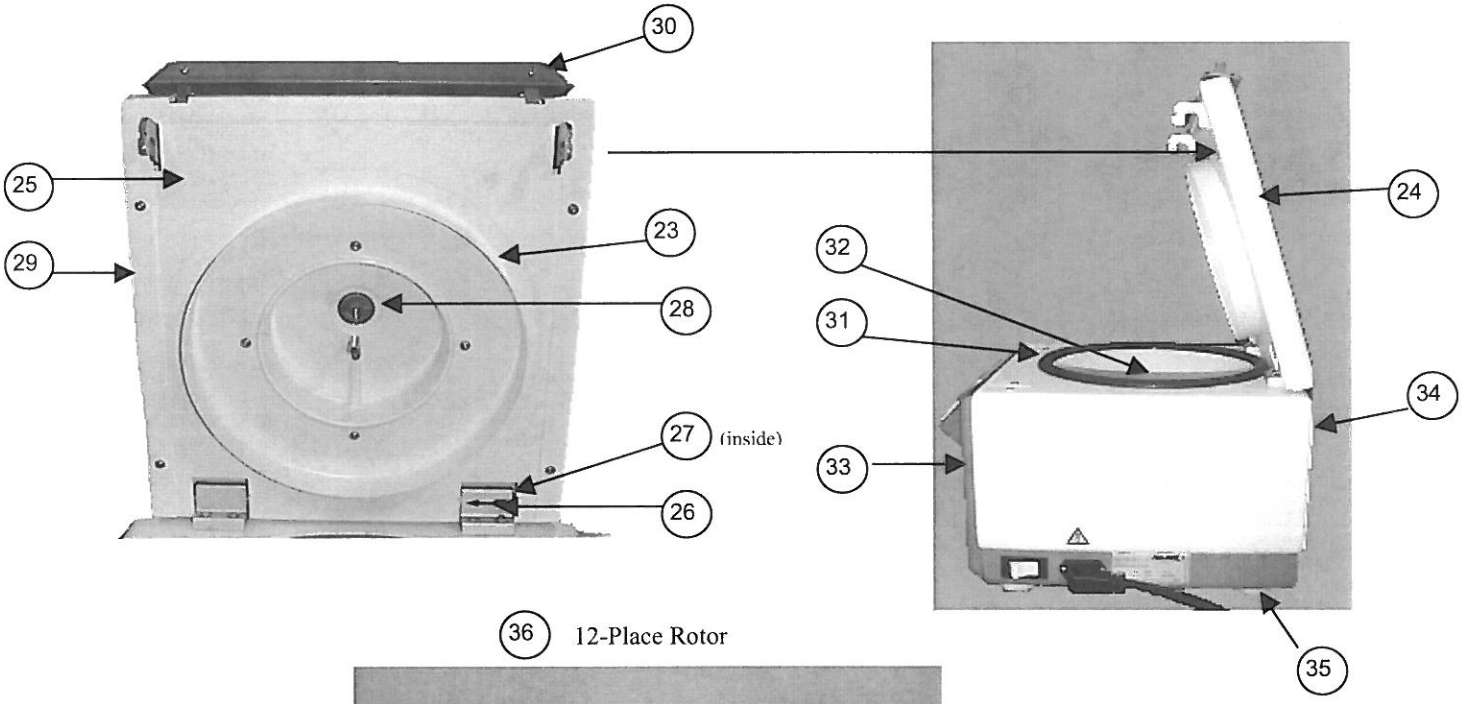


View from top with bowl removed

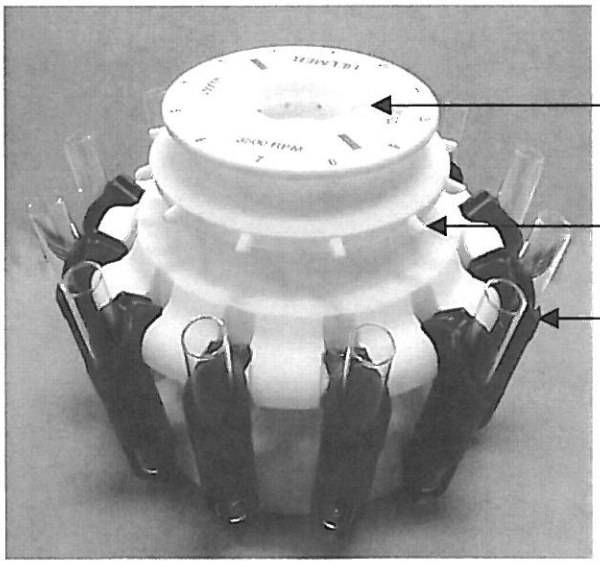




Front **Back**

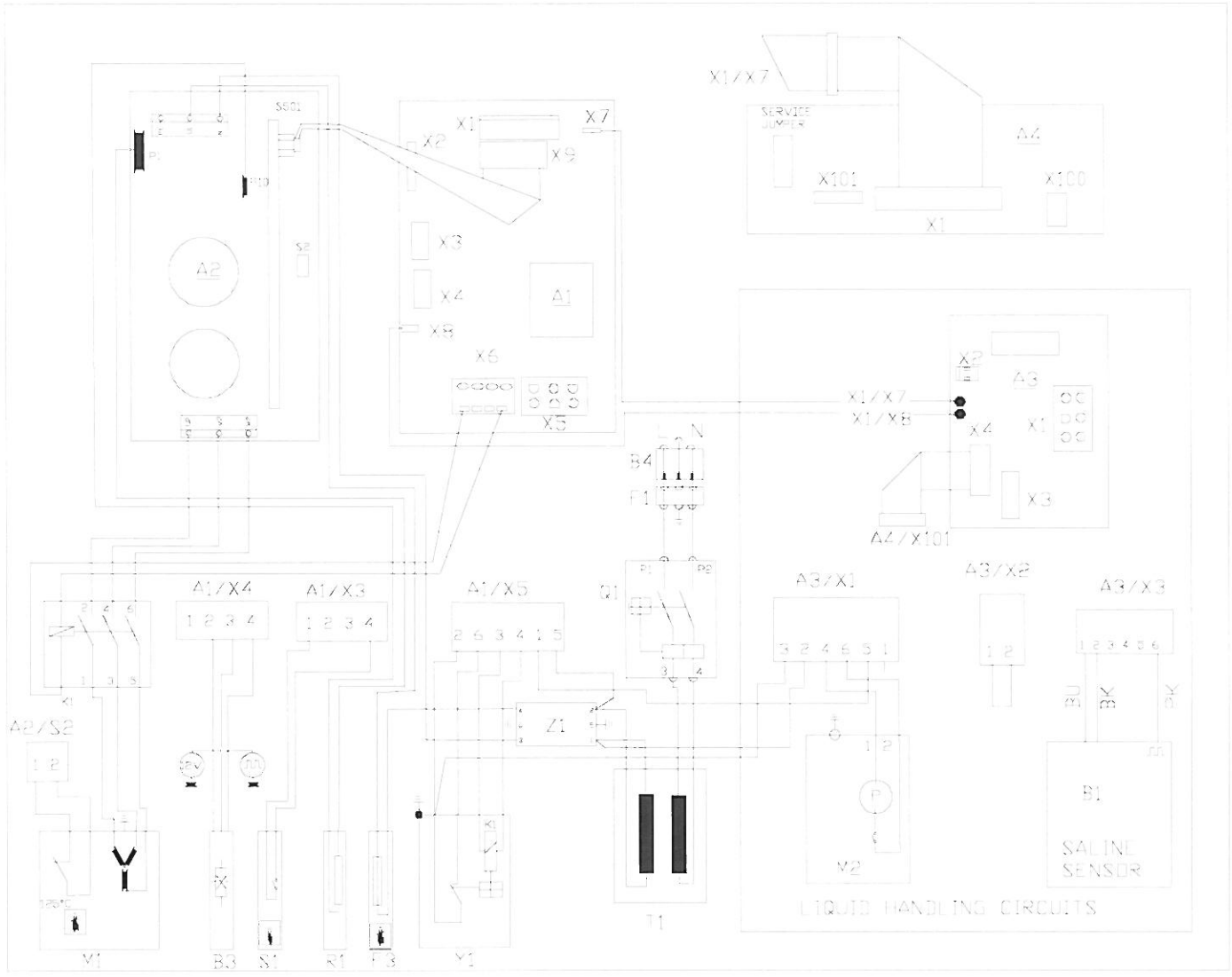


36 12-Place Rotor



Section 8 – Wiring Diagram

A1	POWER SUPPLY BOARD	F3	OVERHEATING PROTECTION BRAKING RESISTOR
A2	FREQUENCY CONVERTER	B1	FLOW METER
A3	LIQUID HANDLING BOARD	B3	SPEED SENSOR
A4	PANEL, CONTROL	B4	POWER ENTRY MODULE
Y1/K1	RELAY, LID LOCK	Q1	SWITCH, MAIN POWER
M1	MOTOR w/OVERTEMPERATURE SWITCH	Z1	RFI FILTER
M2	MOTOR, SALINE PUMP	Y1	LID LOCK
T1	TRANSFORMER	R1	BRAKING RESISTOR
F1	PCB, VARISTOR	S1	MICROSWITCH, IMBALANCE



UltraCW Wiring Diagram

Section 9 -Technical Specifications

Rotor Sizes:	12-Place, 24-Place
Weight:	51.5 lbs
Input Power:	110-127 V 60 Hz
Consumption:	2.5 A
Max RPM:	3500 RPM +/- 20 RPM
Fuse:	2.5 A
Kinetic Energy:	250 Nm
Exterior Dimensions:	13.2 in (W) x 15.5 in. (D) x 11.0 in. (H)
Ambient temperature:	Ambient temperature 5-40°C

This device complies with IEC01010-1, CAN/CSA C22.2 No.1010. 1:92 and UL 61010-1 (2002).

Section 10 – Warranty

For technical service needs, please contact Helmer at 800-743-5637 or www.helmerinc.com. Be sure to have the serial number of the UltraCW available.

When a warranty issue arises it is our desire to respond quickly and appropriately. The Technical Service department at Helmer is here for you. Helmer will oversee the handling of your warranty service from start to finish. Therefore, in order to best serve you, Helmer must give advance authorization for all service calls and/or parts needs relating to a warranty issue.

Parts:
For a period of two (2) years Helmer will supply at no charge, including freight, any part* that fails due to defects in material or workmanship under normal use. Defective parts must be returned, prepaid, with previous return authorization.

* The following expendable items are excluded from this warranty coverage. Specimen tubes, saline supply tubing, drain tubing, internal saline supply tubing, pump tubing and saline supply fitting.

Labor:
For a period of one (1) year Helmer will cover repair labor costs, provided the product is returned to Helmer for warranty service. Labor costs for repairs performed at a location other than Helmer will be the responsibility of the end user.

Helmer will not be responsible for charges incurred for service calls made by third parties prior to authorization from Helmer. Helmer retains the right to replace any product in lieu of servicing it in the field.

Inspection of defective parts by Helmer will be final in determining warranty status. Warranty procedures must be followed in all events.

Additional Product Warranty Information

The warranty period begins two weeks from the date your equipment is shipped from Helmer.

THIS WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, WHETHER WRITTEN, ORAL, OR IMPLIED. NO WARRANTIES OF MERCHANTIBILITY OR FITNESS FOR A PARTICULAR PURPOSE SHALL APPLY. Helmer shall not be liable for any indirect or consequential damages including, without limitation, damages relating to lost profits or loss of products.

This warranty does not cover damage caused in transit, during installation by accident, misuse, fire, flood or acts of God.

Installation and calibration is not covered under this warranty agreement.

HELMER

UltraCW™

Automatic Cell Washing System
Service Manual

UltraCW™ **Version B**

Model UltraCW™

S/N _____

HELMER, INC. 14395 BERGEN BLVD., NOBLESVILLE, IN 46060 USA
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360113-1/B

Contents

About this manual

Welcome to the UltraCW™ Automatic Cell Washing System Service Manual. This section explains the symbols and conventions used in this manual, copyright information about this document, and trademark information for products supplied by Helmer.

Intended audience

This manual is intended for use by qualified service technicians. This manual is to be used in conjunction with the UltraCW™ Automatic Cell Washing System Operation Manual.

Symbols and conventions

Several symbols and conventions are used in this manual.

Warnings

A Warning is used to call attention to a condition or possible situation that could cause injury to the operator.

Warnings are identified as follows:

WARNING:	This is a sample of a warning: Follow all chemical handling and disposal requirements and procedures that are specified by your organization.

Cautions

A Caution is used to call attention to a condition or possible situation that could damage or destroy the equipment or the operator's work.

Cautions are identified as follows:

CAUTION:	This is a sample of a caution: Be sure that the tubing is free of obstructions. Blocked tubing can cause fluid to back up and cause motor failure.

Notes

Notes contain additional information about a topic. Notes are used to provide information about how a topic relates to another topic, or background information about a design characteristic.

Notes are identified as follows:

NOTE:	This is a sample of a note: Tubing kits are available for purchase through Helmer.

Model references

Generic references are used throughout this manual to group models that contain similar features. For example, "UltraCW" refers to both the 115 V and 230 V models. If a feature or procedure applies to a specific voltage, it is stated as such.

Copyright and trademark information

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UltraCW™ is a registered trademark of Helmer, Inc. in the United States of America.

All other trademarks and registered trademarks are the property of their respective owners.

1 Working safely

This section describes general safety information for servicing the UltraCW Automatic Cell Washing System ("cell washer"). The Operation Manual includes additional safety information for operating and cleaning the cell washer. Your organization may provide additional safety information.

1.1 General safety

To avoid injury to yourself and the cell washer, follow these safety instructions:

- Do not use the cell washer if its components are damaged.
- Never attempt to physically restrict any of the moving components.
- Do not move or bump the cell washer during operation.
- Before performing the procedures in this manual, review the specific safety instructions for them.
- Before using tools, materials, and equipment to perform procedures in this manual, review the manufacturer's safety instructions for them.
- Perform only the maintenance described in this manual. Maintenance other than that specified in this manual should only be performed by technical service representatives authorized by Helmer.

1.2 Electrical safety

WARNING: The cell washer has the potential of being a shock hazard. Review all safety instructions.

Review the following safety instructions before troubleshooting, repairing, or replacing parts in the cell washer:

- Before removing covers from the cell washer, disconnect the power to the cell washer.
- Use appropriate grounding precautions when replacing circuit boards and other electrical parts.
- Use power cords and other electrical parts that are designed for use with the cell washer.

1.3 Chemical and biological safety

Review the safety instructions in the Operation Manual before using, cleaning, or servicing the cell washer.

WARNING:

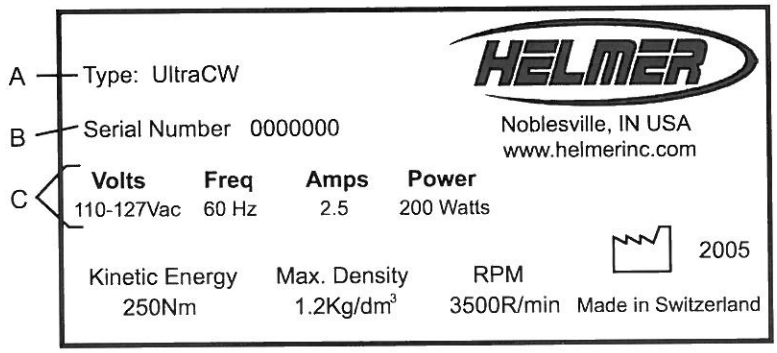
- In addition to the instructions included in this manual and the Operation Manual, follow all chemical handling and disposal requirements and procedures specified by your organization.
- Before sending parts to Helmer or your distributor for service or repair, decontaminate them as appropriate. Any items that have not been decontaminated appropriately will not be accepted. Documentation stating that the contents are not contaminated and are safe to handle must accompany all returns. Contact Helmer or your distributor for decontamination instructions and a return authorization number.

2 Reviewing information about your cell washer

This section explains how to find identification information about your cell washer.

2.1 Finding model and input power information

The Product Specification label is located on the right side of the cell washer next to the power connector.



Product Specification label (sample)

Label	Description
A	Type (Model)
B	Serial number (S/N)
C	Power requirements

2.2 Finding software and part version information

The software version appears on the control panel when you turn on the power.

Additional information is available through the Global menu, as follows:

Parameter	Meaning
CONTROL: XXX h	Number of operating hours
VERS XX °C/* 00	XX is the software version
FU/CCI - 1001	Frequency converter type
FU/CCI - S. XX.XX	Frequency converter software version

To view version information in the Global menu

1. On the control panel, press and hold the parameter selection button (◀) for about eight seconds until VOLUME ADJUST XX appears on the message screen.
2. Press and release the parameter selection button (◀) to cycle through the global parameters.
3. Exit the Global menu by pressing the STOP button or by not pressing any of the buttons for approximately 16 seconds. The message screen returns to display mode for the selected program.

3 Troubleshooting

Before taking actions as described in this section, make sure that operational issues have been addressed as described in the Operation Manual. Also, be sure that the cell washer operator has followed the appropriate laboratory procedures and used the appropriate materials for the task.

This section describes some problems you may experience, explains possible causes, and provides actions you can take to correct them.

WARNING: Review all safety instructions prior to completing troubleshooting recommendations. For more information, see Section 1, "Working safely."

3.1 Troubleshooting general operation problems

Problem	Possible Cause	Action
The cell washer is turned on, but nothing is displayed on the message screen.	There is no power to the cell washer.	1 Verify that the outlet is operational. 2 Try the following tasks in order, testing after each to determine if it solved the problem: a Replace the fuse. b Replace the main power switch. c Replace the transformer. d Replace the RFI filter.
	The display contrast is set too low.	▶ Adjust the display contrast. For instructions, see Section 4.5, "Adjusting the display contrast."
	A part in the LCD circuit is faulty.	▶ Try the following tasks in order, testing after each to determine if it solved the problem: 1 Replace the control panel. 2 Replace the power supply board.
During a saline check, the pump is not making any sound and saline is not being dispensed.	A part in the pump system is faulty.	▶ Remove the pump tubing from the pump. With the pump tubing removed, perform a saline check. ▶ If the pump does not operate, replace the pump. ▶ If the pump does operate, replace the pump tubing, which may have hardened over time.
During a saline check, the pump is operating, but saline is not being dispensed correctly.	A part in the liquid handling system circuit is faulty.	▶ Try the following tasks in order, testing after each to determine if it solved the problem: 1 Replace the flow meter. 2 Replace the liquid handling board.
The tubes were not decanted when they were programmed to do so.	The rotor is faulty.	▶ Verify that all the rotor locks (decant hooks) are intact. If any are broken off or damaged, replace the rotor.
	A part in the motor circuit is faulty.	▶ Try the following tasks in order, testing after each to determine if it solved the problem: 1 Replace the motor. 2 Replace the frequency converter. For instructions, see Section 4.7, "Replacing the frequency converter." 3 Replace the power supply board.

Problem	Possible Cause	Action
The rotor speed seems to be too high or too low.	A part in the speed sensor circuit is faulty.	1 Measure the rotor speed. For instructions, see Section 4.1, "Testing whether the rotor speed is within the design tolerance." 2 Try the following tasks in order, testing after each to determine if it solved the problem: **a** Replace the speed sensor. **b** Replace the motor. **c** Replace the frequency converter. For instructions, see Section 4.7, "Replacing the frequency converter."
Tubes are breaking during processes with a Decant step.	Tube holder inserts were not installed correctly before processing 10 mm x 75 mm tubes.	▶ Install the tube holder inserts, and repeat the process to determine if the problem was solved.
	The top of the tube does not move freely around the fill port.	▶ Ensure that the height of the tubes is within the acceptable tolerance of 75 mm ± 1.5 mm.

3.2 Addressing error messages

In the event of an error condition, the cell washer displays an error message to assist in troubleshooting. This section provides possible causes associated with each error message and actions that should be taken.

XX represents the error message number.

CONTROL - ERROR XX

When a message of this type appears, there is a problem with the lid closing or locking, or a problem with the control panel.

Error message number	Possible cause	Action
04, 06 to 09	The lid lock is faulty.	1 Clear the error message: Open the lid, then turn off the power. After about 10 seconds, turn the power back on. 2 Check if the lid can be opened while the cell washer is turned off. If it can, replace the lid lock.
	A connection in the lid lock circuit is loose.	1 Clear the error message: Open the lid, then turn off the power. After about 10 seconds, turn the power back on. 2 Check the contact connection between the lid lock and the control/display board. 3 Check that the ribbon cable between the control/display board and the power supply board is securely connected.

Continued

Error message number	Possible cause	Action
Continued 04, 06 to 09	A part in the lid lock circuit is faulty.	**1** Clear the error message: Open the lid, then turn off the power. After about 10 seconds, turn the power back on. **2** Try the following tasks in order, testing after each to determine if it solved the problem: **a** Replace the ribbon cable between the control/display board and the power supply board. **b** Replace the power supply board. **c** Replace the control panel.
21 to 26	The control panel is faulty.	**1** Clear the error message: Open the lid, then turn off the power. After about 10 seconds, turn the power back on. **2** Replace the control panel.

FU/CCI - ERROR XX

When a message of this type appears, there is a problem related to the frequency converter.

Error message number	Possible cause	Action
60	A part in the frequency converter circuit is faulty, resulting in a false lid lock release signal.	▶ Try the following tasks in order, testing after each to determine if it solved the problem: **1** Replace the ribbon cable between the control/display board and the power supply board. **2** Replace the ribbon cable between the frequency converter and the power supply board. **3** Replace the frequency converter. For instructions, see Section 4.7, "Replacing the frequency converter." **4** Replace the power supply board. **5** Replace the control panel.
61	A part in the frequency converter circuit is faulty, resulting in a processing error.	**1** Clear the error message: Open the lid, then turn off the power. After about 1 minute, turn the power back on. **2** Try the following tasks in order, testing after each to determine if it solved the problem: **a** Replace the ribbon cable between the control/display board and the power supply board. **b** Replace the ribbon cable between the frequency converter and the power supply board. **c** Replace the frequency converter. For instructions, see Section 4.7, "Replacing the frequency converter." **d** Replace the power supply board. **e** Replace the control panel.

Error message number	Possible cause	Action
62	The main supply voltage is too low, resulting in an undervoltage condition to the frequency converter.	**1** Clear the error message: Open the lid, then turn off the power. After about 1 minute, turn the power back on. **2** Verify that the outlet in the facility is operational and supplying adequate voltage to the cell washer. **3** Try the following tasks in order, testing after each to determine if it solved the problem: **a** Replace the ribbon cable between the control/display board and the power supply board. **b** Replace the ribbon cable between the frequency converter and the power supply board. **c** Replace the frequency converter. For instructions, see Section 4.7, "Replacing the frequency converter." **d** Replace the power supply board. **e** Replace the control panel.
63	A part in the frequency converter circuit is faulty, resulting in an overcurrent condition in the motor.	**1** Clear the error message: Open the lid, then turn off the power. After about 1 minute, turn the power back on. **2** Try the following tasks in order, testing after each to determine if it solved the problem: **a** Replace the motor. **b** Replace the ribbon cable between the frequency converter and the power supply board. **c** Replace the frequency converter. For instructions, see Section 4.7, "Replacing the frequency converter." **d** Replace the power supply board.
64	A part in the frequency converter circuit is faulty, resulting in an overvoltage condition in the braking resistor.	**1** Clear the error message: Open the lid, then turn off the power. After about 1 minute, turn the power back on. **2** Try the following tasks in order, testing after each to determine if it solved the problem: **a** Replace the braking resistor. **b** Replace the ribbon cable between the frequency converter and the power supply board. **c** Replace the frequency converter. For instructions, see Section 4.7, "Replacing the frequency converter." **d** Replace the power supply board.

Error message number	Possible cause	Action
67	A part in the frequency converter circuit is faulty, resulting in an overtemperature condition in the motor.	**1** Clear the error message: Open the lid, then turn off the power. After about 1 minute, turn the power back on. **2** Try the following tasks in order, testing after each to determine if it solved the problem: **a** Test the motor windings. If they are faulty, replace the motor. **b** Replace the ribbon cable between the frequency converter and the power supply board. **c** Replace the frequency converter. For instructions, see Section 4.7, "Replacing the frequency converter." **d** Replace the power supply board.
68	A part in the frequency converter circuit is faulty, resulting in an overvoltage condition in the frequency converter.	**1** Clear the error message: Open the lid, then turn off the power. After about 1 minute, turn the power back on. **2** Confirm that the ambient temperature during operation does not exceed 45 °C. **3** Try the following tasks in order, testing after each to determine if it solved the problem: **a** Replace the ribbon cable between the control/display board and the power supply board. **b** Replace the ribbon cable between the frequency converter and the power supply board. **c** Replace the frequency converter. For instructions, see Section 4.7, "Replacing the frequency converter." **d** Replace the power supply board.
69	The frequency converter is faulty.	**1** Clear the error message: Open the lid, then turn off the power. After about 1 minute, turn the power back on. **2** Replace the frequency converter. For instructions, see Section 4.7, "Replacing the frequency converter."
84	A part in the frequency converter circuit is faulty, resulting the frequency converter detecting excess rotor speed.	▶ Try the following tasks in order, testing after each to determine if it solved the problem: **1** Replace the ribbon cable between the frequency converter and the power supply board. **2** Replace the frequency converter. For instructions, see Section 4.7, "Replacing the frequency converter." **3** Replace the power supply board.

Error message number	Possible cause	Action
85	A part in the frequency converter circuit is faulty, resulting in a processing error.	1 Clear the error message: Open the lid, then turn off the power. After about 10 seconds, turn the power back on. 2 Try the following tasks in order, testing after each to determine if it solved the problem: a Replace the ribbon cable between the frequency converter and the power supply board. b Replace the frequency converter. For instructions, see Section 4.7, "Replacing the frequency converter." c Replace the power supply board.

IMBALANCE

When this message appears, there is a problem with the balance of the rotor.

Error message number	Possible cause	Action
None	The Imbalance initialization parameter was set to the wrong value after the frequency converter was replaced.	1 Clear the error message: Open the lid, then turn off the power. After about 10 seconds, turn the power back on. 2 Check that the Imbalance parameter is set to 2. For more information and instructions, see Section 4.7 "Replacing the frequency converter."
	The imbalance tolerance is set too low.	1 Clear the error message: Open the lid, then turn off the power. After about 10 seconds, turn the power back on. 2 Check the imbalance tolerance and adjust it if necessary. For instructions, see Section 4.2, "Testing whether the imbalance value is in the permissible range."
	One or more motor mounts is worn.	1 Clear the error message: Open the lid, then turn off the power. After about 10 seconds, turn the power back on. 2 Check the motor mounts for wear. Replace them if necessary.
	A connection in the imbalance microswitch circuit is loose.	1 Clear the error message: Open the lid, then turn off the power. After about 10 seconds, turn the power back on. 2 Check the connection between the imbalance microswitch and the power supply board. 3 Check that the ribbon cable between the control/display board and the power supply board is securely connected.

Continued

Error message number	Possible cause	Action
Continued None	A part in the imbalance microswitch circuit is faulty	**1** Clear the error message: Open the lid, then turn off the power. After about 10 seconds, turn the power back on. **2** Try the following tasks in order, testing after each to determine if it solved the problem: **a** Check the continuity of the imbalance microswitch, which is normally closed. The resistance should be 0 Ω when the switch is closed (not activated). If there is resistance, replace the imbalance microswitch, then set the imbalance tolerance. For instructions, see Section 4.3, "Adjusting the imbalance microswitch." **b** Replace the ribbon cable between the control/display board and the power supply board. **c** Replace the power supply board. **d** Replace the control panel.

LOW SALINE

When this message appears, there is a problem with the flow of saline into the cell washer.

Error message number	Possible cause	Action
None	A connection in the liquid handling system circuit is loose.	**1** Clear the error message: Open the lid, then turn off the power. After about 10 seconds, turn the power back on. **2** Check the connection between the liquid handling board and the power supply board.
	A part in the pump system is faulty.	**1** Clear the error message: Open the lid, then turn off the power. After about 10 seconds, turn the power back on. **2** Remove the pump tubing from the pump. With the pump tubing removed, perform a saline check. ▶ If the pump does not operate, replace the pump. ▶ If the pump does operate, replace the pump tubing, which may have hardened over time.
	A part in the liquid handling system circuit is faulty.	**1** Clear the error message: Open the lid, then turn off the power. After about 10 seconds, turn the power back on. **2** Try the following tasks in order, testing after each to determine if it solved the problem: **a** Replace the flow meter. **b** Replace the liquid handling board.

N > MAX XX

When this message appears, the rotor speed being detected exceeds the maximum allowable speed.

Error message number	Possible cause	Action
05	The insulation on the speed sensor cable is faulty.	**1** Clear the error message: Turn off the power. After about 10 seconds, turn it back on. **2** Check the speed sensor cable for wear. If worn, replace the speed sensor.
	A connection in the speed sensor circuit is loose.	**1** Clear the error message: Turn off the power. After about 10 seconds, turn it back on. **2** Check the connection between the speed sensor and the power supply board. **3** Check that the ribbon cable between the control/display board and the power supply board is securely connected.
	A part in the speed sensor circuit is faulty.	**1** Clear the error message: Turn off the power. After about 10 seconds, turn it back on. **2** Try the following tasks in order, testing after each to determine if it solved the problem: **a** Test the speed sensor by measuring the rotor speed. For instructions, see Section 4.1, "Testing whether the rotor speed is within the design tolerance." If the speed is not within the tolerance, replace the speed sensor. **b** Replace the ribbon cable between the control/display board and the power supply board. **c** Replace the ribbon cable between the frequency converter and the power supply board. **d** Replace the frequency converter. For instructions, see Section 4.7, "Replacing the frequency converter." **e** Replace the power supply board. **f** Replace the control panel.

N < MIN XX

When this message appears, the rotor is rotating too slowly.

Error message number	Possible cause	Action
13	A connection in the motor circuit is loose.	**1** Clear the error message: Open the lid, then turn off the power. After about 10 seconds, turn the power back on. **2** Check the connection between the motor and the frequency converter.
	A part in the motor circuit is faulty.	**1** Clear the error message: Open the lid, then turn off the power. After about 10 seconds, turn the power back on. **2** Try the following tasks in order, testing after each to determine if it solved the problem: **a** Test the motor windings. If they are faulty, replace the motor. **b** Replace the frequency converter. For instructions, see Section 4.7, "Replacing the frequency converter."
	The silicone motor seal is loose.	**1** Clear the error message: Open the lid, then turn off the power. After about 10 seconds, turn the power back on. **2** Check that the motor seal has been installed properly. For more information, see Section 4.8, "Removing and installing the bowl assembly."

POWER INTERRUPT

When this message appears, the AC power was interrupted during operation, or was sensed as being interrupted.

Error message number	Possible cause	Action
None	A connection between the control/ display board and the power supply board is loose.	**1** Clear the error message: Open the lid then press the START WASH button. **2** Check the connection between the control/ display board and the power supply board.
	A part in the control panel and power supply circuit is faulty.	**1** Clear the error message: Open the lid then press the START WASH button. **2** Try the following tasks in order, testing after each to determine if it solved the problem: **a** Replace the power supply board. **b** Replace the ribbon cable between the control/display board and the power supply board. **c** Replace the control panel.

SER I/O - ERROR XX

When a message of this type appears, there is a problem with communication between components.

Error message number	Possible cause	Action
30 and 31	A connection in the frequency converter circuit is loose.	**1** Clear the error message: Turn off the power. After about 10 seconds, turn it back on. **2** Check the connection between the frequency converter and the power supply board. **3** Check the connections between the frequency converter and the RFI filter and braking resistor overtemperature switch.
	The connections between the frequency converter and the RFI filter and braking resistor overtemperature switch are wrong.	**1** Clear the error message: Turn off the power. After about 10 seconds, turn it back on. **2** Check that the connections on the frequency converter at connector S102 are correct.
	The braking resistor overtemperature switch has opened.	**1** Clear the error message: Turn off the power. After about 10 seconds, turn it back on. **2** Replace the braking resistor overtemperature switch.
	A part in the frequency converter circuit is faulty.	**1** Clear the error message: Turn off the power. After about 10 seconds, turn it back on. **2** Try the following tasks in order, testing after each to determine if it solved the problem: **a** Replace the frequency converter. For instructions, see Section 4.7, "Replacing the frequency converter." **b** Replace the ribbon cable between the control/display board and the power supply board. **c** Replace the ribbon cable between the frequency converter and the power supply board. **d** Replace the control panel. **e** Replace the power supply board.
33, 34, and 36	A part in the frequency converter and control panel circuit is faulty.	**1** Clear the error message: Turn off the power. After about 10 seconds, turn it back on. **2** Try the following tasks in order, testing after each to determine if it solved the problem: **a** Replace the frequency converter. For instructions, see Section 4.7, "Replacing the frequency converter." **b** Replace the ribbon cable between the control/display board and the power supply board. **c** Replace the ribbon cable between the frequency converter and the power supply board. **d** Replace the control panel. **e** Replace the power supply board.

TACHO - ERROR XX

When a message of this type appears, the rotor is not installed, or the speed is being controlled or sensed incorrectly.

Message number	Possible cause	Action
01	A connection in the speed sensor circuit is loose, resulting in the interruption of speed sensor pulses.	1 Clear the error message by doing the following: **a** Open the lid, then turn off the power. **b** While spinning the rotor clockwise by hand, turn on the power. 2 Check the connection between the speed sensor and the power supply board.
	A part in the speed sensor circuit is faulty.	1 Clear the error message by doing the following: **a** Open the lid, then turn off the power. **b** While spinning the rotor clockwise by hand, turn on the power. 2 Try the following tasks in order, testing after each to determine if it solved the problem: **a** Test the speed sensor by measuring the rotor speed. For instructions, see Section 4.1, "Testing whether the rotor speed is within the design tolerance." If the speed is not within the tolerance, replace the speed sensor. **b** Replace the ribbon cable between the control/display board and the power supply board. **c** Replace the ribbon cable between the frequency converter and the power supply board. **d** Replace the frequency converter. For instructions, see Section 4.7, "Replacing the frequency converter." **e** Replace the control panel. **f** Replace the power supply board.

Message number	Possible cause	Action
02	A connection in the speed sensor and motor circuit is loose, resulting in no speed sensor pulses after start-up.	**1** Clear the error message by doing the following: **a** Open the lid, then turn off the power. **b** While spinning the rotor clockwise by hand, turn on the power. **2** Check the connection between the speed sensor and the power supply board. **3** Check the motor connections.
	A part in the speed sensor and motor circuit is faulty.	**1** Clear the error message by doing the following: **a** Open the lid, then turn off the power. **b** While spinning the rotor clockwise by hand, turn on the power. **2** Try the following tasks in order, testing after each to determine if it solved the problem: **a** Test the motor windings. If they are faulty, replace the motor. **b** Test the speed sensor by measuring the rotor speed. For instructions, see Section 4.1, "Testing whether the rotor speed is within the design tolerance." If the speed is not within the tolerance, replace the speed sensor. **c** Replace the ribbon cable between the control/display board and the power supply board. **d** Replace the ribbon cable between the frequency converter and the power supply board. **e** Replace the frequency converter. For instructions, see Section 4.7, "Replacing the frequency converter." **f** Replace the control panel. **g** Replace the power supply board.

VERSION - ERROR XX

When a message of this type appears, there is a problem with the control panel.

Message number	Possible cause	Action
12	The cell washer was not initialized after replacing the frequency converter.	**1** Clear the error message: Turn off the power. After about 10 seconds, turn it back on. **2** Initialize the cell washer. For instructions, see Section 4.7.2, "Initializing the cell washer." Reset the power to clear the error message.
	A component on the control panel is not compatible with the frequency converter.	**1** Clear the error message: Turn off the power. After about 10 seconds, turn it back on. **2** Replace the control panel.

4 Servicing the cell washer

This section explains how to access serviceable parts, as well as how to perform some service procedures.

4.1 Testing whether the rotor speed is within the design tolerance

NOTE: You cannot test the decant speed, but you can change it by changing a global parameter value. For instructions, refer to the Operation Manual.

You can measure the rotor speed to determine whether it is within the design tolerance.

The cell washer has a sight window in the lid and an optical reference on the rotor so that you can easily measure the speed of the rotor during operation.

When the rotor is programmed to spin at 3500 r/min (RPM), the measured speed should be 3500 r/min ± 20 r/min.

For more information and instructions to program and use the cell washer, refer to the Operation Manual.

You will need the following to test the rotor speed:

► Laser tachometer (calibrated and capable of measuring r/min)

WARNING: Prior to using the laser tachometer, review all safety and usage instructions provided by the manufacturer.

To test whether the rotor speed is within the design tolerance

NOTE: Regulations for your organization may recommend test methods different from what appear here. Use the appropriate methods for your organization.

1. Install the rotor.
2. Program the Spin (S) program with a spin speed of 3500 r/min and a spin time that is long enough for you to measure the speed.
3. Start the Spin (S) program by pressing the SPIN button.
4. While the rotor is spinning and 3500 is displayed on the message screen, point the tachometer's laser beam through the sight window on the lid. As the rotor spins, the laser momentarily reflects off the optical reference on the rotor.
5. Obtain the reading from the tachometer. If the speed is not within the tolerance of 3500 r/min ± 20 r/min, follow the appropriate troubleshooting steps to determine how to proceed.

4.2 Testing whether the imbalance value is in the permissible range

The imbalance microswitch senses whether the rotor is balanced during operation. If the rotor is not balanced, an imbalance error results. The weight at which the imbalance error occurs is the imbalance value.

At the factory, the microswitch is positioned to allow an imbalance value that lies between 5 g and 10 g when the rotor is spinning at 1500 r/min. For example, if the imbalance value were 7 g (the middle of the range), an imbalance error would result only if one side of the rotor were more than 7 g heavier than the other. One gram is approximately equal to 1 ml of saline solution.

Continual operation of the cell washer when the imbalance value of greater than or equal to 10 g may damage the cell washer. An imbalance value of less than or equal to 5 g is overly sensitive to the normal variations in weight that occur during operation.

For more information and instructions to program and use the cell washer, refer to the Operation Manual.

You will need the following to test whether the imbalance value is in the permissible range:

- Tubes (enough to fill all available positions on the rotor)
- Saline solution. One test run requires 15 g (approximately 15 ml)
- Scale (calibrated and capable of measuring 10 g)

To test whether the imbalance value is in the permissible range

NOTE: Regulations for your organization may recommend test methods different from what appear here. Use the appropriate methods for your organization.

1. Add tubes to all the available positions in the rotor. If you are using 10 mm x 75 mm tubes, confirm that the tube inserts are installed correctly in all the tube holders.
2. Program the Spin (S) program with a spin speed of 1500 r/min and a spin time of 20 seconds.
3. Test whether the imbalance value is below the upper limit of the permissible range.
   a. Starting with empty tubes, add a total of 10 g of saline solution to one or more tubes on one side of the rotor.
   b. Install the rotor.
   c. Start the Spin program. If the program completes without an imbalance error, then the imbalance value is too high and must be decreased. For instructions, see Section 4.3, "Adjusting the imbalance microswitch."
4. Test whether the imbalance value is above the lower limit of the permissible range.
   a. Add a total of 5 g of saline solution to one or more tubes on one side of the rotor.
   b. Install the rotor.
   c. Start the Spin program. If an imbalance error occurs, then the imbalance value is too low and must be increased. For instructions, see Section 4.3, "Adjusting the imbalance microswitch."

4.3 Adjusting the imbalance microswitch

NOTE: For more information about locating and identifying parts, see Section 5, "Parts" and Section 6, "Schematic."

The imbalance microswitch senses whether the rotor is balanced during operation. If the rotor is not balanced, an imbalance error results.

The proximity of the microswitch to the motor shaft determines the value at which the rotor is considered to be imbalanced. The higher the imbalance of the rotor, the closer the motor shaft moves toward the microswitch during operation.

You may need to adjust the imbalance microswitch in the following circumstances:

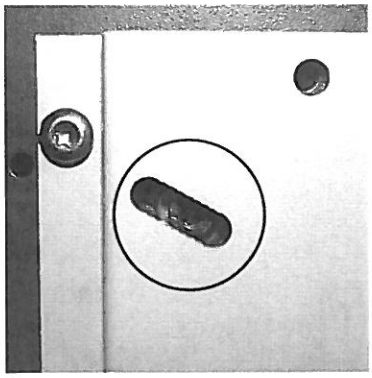
- The imbalance value is outside of the permissible range.
- Imbalance errors continue to appear, even after you have addressed other possible causes.
- You replaced the imbalance microswitch.

You will need the following to adjust the position of the imbalance microswitch:

- #15 TORX® screwdriver

To adjust the imbalance microswitch

1. Remove the rotor from the cell washer, and close the lid.
2. Turn off the cell washer and disconnect it from power.
3. Turn the cell washer so that it rests on the left side.
4. On the bottom of the cell washer, use the screwdriver to loosen the screw in the slot. This screw secures the imbalance microswitch bracket to the base.



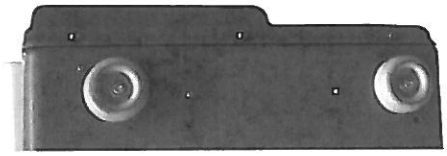
Bottom of cell washer with imbalance adjustment screw circled

5. Do one of the following:
   - To decrease the imbalance value, slide the screw toward the center of the cell washer. The switch moves closer to the motor shaft.
   - To increase the imbalance value, slide the screw away from the center of the cell washer. The switch moves farther away from the motor shaft.
6. Tighten the screw to secure the imbalance bracket to the base.
7. Test the imbalance value to ensure that it in the permissible range. For instructions, see Section 4.2, "Testing whether the imbalance value is in the permissible range."

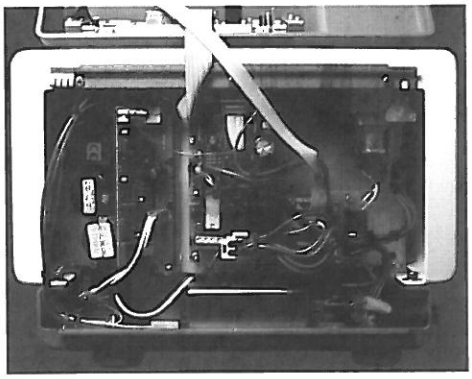
4.4 Removing and installing the front panel

NOTE: For more information about locating and identifying parts, see Section 5, "Parts" and Section 6, "Schematic."

Several serviceable parts are located behind the front panel. This section explains how to access them.



Bottom view of the front of the cell washer



Cell washer with front panel removed and flipped upward

You will need the following to remove or install the front panel:

- 2.5 mm Allen wrench

To remove the front panel

1. Open the lid, turn off the cell washer, and disconnect it from power.
2. Remove the three screws that secure the bottom of the front panel to the base.
3. Gently pull the bottom of the panel away from the base.
4. Lift the front panel until the groove on the panel disengages from the tongue on the housing.

To install the front panel

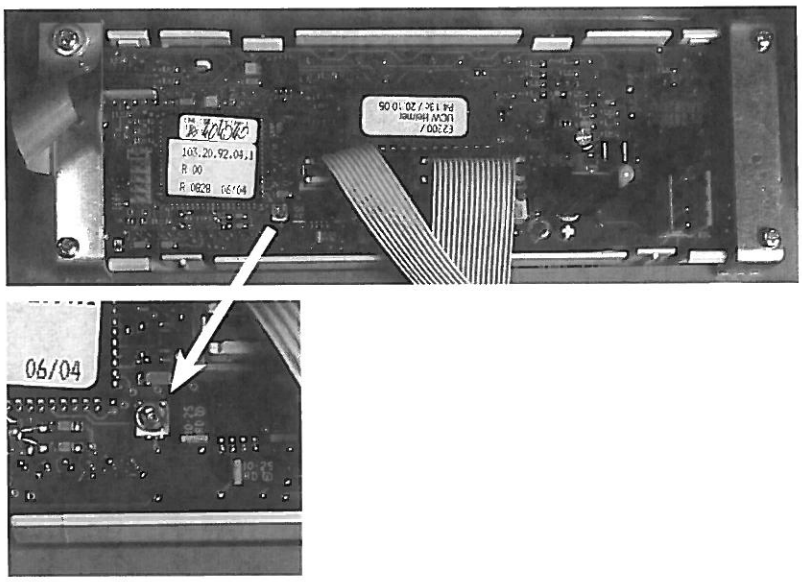
1. With the lid open, place the front panel on the front of the housing so that the groove on the panel fits around the tongue on the housing.
2. Press front panel downward to engage the tongue and groove.
3. Press the bottom of the panel against the base.
4. Slide the front panel sideways until the sides of the panel align with the base and the screw holes align.
5. Install the three screws to secure the panel to the base.

4.5 Adjusting the display contrast

NOTE: For more information about locating and identifying parts, see Section 5, "Parts" and Section 6, "Schematic."

You will need the following to adjust the display contrast:

- Small flathead screwdriver with insulated shank



Control/display board with detail of the trimming potentiometer

To adjust the display contrast

1. Remove the rotor from the cell washer, and leave the lid open.
2. Turn off the cell washer and disconnect it from power.
3. Remove the front panel. For instructions, see Section 4.4, "Removing and installing the front panel."
4. On the control/display board, use the screwdriver to turn the trimming potentiometer. Turning the potentiometer clockwise makes the screen darker (decreases the contrast).
5. Install the front panel. For instructions, see Section 4.4, "Removing and installing the front panel."
6. Connect the cell washer to power.
7. Turn on the cell washer and check the contrast.
8. Repeat as necessary until the contrast level is acceptable.

4.6 Viewing and changing the fill speed

You can change the value for the Fill (rpm) parameter, which is used to control the rotor speed during Fill and Suspension steps in non-cleaning processes.

The Fill (rpm) parameter is factory preset to 1100 r/min for use in cell washing processes. This parameter should only be changed if the cell washer is being used for other applications that may require a different fill speed. Available values are 100 to 1500, inclusive.

For more information about how the rotor speed is controlled for other steps, and instructions to change the rotor speed for those steps, refer to the Operation Manual.

You will need the following to view and change the fill speed:

- 2.5 mm Allen wrench
- #20 TORX screwdriver
- Standard 2-pin jumper

To view and change the fill speed

1. Put the cell washer into initialization mode.
   a. Remove the rotor from the cell washer, and leave the lid open.
   b. Turn off the cell washer and disconnect it from power.
   c. Use the Allen wrench to remove the front panel. For instructions, see Section 4.4, "Removing and installing the front panel."
   d. On the back of the front panel, locate the control/display board.
   e. On the control/display board, add the 2-pin jumper and configure the jumpers for initialization mode. For instructions, see Section 4.7.1, "Setting jumpers."
   f. Install the front panel. For instructions, see Section 4.4, "Removing and installing the front panel."
   g. Connect the cell washer to power.
   h. Turn on the cell washer. The software version appears on the message screen and all lamps are lit. After about eight seconds, * INIT - MODE * appears on the message screen.
2. Press and release the parameter selection button (◀) until the Fill (rpm) parameter appears on the message screen.
3. (Optional) Change the value of the parameter that is displayed by pressing and releasing either parameter value button (▲ or ▼) until the value that you want to use appears.
4. (Optional) Press and release the parameter selection button (◀) to view the remaining initialization parameters.
5. Press the START WASH button. The message screen changes to ***ok*** to indicate that the new values were saved. PARAM - INIT XYYY appears on the message screen to indicate the number of initializations that have been performed.
6. (Optional) To view or change the initialization parameters again, turn the cell washer off and back on again, then repeat steps 2-5.
7. Remove the extra jumper and move the other one back to its original position to resume normal operation.

4.7 Replacing the frequency converter

NOTE: For more information about locating and identifying parts, see Section 5, "Parts" and Section 6, "Schematic."

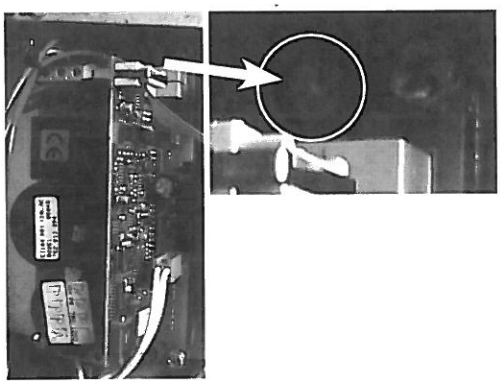
The frequency converter generates and monitors the current supply for the drive motor. It also monitors the motor temperature and transfers the electrical energy produced during braking to the braking resistor. If there is a problem with the frequency converter, it may need to be replaced.

You will need the following to replace the frequency converter:

- 2.5 mm Allen wrench
- #20 TORX screwdriver
- Standard 2-pin jumper

To replace the frequency converter

1. Remove the rotor from the cell washer, and leave the lid open.
2. Turn off the cell washer and disconnect it from power.
3. Use the Allen wrench to remove the front panel. For instructions, see Section 4.4, "Removing and installing the front panel."
4. Disconnect the wiring to other components. For more information, see Section 6, "Schematic."
5. Using the TORX screwdriver, remove the four screws that secure the frequency converter board and underlying heat sink to the interior housing, then remove the frequency converter and heat sink together.

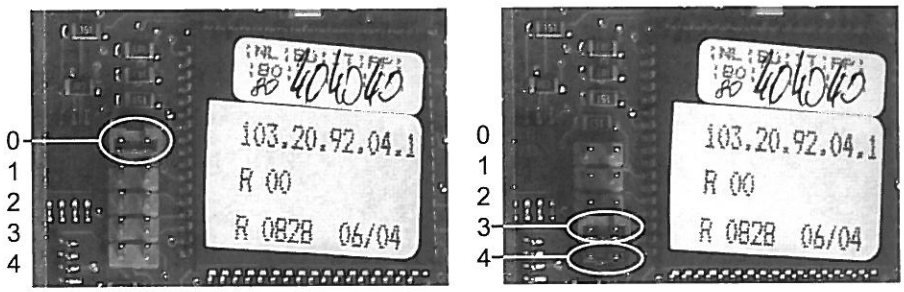


Left: Frequency converter. Right: Detail of one of four TORX screws that secure the frequency converter to the interior housing.

6. Install the new frequency converter and reinstall the screws, making sure that there is sufficient heat conduction paste between the heat sink and the interior housing. If necessary, scrape off the paste from the old frequency converter and apply it on the new one.
7. Reconnect the wiring.
8. On the back of the front panel, locate the control/display board.
9. On the control/display board, add the 2-pin jumper and configure the jumpers for initialization mode. For instructions, see Section 4.7.1, "Setting jumpers."
10. Install the front panel. For instructions, see Section 4.4, "Removing and installing the front panel."
11. Initialize the cell washer. For instructions, see Section 4.7.2, "Initializing the cell washer."
12. Perform a functional check of the cell washer. For instructions, see Section 4.9, "Performing post-repair checks."

4.7.1 Setting jumpers

The jumper settings on the control/display board must be changed to enter initialization mode.



Jumper settings. Left: Normal operating mode. Right: Initialization mode.

The control/display board has one jumper installed. To set the jumpers for initialization mode, you will need a second standard 2-pin jumper.

To set the jumpers for normal operating mode

► On the control/display board, install a jumper at position 0, and remove jumpers from positions 1-4.

To set the jumpers for initialization mode

► On the control/display board, move the existing jumper to position 3, and add a jumper to position 4.

4.7.2 Initializing the cell washer

The cell washer must be initialized whenever the frequency converter is replaced, otherwise the cell washer displays the IMBALANCE error at all times.

To initialize the cell washer

1. On the control/display board, ensure that the jumpers are set for initialization mode. For instructions, see Section 4.7.1, "Setting jumpers."
2. Connect the cell washer to power.
3. Turn on the cell washer. The software version appears on the message screen and all lamps are lit. After about eight seconds, * INIT - MODE * appears on the message screen.
4. Press and release the parameter selection button (◀) until the IMBALANCE MODE parameter appears on the message screen.
5. Press and release either parameter value button (▲ or ▼) until the parameter is set to 2.
6. (Optional) Press and release the parameter selection button (◀) to cycle through the initialization parameters.
7. To save your changes, press the START WASH button. The message screen changes to ***ok*** to indicate that the new value was saved. PARAM - INIT XYYY appears on the message screen to indicate the number of initializations that have been performed.
8. Remove the extra jumper and move the other one back to its original position to resume normal operation.

4.8 Removing and installing the bowl assembly

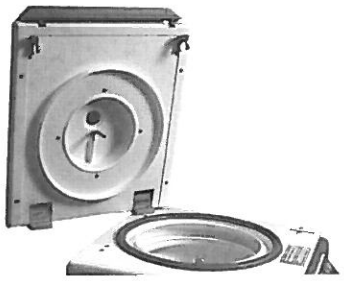
NOTE: For more information about locating and identifying parts, see Section 5, "Parts" and Section 6, "Schematic."

You will need the following to remove or install the bowl assembly:

- Small flathead screwdriver
- Allen wrenches in the following sizes: 2 mm, 2.5 mm, 4 mm, and 5 mm. The transport bolt removal tool is a 5 mm Allen wrench.
- Clear silicone paste

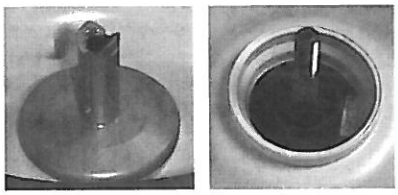
To remove the bowl assembly

1. Remove the rotor from the cell washer, and leave the lid open.
2. Turn off the cell washer and disconnect it from power.
3. Using the 4 mm Allen wrench, remove three screws that secure the lid hinges to the housing, then swing the lid assembly away from the cell washer. This provides clearance for removing the bowl assembly.



Lid loosened and swung away from the cell washer.

4. Remove the rotor shaft/motor hub.



Left: Rotor shaft/motor hub with black plastic cap. Right: Rotor shaft/motor hub removed.

   a. Using the flathead screwdriver, pry the black plastic cap off the top of rotor shaft.
   b. Using the 5 mm Allen wrench, turn the bottom nut inside the shaft counter-clockwise to loosen it.

CAUTION: Loosening the top nut, which is a 6 mm nut, may damage the rotor shaft and bowl assembly.

   c. Lift the rotor shaft/motor hub from the motor shaft.
5. Separate the bowl assembly from the housing.
   a. Using the 2 mm Allen wrench, remove the eight screws that secure the top of the bowl to the housing. Fold back the gasket to access the screws.
   b. On the rear of the cell washer, use the 2.5 mm Allen wrench to remove the two screws that secure the drain connector to the base.

c Working your way around the hole in the bowl, gently pull the silicone motor seal toward the motor shaft.

6 Lift the gasket, drainage rings, and bowl assembly from the housing, tilting the bowl so that the drain connector clears the housing.

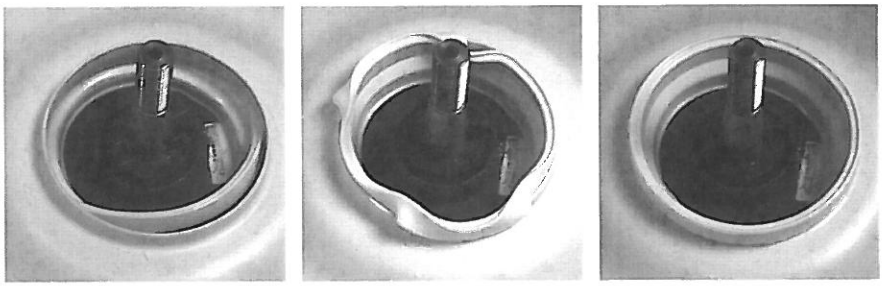
CAUTION: If the drain connector is damaged, the bowl assembly must be replaced.

To install the bowl assembly

1 Lower the gasket, drainage rings, and bowl assembly into the housing. The drain connector should emerge through the hole in the base, and the bowl should be centered over the motor shaft.

CAUTION: If the drain connector is damaged, the bowl assembly must be replaced.

2 Adjust the silicone motor seal to the correct position.



Left: Seal partially pinched under the bowl. Middle: Seal pulled toward shaft, with the edges partially pulled around the edge of the center hole. Right: Seal correctly adjusted.

a Working your way around the hole in the bowl, gently pull the silicone motor seal toward the motor shaft so that no part of the seal is pinched under the bowl.

b Working your way around, pull the edges of the seal up and over the edge of the hole.

3 Secure the bowl assembly to the housing.

a While folding back the gasket to access the screw holes on the rim of the bowl assembly, use the 2 mm Allen wrench to install and tighten the eight screws until they are snug.

CAUTION: Do not overtighten the screws. Overtightening them may damage the bowl assembly.

b On the rear of the cell washer, use the 2.5 mm Allen wrench to install and tighten the two screws that secure the drain connector to the base.

4 Install the rotor shaft/motor hub.

a Lower the rotor shaft/motor hub onto the motor shaft, aligning the slots in the hub with the tongues in the motor shaft.

b Using the 5 mm Allen wrench, turn the bottom nut inside the shaft clockwise to tighten it.

CAUTION: Tightening the top nut, which is a 6 mm nut, may damage the rotor shaft and bowl assembly.

c Apply the clear silicone paste to the underside of the black plastic cap, then press the cap onto the top of the rotor shaft.

5 Swing the lid assembly back into position, and use the 4 mm Allen wrench to tighten the screws that secure the hinges to the housing.

4.9 Performing post-repair checks

Perform functional and safety checks of the cell washer after repairing or replacing parts.

For more information and instructions to program and use the cell washer, refer to the Operation Manual.

To perform a functional check

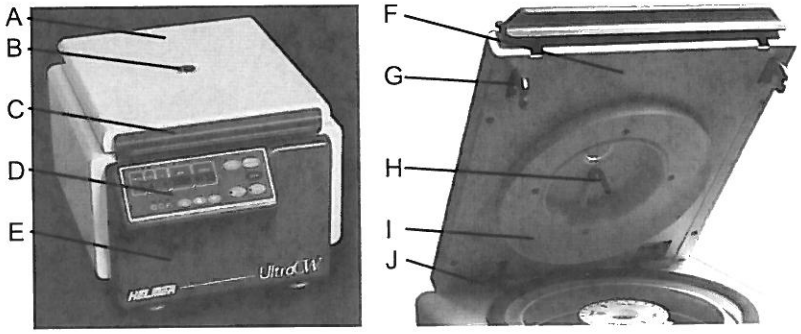
NOTE: Regulations for your organization may recommend test methods different from what appear here. Use the appropriate methods for your organization.

1. Ensure that the cell washer is connected to power and turned on.
2. Load the rotor with tubes and install the rotor.
3. Verify that the buttons, display, and indicator lamps are working correctly.
4. Start a multiple-cycle wash process.
5. During the Fill step, press the CHECK button to pause the process.
6. Open the lid and verify that the tubes are equally filled with the programmed amount of saline solution, within a range that is acceptable according to the guidelines for your organization. If too much or too little liquid is dispensed, the fill volume may need to be adjusted.
7. Press the START WASH button to resume the process.
8. During the Decant step, press the CHECK button to pause the process.
9. Open the lid and verify the following:
   - ► The tubes are decanted equally, within a range that is acceptable according to the guidelines for your organization.
   - ► The amount of liquid, if any, is within a range that is acceptable according to the guidelines for your organization. If too much liquid remains, the decanting speed may need to be adjusted.
10. Press the START WASH button to resume the process.
11. During the Agitation step, ensure that the tubes are being shaken.
12. Test whether the imbalance value is in the permissible range. For instructions, see Section 4.2, "Testing whether the imbalance value is in the permissible range."

5 Parts

The Troubleshooting section recommends replacing parts in certain situations. This section shows where to find replaceable parts and lists part numbers for them. It also includes references to the parts on the electrical schematic, as appropriate. See Section 6, "Schematic," for more information.

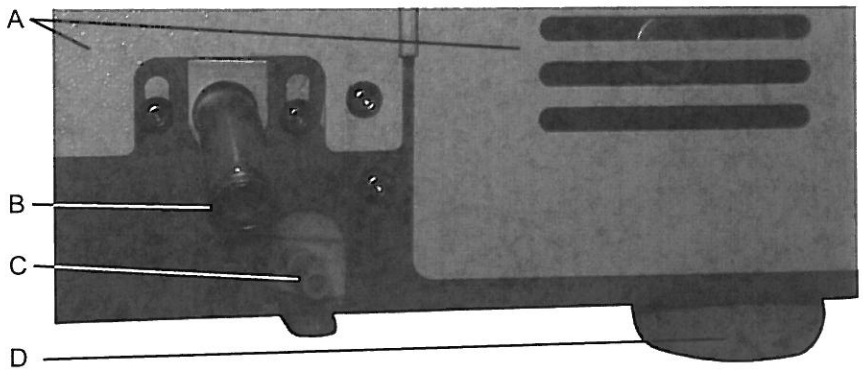
5.1 Parts on the front and lid



Parts on the front and lid

Label	Description	Replacement part numbers
A	Outer lid	E2186 Also part of the Lid assembly (E2184), which includes all parts on the lid plus the hinges
B	Sight window	E1323 (includes gluing ring)
C	Lid handle	E2189 Also part of the Lid assembly (E2184), which includes all parts on the lid plus the hinges
D	Control panel	E2148 (includes the control/display board, LCD display, and touchpad)
E	Front panel	E2188
F	Inner lid	E2185 Also part of the Lid assembly (E2184), which includes all parts on the lid plus the hinges
G	Lid handle latch	Part of the Lid assembly (E2184), which includes all parts on the lid plus the hinges
H	Nozzle	Part of the Lid assembly (E2184), which includes all parts on the lid plus the hinges
I	Splash guard	Part of Drainage system kit (E2535), which includes the drainage rings. Part of the Lid assembly (E2184), which includes all parts on the lid plus the hinges
J	Lid hinge	E1563 Also part of the Lid assembly (E2184), which includes all parts on the lid plus the hinges
Not shown	Lid spring	E1565

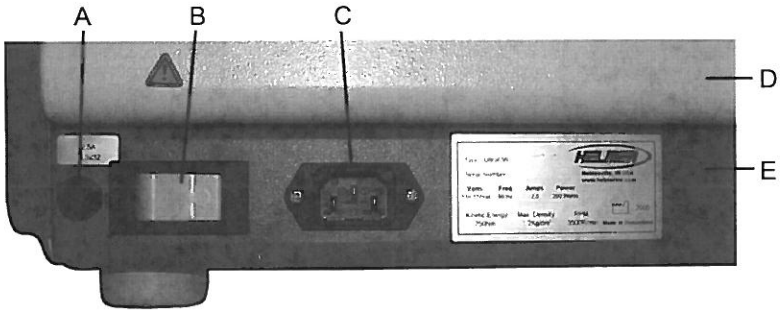
5.2 Parts on the rear and bottom



Parts on the rear and bottom of the cell washer

Label	Description	Replacement part numbers	Label on schematic
A	Rear panel	E2107	-
B	Drain connector	Part of Bowl assembly (E2104-A), which includes the bowl	-
C	Supply connector	Part of Flow meter (E2103)	B1
D	Foot	3680	-

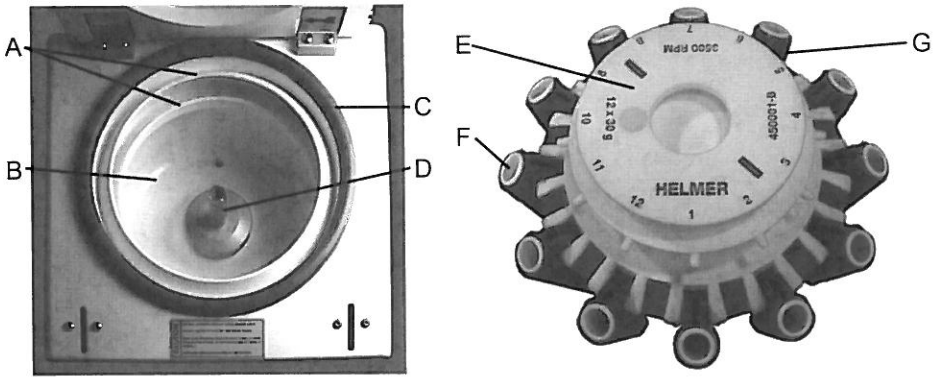
5.3 Parts on the side



Parts on the right side of the cell washer

Label	Description	Replacement part numbers	Label on schematic
A	Fuse (2.5 A)	E2268	F2
B	Main power switch	E1009	Q1
C	Power connector	E507	X1

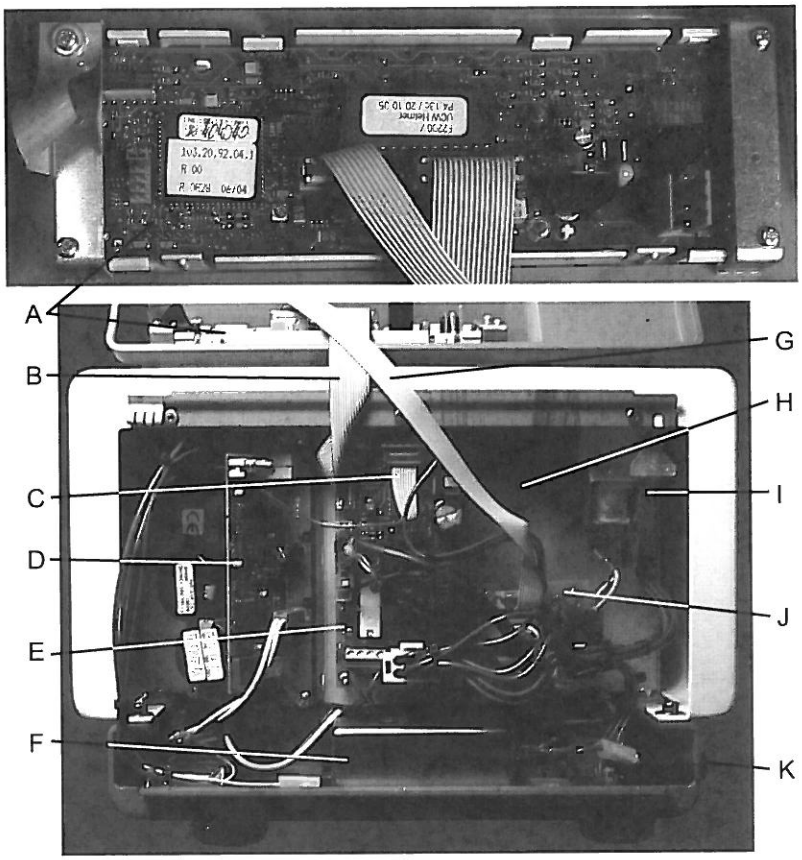
5.4 Parts on the bowl and rotor



Parts on the bowl and rotor

Label	Description	Replacement part numbers
A	Drainage rings	Part of Drainage system kit (E2535), which includes the splash guard
B	Bowl	Part of Bowl assembly (E2104-A), which includes the metal drain connector
C	Gasket	E2105
D	Rotor shaft/motor hub	E2370
E	Rotor, 12-place	450001-1 (includes 12 tube holders)
F	Tube holder insert	E2551
G	Tube holder (12 mm x 75 mm)	E2197 Also available in a Kit (12 pieces): 400596-1, and as part of the rotor
Not shown	Rotor, 24-place	450002-1 (includes 24 tube holders)

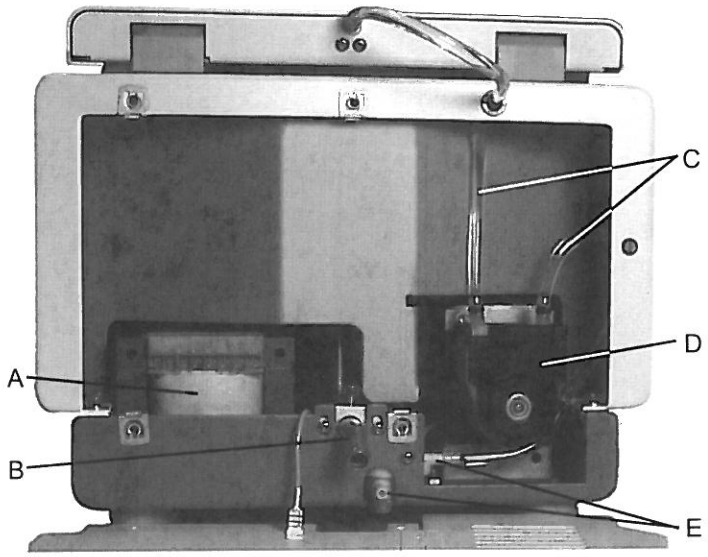
5.5 Parts behind the front panel



Cell washer with front panel removed and flipped upward.

Label	Description	Replacement part numbers	Label on schematic
A	Control/display board	Part of Control panel (E2148), which includes the LCD display and touchpad	A4
B	Ribbon cable 140/16 pole	E1332	C1
C	Ribbon cable 130/10 pole	E1333	C2
D	Frequency converter board	Part of the Frequency converter (E1184), which includes the underlying heat sink	A2
E	Power supply board	E1888	A1
F	RFI filter	E1284	Z1
G	Ribbon cable 250/10 pole	E1327	C3
H	Interior housing	-	-
I	Lid lock	E1478	Y1
J	Liquid handling board	E2130	A3
K	Fuse (2.5 A)	E2268	F2

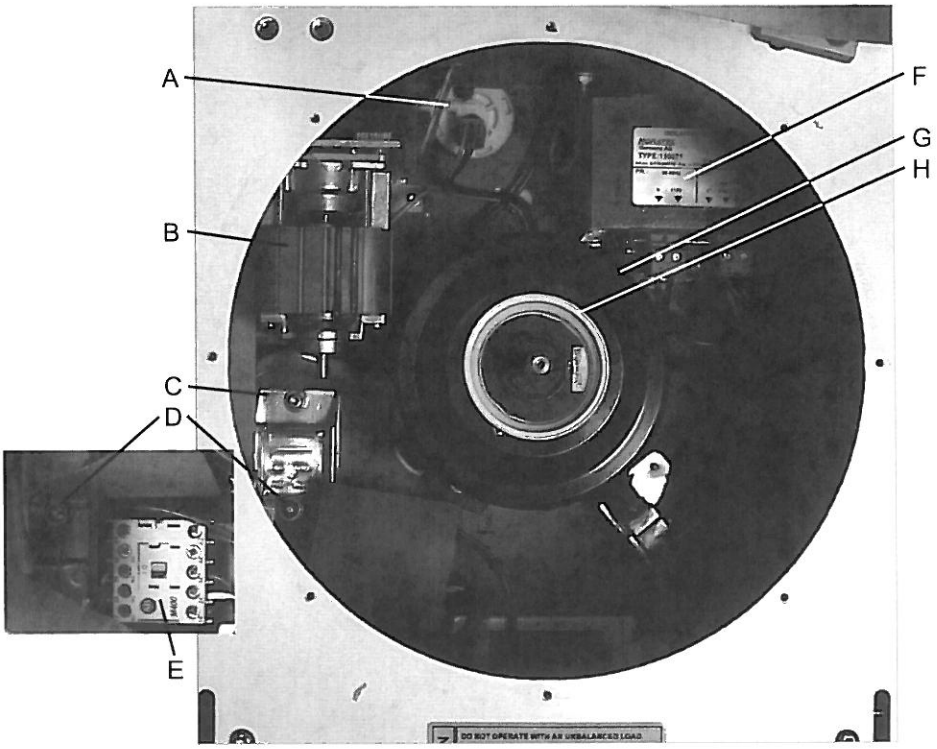
5.6 Parts behind the rear panel



Cell washer with rear panel removed

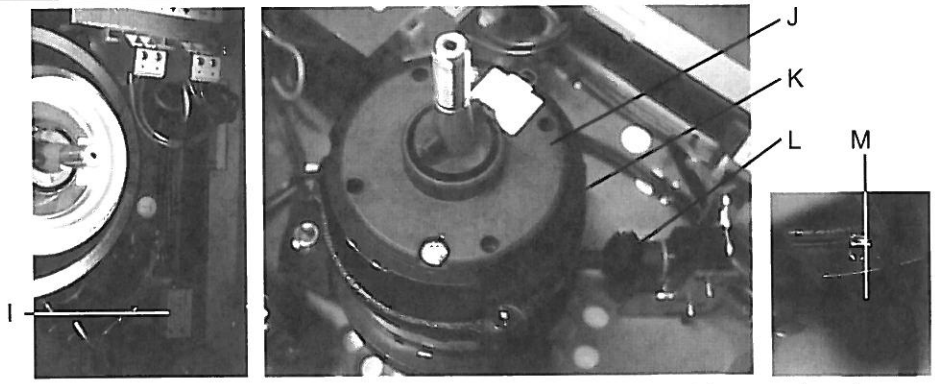
Label	Description	Replacement part numbers	Label on schematic
A	Isolation transformer	E2195	T1
B	Drain connector	Part of Bowl assembly (E2104-A), which includes the bowl	-
C	Pump tubing assembly	450005-1	-
D	Pump	E2096	M2
E	Supply connector	Part of Flow meter (E2103)	B1

5.7 Parts under the bowl



Top view of cell washer with bowl removed

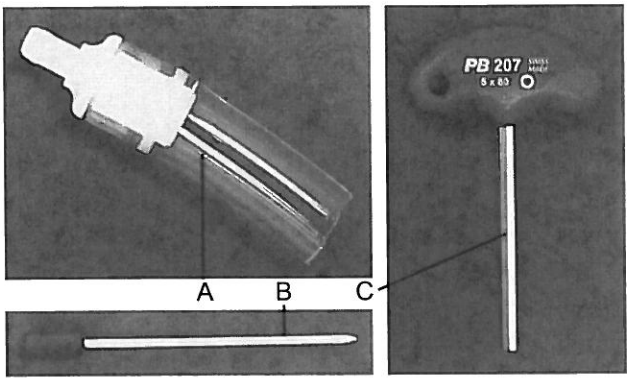
Label	Description	Replacement part numbers	Label on schematic
A	Flow meter	E2103 (includes supply connector)	B1
B	Pump	E2096	M2
C	Braking resistor	E1461 (includes braking resistor overtemperature switch)	R1
D	Braking resistor overtemperature switch	-	F3
E	Motor relay	E2193	K1
F	Isolation transformer	E2195	T1
G	Motor hood	E2191	-
H	Silicone motor seal	E2690	-



Parts under the bowl. Left: Parts on right side. Middle: Motor with motor hood removed. Right: Motor mount.

Label	Description	Replacement part numbers	Label on schematic
I	Varistor board	E1463	F1
J	Speed sensor	E730	B2
K	Motor	E823	M1
L	Imbalance microswitch	E2528	S1
M	Motor mount	E2915	-

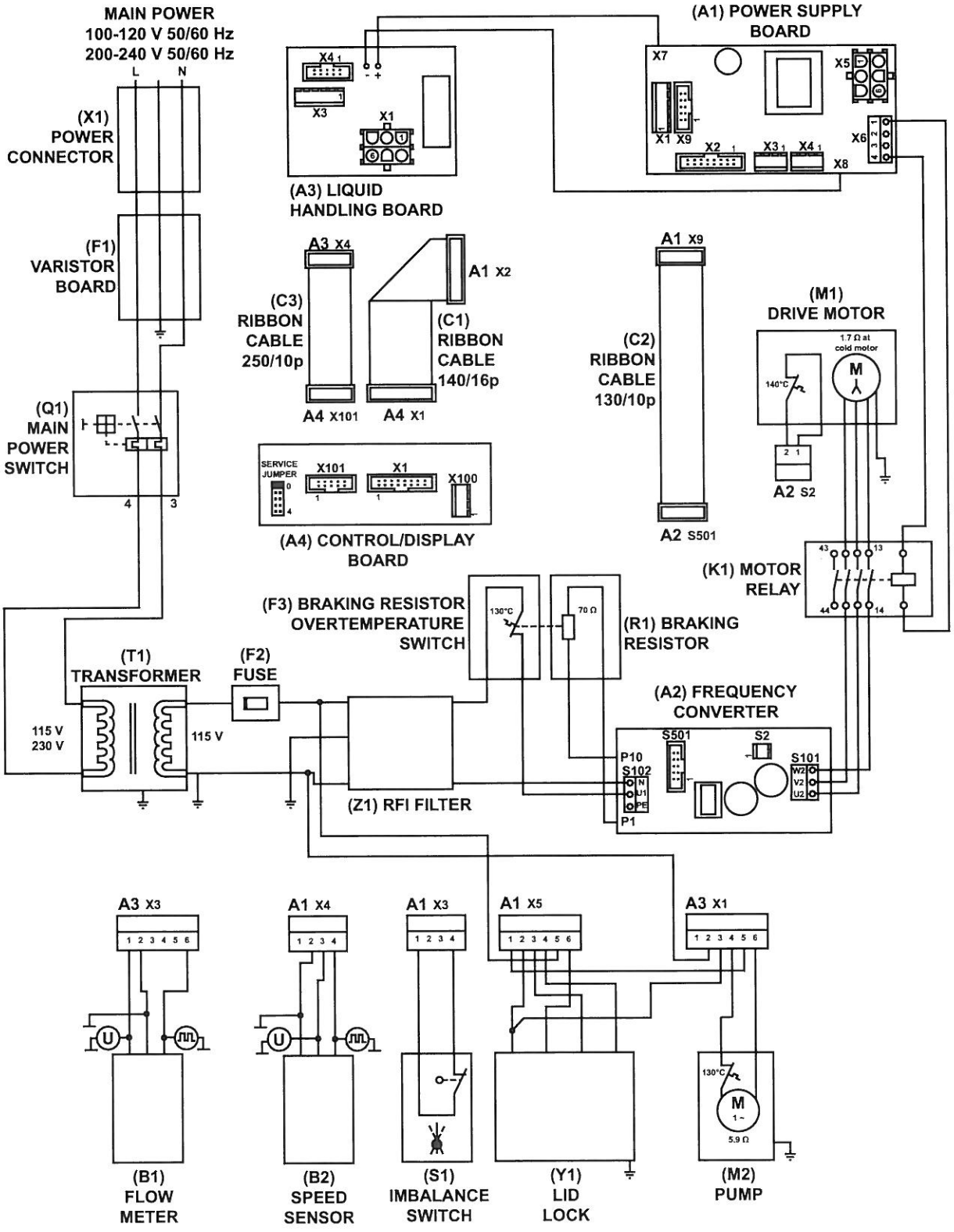
5.8 Accessories



Cell washer accessories

Label	Description	Replacement part numbers
A	Saline adapter	Part of the Drain/fill tubing assembly (450006-1) Also part of the Tubing kit (450003-1), which includes the Drain/fill tubing assembly
B	Bypass tool	E003
C	Transport bolt removal tool (Note: This tool is also used to remove the rotor shaft/motor hub)	E613
Not shown	Power cord	115 V: 6083 230 V: 120156
Not shown	Pump tubing assembly	450005-1 Also part of the Tubing kit (450003-1), which includes the Drain/fill tubing assembly
Not shown	Drain/fill tubing assembly	450006-1 Also part of the Tubing kit (450003-1), which includes the Pump tubing assembly

6 Schematic


MAIN POWER
100-120 V 50/60 Hz
200-240 V 50/60 Hz
L
N
(X1)
POWER
CONNECTOR
(F1)
VARISTOR
BOARD
(Q1)
MAIN
POWER
SWITCH
4
3
(A3) LIQUID
HANDLING BOARD
(A1) POWER SUPPLY
BOARD
A3 X4
A1 X2
(C3)
RIBBON
CABLE
250/10p
(C1)
RIBBON
CABLE
140/16p
A4 X101
A4 X1
A1 X9
(C2)
RIBBON
CABLE
130/10p
A2 S501
(M1)
DRIVE MOTOR
1.7 Ω at
cold motor
140°C
M
A2 S2
SERVICE
JUMPER
X101
X1
X100
(A4) CONTROL/DISPLAY
BOARD
(K1) MOTOR
RELAY
(F3) BRAKING RESISTOR
OVERTEMPERATURE
SWITCH
130°C
70 Ω
(R1) BRAKING
RESISTOR
(T1)
TRANSFORMER
(F2)
FUSE
115 V
230 V
115 V
(A2) FREQUENCY
CONVERTER
S501
S2
S101
P10
S102
P1
(Z1) RFI FILTER
A3 X3
A1 X4
A1 X3
A1 X5
A3 X1
(B1)
FLOW
METER
(B2)
SPEED
SENSOR
(S1)
IMBALANCE
SWITCH
(Y1)
LID
LOCK
(M2)
PUMP
130°C
M
1~
5.9 Ω

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