

Electrochemical Test Cell - ECC-STD



User Manual

Release: 2.0

2012-02-04

The information in this manual has been carefully checked and believed to be accurate; however, no responsibility is assumed for inaccuracies.

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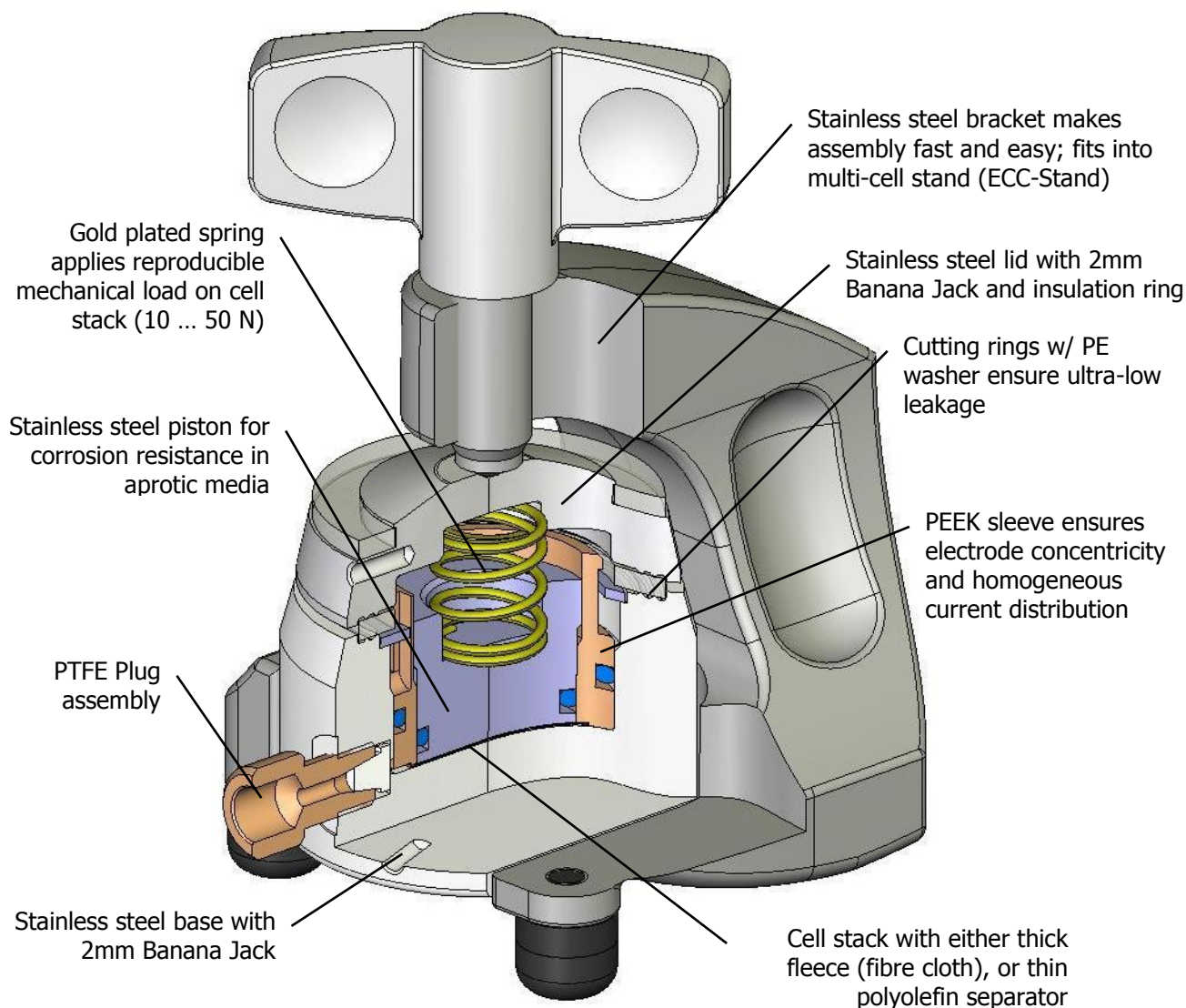
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1. Product Description

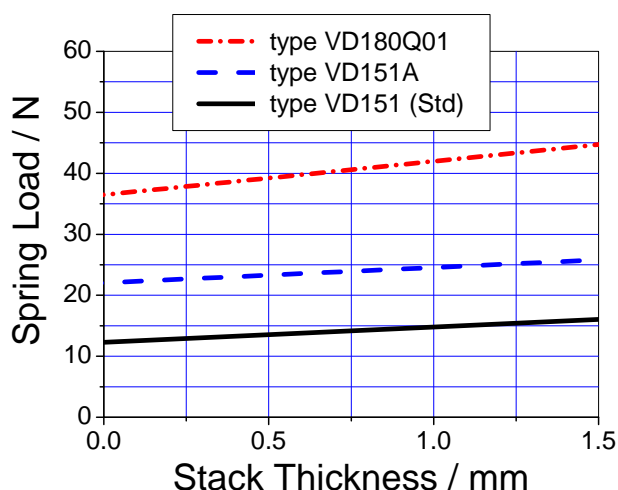
The ECC Electrochemical Cell is a standard test cell for the characterization of lithium ion battery systems as well as other aprotic chemistries. With the ECC cell design we have adapted the advantages of the industry's standard button (coin) cell while avoiding its serious shortcomings for everyday lab usage. The ECC cell design is the result of many years' experience and iterative improvement in lithium ion battery and supercapacitor electrode testing. It is perfectly suited for voltammetry and impedance as well as cycle life testing.

The ECC-STD test cell is a member of the modular ECC test cell series, and thus can easily be refitted for other purposes (e.g., use of an additional reference or compatibility with aqueous electrolytes). This manual covers only the ECC standard test cell.



2. Features

- High precision 18 mm diameter sandwich geometry with <0.1 mm electrode concentricity
- Reliable low leakage sealing with PE washers, He leakage rate <math><10^{-8}</math>std cm³/s
- Temperature operation range -40 to +80 °C
- Easy and reliable electrolyte filling either upon assembly or afterwards via syringe (vacuum) method
- Fast assembly and dismantling, and easy cleaning of cell components
- Electrodes are easily accessible for post-mortem analysis
- Reusable cell components except for PE sealing (and internal seals if used in “syringe” mode)
- Small and defined electrolyte volume down to 0.1 cm³ due to minimized dead volume
- Adjustable, reproducible and homogeneous mechanical pressure on electrodes



Spring load on stack vs. stack thickness for different springs. Standard is VD151.

- Materials in media contact are stainless steel and PEEK (other materials on request)
- Modular cell construction with many interchangeable components
- Optional refitting kits e.g. for aqueous electrolytes and use of a reference electrode
- “Plug and play” multi-cell fixture available for operation inside temperature chamber or wall mounting, and for connection to a multi-channel potentiostat or battery tester
- Size (including bracket): 90 mm x 54 mm x 70 mm (height x width x depth)
- Weight: 680 g

3. Safety Precautions

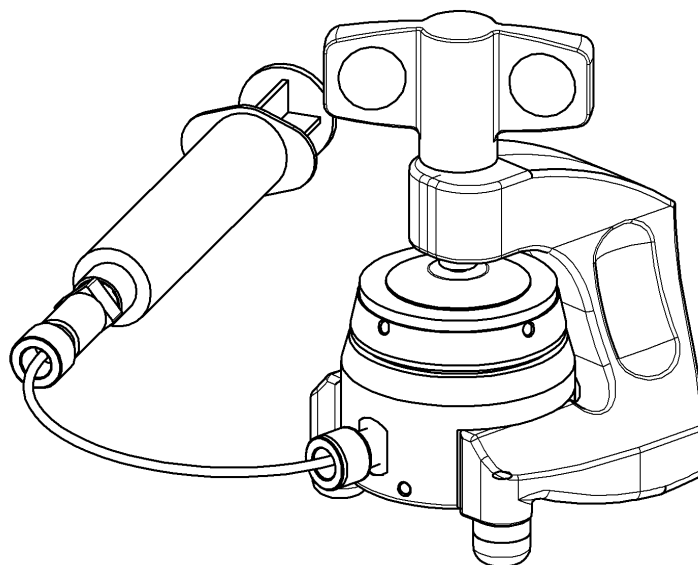
Use proper safety precautions when using hazardous electrode materials and electrolytes. Wear protective glasses and gloves to protect you against electrolyte that may accidentally spill out during filling and disassembly. Upon cell disassembly, dispose all materials properly. Metallic lithium and some insertion compounds may decompose heavily in contact with water and other solvents, and can cause fire.

4. Unpacking

Check the contents of the packages against the list given below to verify that you have received all of the components. Contact the factory if anything is missing or damaged. **NOTE:** Damaged shipments must remain with the original packaging for freight company inspection.

List of Components

1. Test cell with bracket, fully assembled with plug attached to the side opening
2. PE Washers (10 pieces)
3. Low-friction 5 ml syringe with transfer line, Luer adapter and nut
4. O-ring seals for vacuum filling (2 x 2 pieces)
5. Sleeve removal tool
6. Glass fiber separator 1.55 mm thick (10 pieces)



5. ECC Assembly

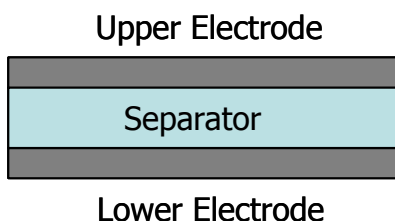
The ECC electrochemical cell may be operated in several modes which differ in the size of the components used (diameter and thickness), and in the way the cell is filled with electrolyte (dropping onto separator or electrode during assembly, or vacuum filling afterwards).

When using air sensitive electrodes like metallic lithium, the cell is being assembled and filled with electrolyte inside a glove box. Prior to assembly, all cell components are to be dried overnight in vacuum at 80 °C.

To avoid corrosion issues, the upper electrode (in contact with the piston) should be at more positive potentials than the lower electrode (in contact with the cell base). We hereafter refer to the upper electrode as cathode, and to the lower electrode as anode.

5.1 AAA Mode

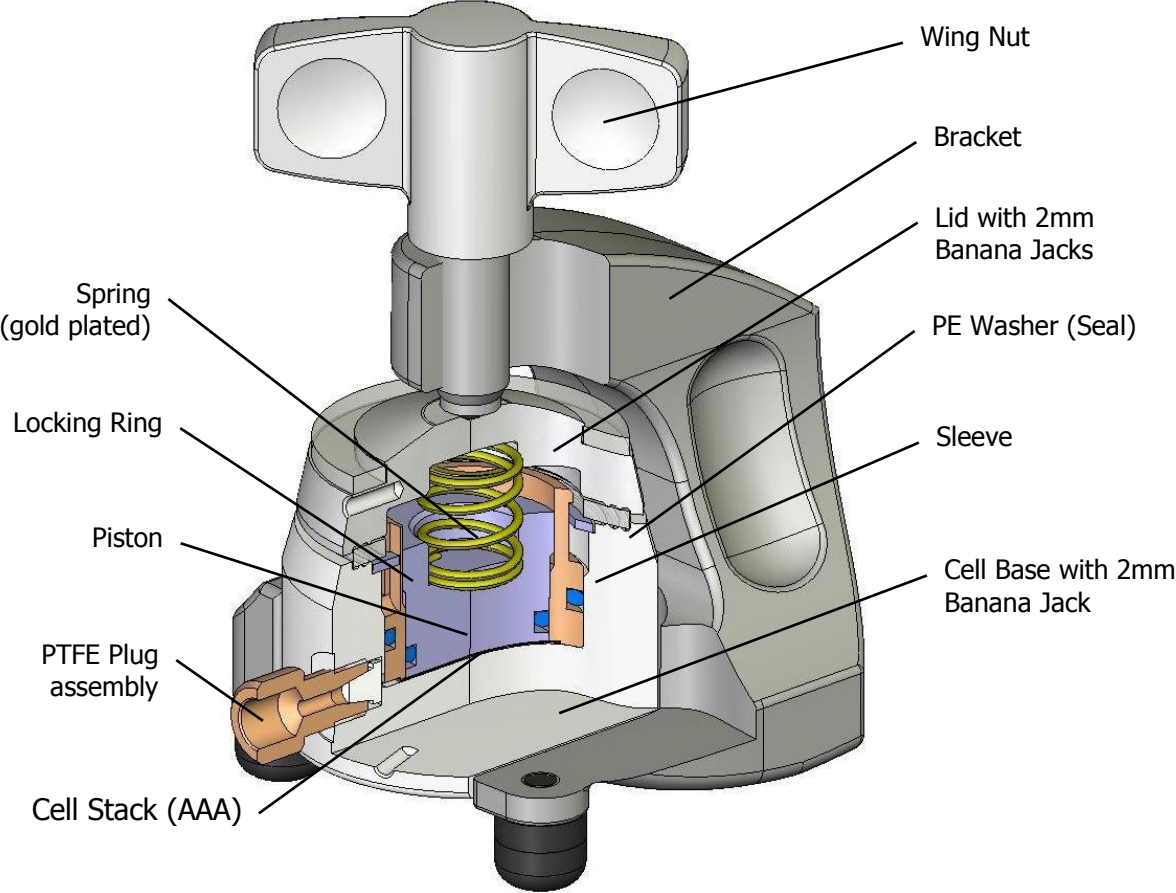
In this mode the cell is assembled with a thick fiber cloth (fleece) separator having the same 18 mm diameter as the two adjacent electrodes. The cell is filled with the electrolyte by dropping a given volume of electrolyte directly onto the separator (0.2 to 0.7 ml, depending on the separator and electrodes used). Only when applying the spring load upon final cell closure, a defined amount of electrolyte is squeezed out of the separator and soaks the two adjacent electrodes. The confinement of the cell stack by an insulating sleeve ensures a homogeneous current distribution and thus makes this configuration ideal for impedance measurements.



Assembly Steps:

- i) Close the side opening of the cell base with the provided plug.
- ii) Insert the piston into the sleeve and place the piston/sleeve assembly onto the workbench with the contact face of the piston pointing upwards.
- iii) Place the working electrode (cathode) and the cloth separator into the assembly.
- iv) Dispense a defined amount of electrolyte onto the separator, and finally place the counter electrode on top inside the sleeve.
- v) Push the cell base over the assembly, press onto the piston, and turn the cell around into the upright position.
- vi) Mount the spring and the PE washer.
- vii) Attach the cell lid, insert the cell into the bracket, and tighten the wing nut.

Note: The adequate amount of electrolyte depends on the porosity and thickness of the components used, and thus has to be determined in pre-tests. The amount must be smaller than the absorption capacity of the separator in its uncompressed state.

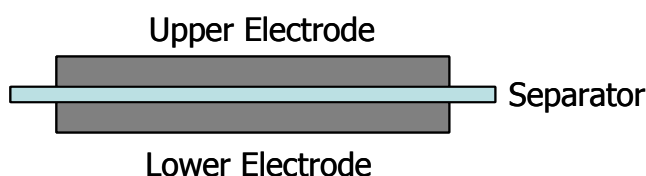


ECC test cell in the AAA assembly mode

5.2 ABA Mode

This procedure is recommended for standard Li-ion battery materials in combination with thin technical separators like Celgard 2325 (25 μm thick).

In the ABA assembly mode the two electrodes are both 18 mm, and the separator is 22 mm in diameter in order to prevent a short circuit along the edge of the separator. In a first step, the lower electrode (anode) is centrally adhered (glued) to the bottom of the cell base. Second, the upper electrode (cathode) is placed into the piston/sleeve assembly, and soaked with some excess of electrolyte. Third, the oversized separator is placed on top and the whole assembly is pushed from below into the cell base into which anode and separator have been placed in the first step. The electrolyte is drawn into the initially dry separator and anode by capillary forces.



Assembly Steps:

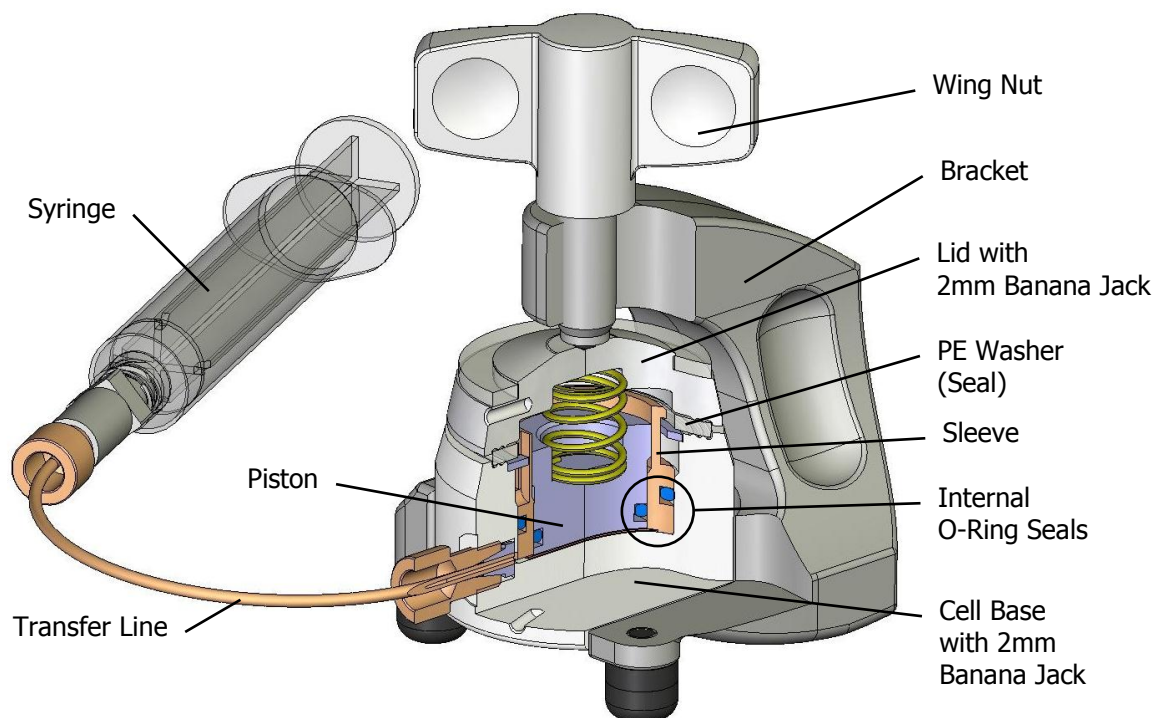
- i) Close the side opening of the cell base with the provided plug.
- ii) Insert the piston into the sleeve and place the assembly onto the workbench.
- iii) Place the anode into the piston/sleeve assembly with the back (i.e., the metal foil current collector) pointing upwards.
- iv) Charge a pipette with 80 μL of electrolyte and place a tiny drop of the electrolyte onto the back of the anode. We recommend using an adjustable volume pipette with disposable tip.
- v) Support the piston/sleeve assembly manually. Then push the cell base over the assembly, press onto the piston, and remove the piston/sleeve assembly. The anode is now centrally adhered (glued) to the bottom of the cell base.
- vi) Again, insert the piston into the sleeve and place the piston/sleeve assembly onto the workbench
- vii) Place the cathode into the piston/sleeve assembly, with the back pointing downwards.
- viii) Dispense the electrolyte onto the cathode.
- ix) Place the separator (22 mm in diameter) onto the assembly, and roughly align the separator concentrically.
- x) Push the cell base (with the anode glued to its bottom) over the assembly, press onto the piston, and turn the cell into the upright position.
- xi) Mount the spring and the PE washer.
- xii) Attach the cell lid, insert the cell into the bracket, and tighten the wing nut.

5.3 ABA-Vacuum Mode

The ABA-Vacuum mode is recommended when working with electrolytes that do not easily soak the electrodes and separator used as sometimes the case with experimental materials. The assembly steps are almost the same as in the ABA mode except that O-ring seals are to be mounted to both piston and sleeve. These seals are required to effectively apply vacuum after the assembly procedure.

Assembly Steps:

- i) Mount O-ring seals to piston and sleeve. Leave the side opening of the cell base unplugged.
- ii) Insert the piston into the sleeve and place the piston/sleeve assembly upside down onto the workbench.
- iii) Place the anode into the piston/sleeve assembly with the back (i.e., the metal foil current collector) pointing upwards.
- iv) Place a tiny drop of the electrolyte onto the back of the anode
- v) Support the piston/sleeve assembly manually. Then push the cell base over the assembly, press onto the piston, and remove the piston/sleeve assembly. The anode is now centrally adhered (glued) to the bottom of the cell base.
- vi) Again, insert the piston into the sleeve and place the piston/sleeve assembly upside down onto the workbench
- vii) Place the cathode into the piston/sleeve assembly, with the back pointing downwards.
- viii) Optional: Pre-wet cathode by dispensing some electrolyte onto the cathode.
- ix) Place the separator (22 mm diameter) onto the assembly, and roughly align the separator concentrically.
- x) Push the cell base (with the anode glued to its bottom) over the assembly, press onto the piston, and turn the cell into the upright position.
- xi) Mount the spring and the PE washer.
- xii) Attach the cell lid, insert the cell into the bracket, and tighten the wing nut.
- xiii) Fill the cell by means of the syringe (vacuum) method according to the following procedure.
 - a. Charge a 5 ml syringe with ca. 0.3 ml of electrolyte.
 - b. Connect the syringe via the transfer line to the side opening of the cell.
 - c. Push the syringe piston back to evacuate the cell. Hold the piston a few seconds in the strained position.
 - d. Hold the syringe with the piston upwards, and release the piston so that the electrolyte is drawn into the cell.
 - e. Repeat the two previous steps to complete filling.
 - f. Remove the syringe together with the transfer line, and close the cell with the provided plug.



ECC test cell in the ABA Vacuum mode.

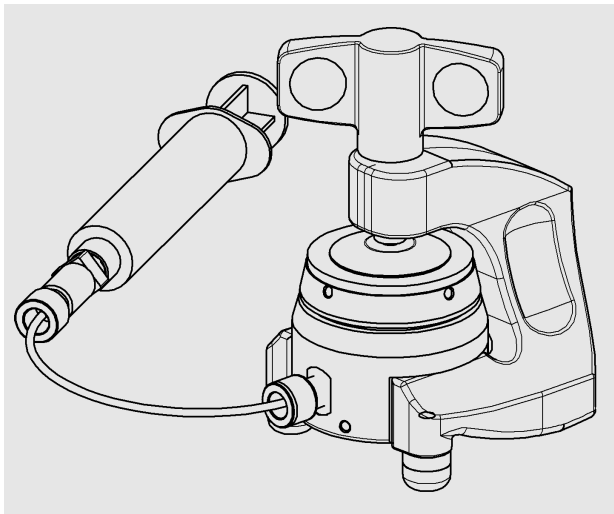
6. Disassembly and Cleaning

Right after use, disassemble the cell in the reverse order of assembly.

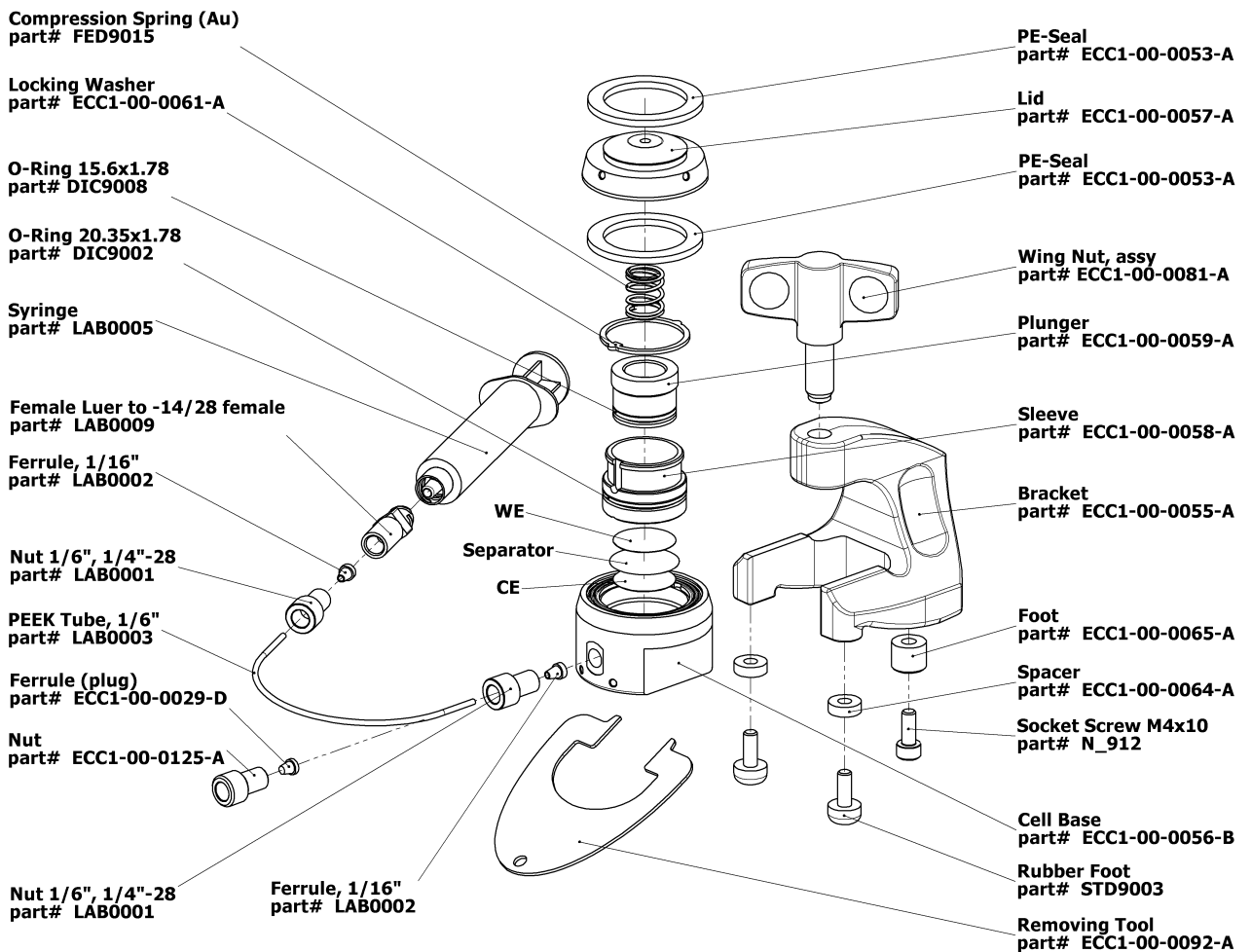
All chemicals used have to be disposed properly. All wetted parts are to be cleaned with water and/or other appropriate solvents. Ultrasonic cleaning is recommended. All parts are to be dried immediately after cleaning at 80°C.

NOTE: Leaving cell parts in contact with ambient atmosphere while still being wetted with electrolyte may result in severe corrosion.

7. Accessories and Spare Parts



ECC Standard Test Cell



8. Technical Support

Technical support for this product is exclusively handled by EL-Cell GmbH.
The following procedure must be followed when the ECC test cell or any part of it is returned to EL-Cell GmbH for repair:

1. Send an e-mail to info@el-cell.com to obtain a return authorization number and a decontamination report form.
2. Sign the decontamination report asserting that the instrument has been decontaminated and is safe for technicians to work on it.
3. Describe in detail what is wrong.
4. Include a contact name, address, telephone number, and email address.
5. Return the equipment to

EL-Cell GmbH

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D-21079 Hamburg - Germany
phone: +49 (0)40 790 12 733
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email: info@el-cell.com
web: www.el-cell.com

9. Warranty

For a period of one year from the date of shipment, EL-Cell GmbH (hereinafter Seller) warrants the goods to be free from defect in material and workmanship to the original purchaser. During the warranty period, Seller agrees to repair or replace defective and/or nonconforming goods or parts without charge for material or labor, or, at the Seller's option, demand return of the goods and tender repayment of the price. Buyer's exclusive remedy is repair or replacement of defective and nonconforming goods, or, at Seller's option, the repayment of the price.

Seller excludes and disclaims any liability for lost profits, personal injury, interruption of service, or for consequential incidental or special damages arising out of, resulting from, or relating in any manner to these goods.

This Limited Warranty does not cover defects, damage, or nonconformity resulting from abuse, misuse, neglect, lack of reasonable care, modification, or the attachment of improper devices to the goods. This Limited Warranty does not cover expendable items. This warranty is void when repairs are performed by a non-authorized person or service center. At Seller's option, repairs or replacements will be made on site or at the factory. If repairs or replacements are to be made at the factory, Buyer shall return the goods prepaid and bear all the risks of loss until delivered to the factory. If Seller returns the goods, they will be delivered prepaid and Seller will bear all risks of loss until delivery to Buyer. Buyer and Seller agree that this Limited Warranty shall be governed by and construed in accordance with the laws of Germany.

The warranties contained in this agreement are in lieu of all other warranties expressed or implied, including the warranties of merchantability and fitness for a particular purpose.

This Limited Warranty supersedes all prior proposals or representations oral or written and constitutes the entire understanding regarding the warranties made by Seller to Buyer. This Limited Warranty may not be expanded or modified except in writing signed by the parties hereto.