

User Manual

Release 1.42

Electrochemical Test Cell ECC-DEMS



July 2017

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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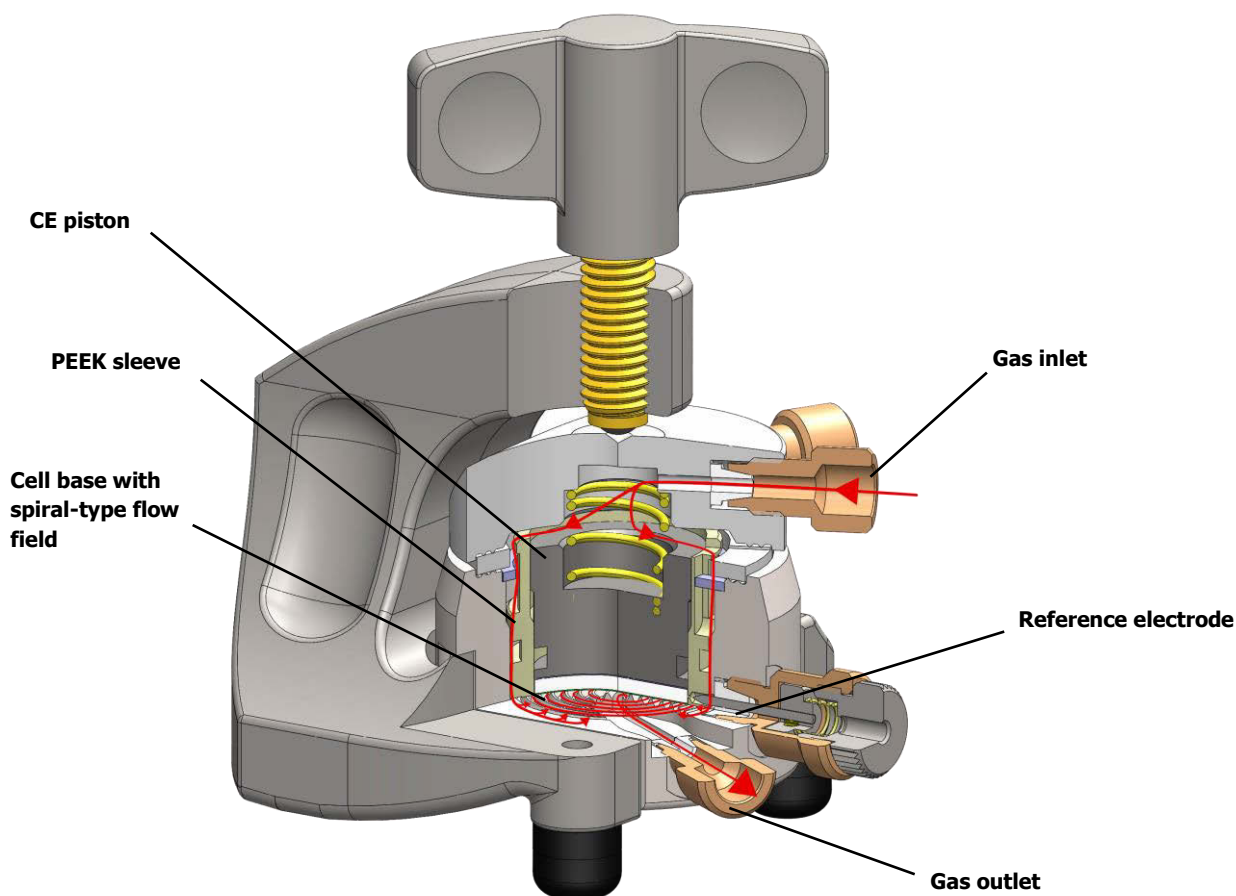
1 Product Description

The ECC-DEMS is another member of the modular ECC series dedicated to the time-resolved analysis of the gases evolved during the charge/discharge of aprotic electrolyte based battery chemistries including lithium-ion and lithium-air.

The ECC-DEMS cell design is based on recent work on lithium-air batteries (Z. Peng, S.A. Freunberger, Y. Chen, P.G. Bruce, *Science*, Vol. 337 no. 6094 pp. 563-566). We especially thank Stefan Freunberger for his help to realize this test cell as another member of our ECC test cell series.

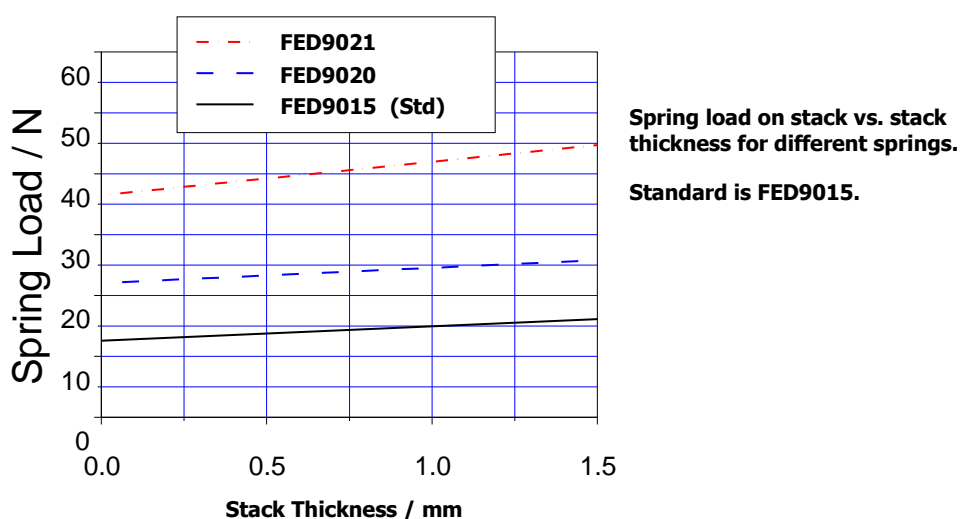
Basically, the test cell accommodates the cell stack with the working electrode placed at the cell bottom on a spiral-type flow field. The working electrode may be a gas diffusion electrode (like with lithium-air) or a standard lithium-ion electrode on a perforated (gas permeable) current collector foil. Lithium metal may be used for both the counter and reference electrode, and glass fiber as the separator material.

During charge/discharge, a gentle mass-controlled stream of a gas (or gas mixture) is to be purged through the spiral-type flow field below the working electrode. The gas composition at the gas outlet may be analysed e.g. by a mass spectrometer. The gas comes in through the cell lid, passes along the perimeter of the PEEK sleeve and then enters into a plug-flow along the spiral-type flow field at the bottom of the cell base.



2 Features

- Test cell dedicated to the time-resolved analysis of the gases evolved during the charge/discharge of aprotic electrolyte based chemistries such as lithium-ion and lithium-air.
- Gases evolved or consumed at the working electrode may be analysed through the composition change of the gas stream that is to be passed along the spiral-type flow field below the working electrode.
- Pressure gradient between cell headroom and spiral-type flow field effectively prevents back-mixing and ensures best possible time resolution
- Operation with or without reference electrode
- High precision 18 mm diameter sandwich geometry with <0.1 mm electrode concentricity
- Reliable low leakage sealing with PE seals
- Temperature operation range -20 to +70 °C
- Easy and reliable electrolyte filling upon assembly
- Fast assembly and dismantling, and easy cleaning of cell components
- Electrodes are easily accessible for post-mortem analysis
- Reusable cell components except for PE seal
- Adjustable, reproducible and homogeneous mechanical pressure on electrodes



- Materials in media contact are stainless steel 1.4404 and PEEK (other materials on request)
- Size (including bracket):
- 90 mm x 54 mm x 70 mm (height x width x depth)
- Weight: 650 g

3 Safety Precautions

Use proper safety precautions when using hazardous electrolyte and electrode materials. Wear safety glasses and gloves to protect you against electrolyte that may accidentally spill out of the instrument during filling, operation, and disassembly.

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

- **ECC-DEMS test cell** with bracket, fully equipped for operation with and without reference
- **Accessories Kit**
 1. PE seals (10 pcs) [ECC1-00-0053-A/X](#)
 2. Glass fiber separator 18 mm diameter, 1.55 mm thick (10 pcs) [ECC1-01-0012-C/X](#)
 3. Separator (Celgard 2325) 24 mm diameter, 0.025 mm thick (10 pcs) [ECC1-01-0022-D/X](#)
 4. Nut (2 pcs) [ECC1-00-0125-A](#)
 5. Ferrule 1.6 (2pcs) [ECC1-00-0029-E](#)
 6. Sleeve removing tool [ECC1-00-0092-A](#)



5 Cell Assembly

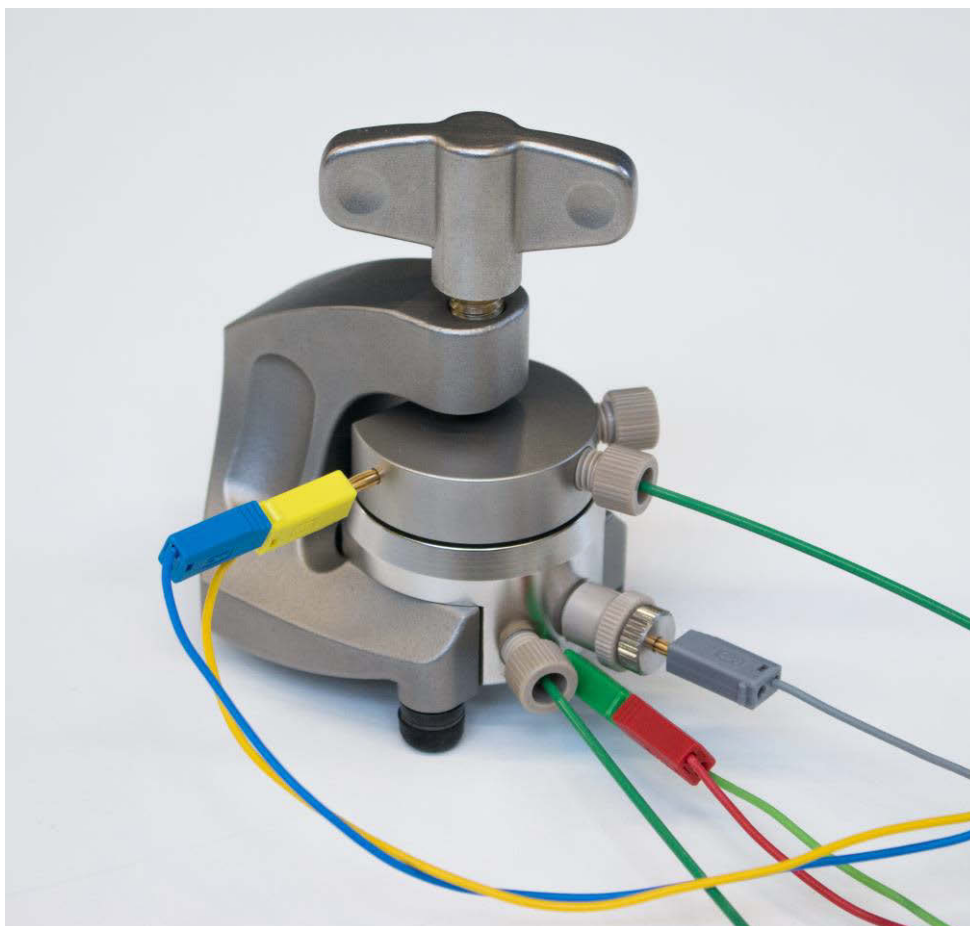
The test cell can either be operated in 2-electrode or 3-electrode (reference) configuration. In the following, the cell assembly is described for operation with a lithium metal reference and a lithium metal counter electrode. For more details please refer to the separate manuals of the ECC-REF and the ECC-STD test cell.

Generally, all assembly steps are to be carried out in inert glove box atmosphere. All components used are to be dried upfront in a vacuum oven at 80°C for at least 12 hours.

Assembly:

- i) Load the feed-through hole of the REF sleeve with a small amount of lithium metal with the aid of a metal wire. Take care that the narrow part of the feed-through hole is COMPLETELY filled with lithium, so that the lithium filling gets into direct contact with the separator inside the sleeve and with the REF pin from outside. A dedicated tool, the ECC-RefLoad, is optionally available to ease the procedure (
- ii) Insert the REF sleeve into the cell base.
- iii) Mount the locking washer, thereby aligning the side opening of the cell base with the feed-through hole of the REF sleeve.
- iv) Attach the reference pin assembly to the cell base.
- v) Place the working electrode into the sleeve on the spiral-type flow field.
- vi) Put the glass fibre separator on top of the working electrode.
- vii) Dispense a defined amount of electrolyte, approx. 0.5 cm³, onto the separator
- viii) Place a lithium metal disc (18 mm diameter) on top of the separator inside the sleeve.
- ix) Insert the plunger, the spring, and the PE seal.
- x) Attach the cell lid, insert the cell into the bracket, and tighten the wing nut.
- xi) Connect the cell to the gas supply and to the instrumentation used for gas analysis. The provided fittings are compatible with 1/16 inch outer diameter tubing. We recommend the use of stainless steel or PEEKsil™ capillary tubing.

NOTE: Make sure not to short circuit cell lid and base through electrically conducting tube. Consider using a floating mode potentiostat when grounding either the cell lid or base by using metal tubing.



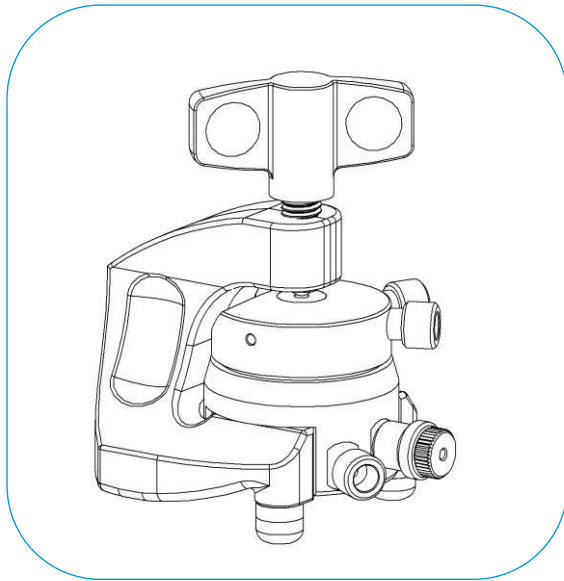
6 Disassembly and Cleaning

Right after use, disassemble the cell in the reverse order of assembly. Note that the reference pin MUST be detached before the REF sleeve can be removed.

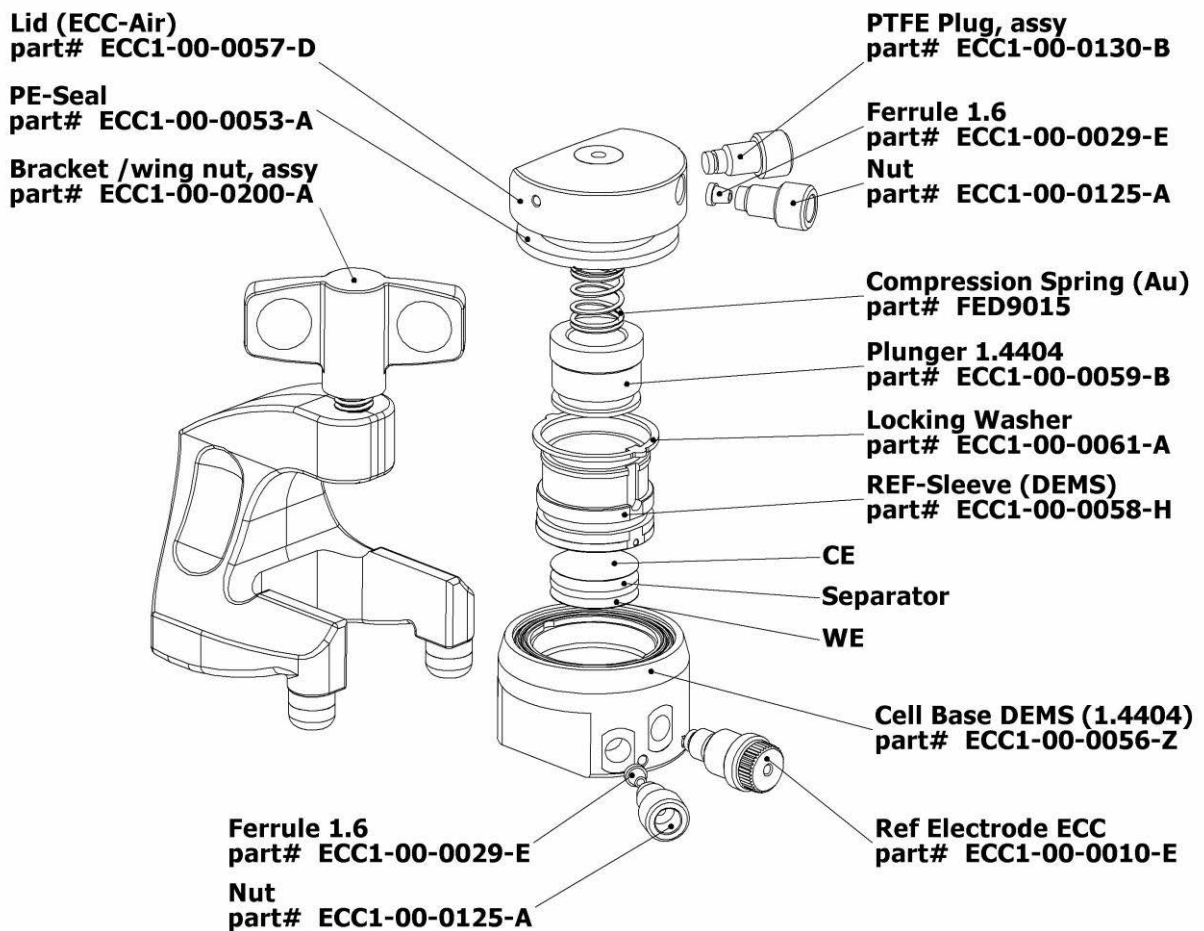
All chemicals used have to be disposed properly. The cell parts including the lid and the spring are to be cleaned in an ultrasonic bath with detergent wash. Persistent dirt on the cell base and plunger may be removed by treating these parts with aqueous nitric acid (20%, 2 hours at room temperature). Afterwards, the parts are to be rinsed with water, and to be dried at 80°C. PE seals and PTFE ferrules are to be replaced.

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-DEMS 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-DEMS or any part of it is returned to EL-CELL GmbH for repair:

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.