

Quick Reference



Electrochemical Dilatometer **ECD-1**

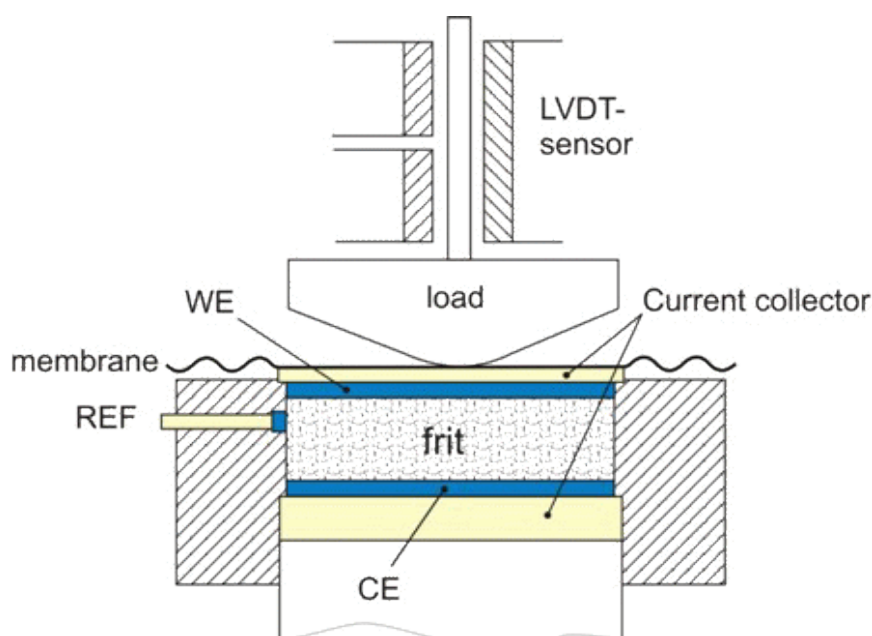
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Product Description

The ECD-1 is a research grade instrument dedicated to the measurement of charge-induced strain (expansion and shrinkage) of electrodes down to the sub-micrometer range. The ECD-1 is particularly developed for the investigation of Li-ion battery and other insertion-type electrodes. It may, however, also be used for many other electrochemical systems utilizing organic as well as aqueous electrolyte solutions. The electrode materials used can either be bound films (<10 mm dia, <1 mm thick), single crystals (e.g. HOPG), or binder-free powders.

The heart of the ECD-1 is an electrochemical cell, hermetically tight against ambient atmosphere. The two electrodes inside are separated by a stiff glass frit that is fixed in position. The upper (working) electrode is sealed by means of a thin metal membrane, through which any charge-induced height change is transmitted towards the sensor/load unit above. This working principle allows determining the height change of the working electrode (WE) without any interference from that of the counter electrode (CE).



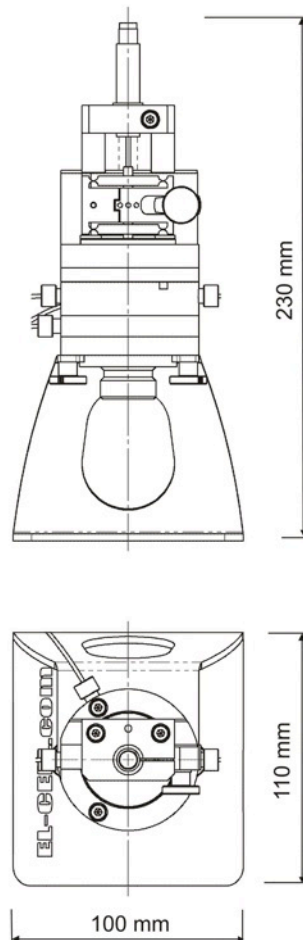
Dilatometer working principle.

A high-resolution displacement (LVDT) transducer detects dimensional changes of the WE ranging from 20 nanometers up to 500 micrometers, during one and the same experiment that may last between a few seconds to many days. A simple weight serves to adjust the load on the working electrode. The electrode potential can either be controlled against the counter electrode (cell voltage control) or against an additional reference electrode.

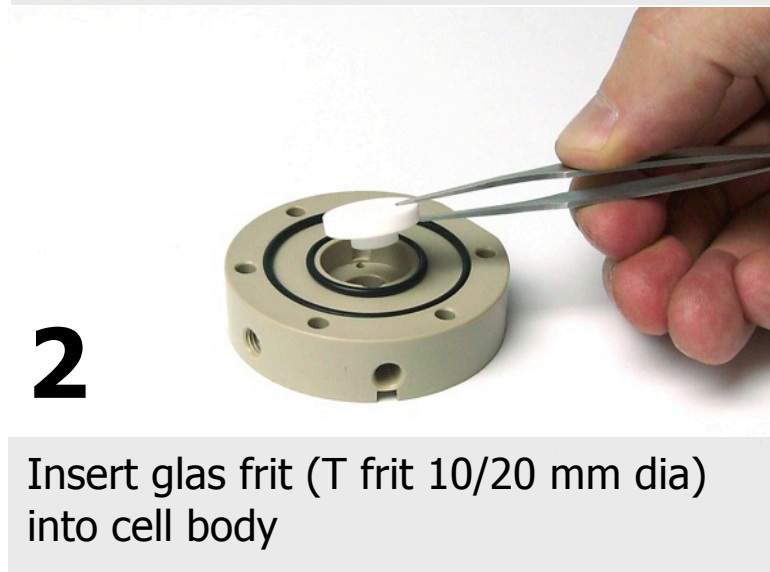
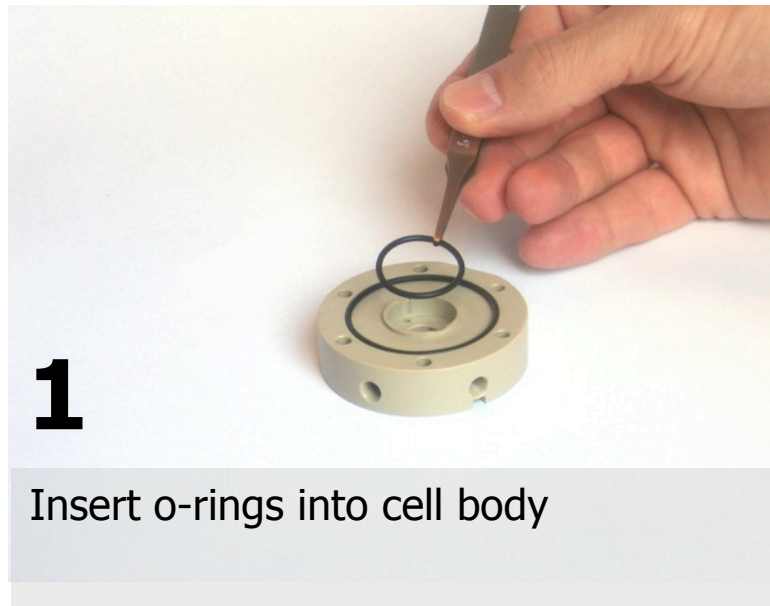
For best accuracy and drift stability, we recommend operating the ECD-1 inside a temperature controlled chamber, and recording the dc output signal of the LVDT-sensor with a high-precision data logger.

ECD-1 Main Characteristics:

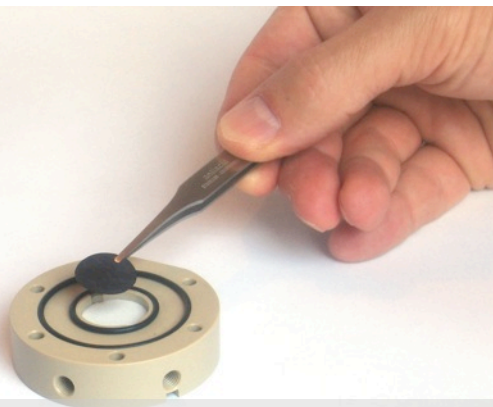
- 500 micrometer full range with 20 nm maximum resolution (LVDT sensor with dc voltage output, 2 to 10 V)
- Choice between many different electrode types: bound films (up to 10 mm in diameter, up to 1 mm thick), binder-free powders or single crystals
- Compatible with aprotic as well as aqueous electrochemistry by proper choice of construction materials (standard is gold or titanium for current collectors, PEEK for cell housing, and EPDM for seals)
- Small cell volume (ca. 3 ml electrolyte required)
- High drift stability of height signal for long-term experiments (drift <0.1 micrometer per hour)
- Easy-to-assemble, easy-to-handle, and robust construction
- Choice of load on working electrode (30 and 130 g)
- Broad temperature range, -20 to +80 °C, in combination with a temperature controlled chamber
- Modular design allows to separate electrolyte filling (e.g. inside a glove box) independent of dilatometer operation (e.g. inside a temperature chamber)



Assembly Instructions:

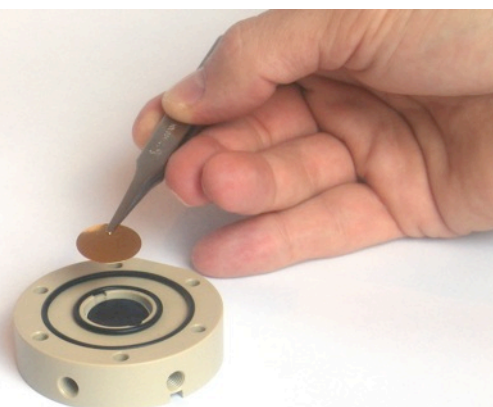


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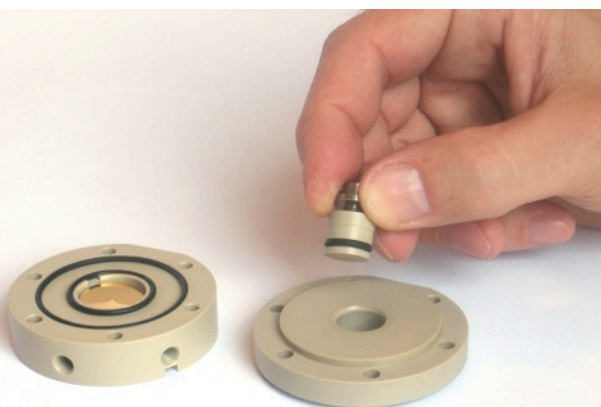
Place CE (dia \leq 20 mm) with the active layer downside on top of the glass frit

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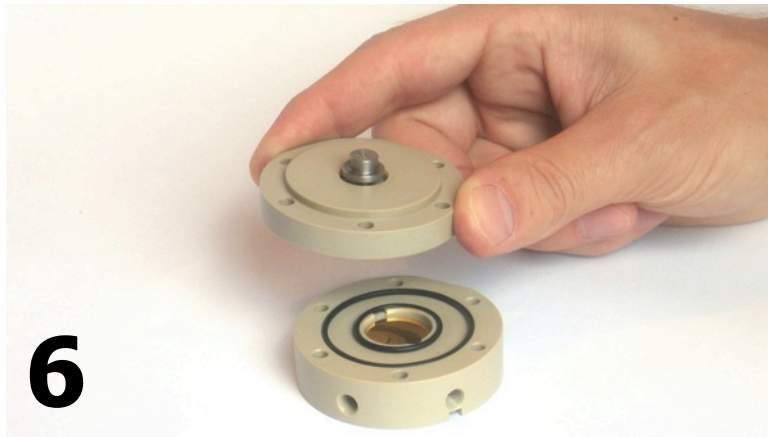


Place current collector on top of the CE

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Insert the central CE piston into the cell base



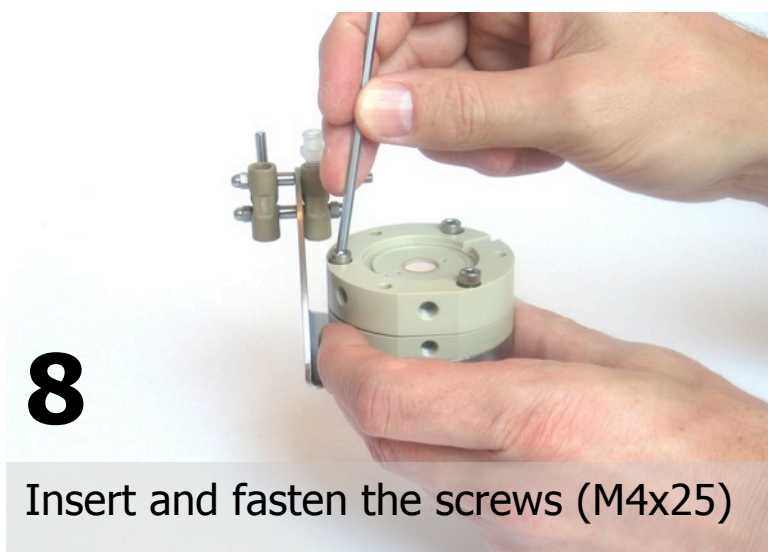
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Stack cell base (with central CE piston) on top



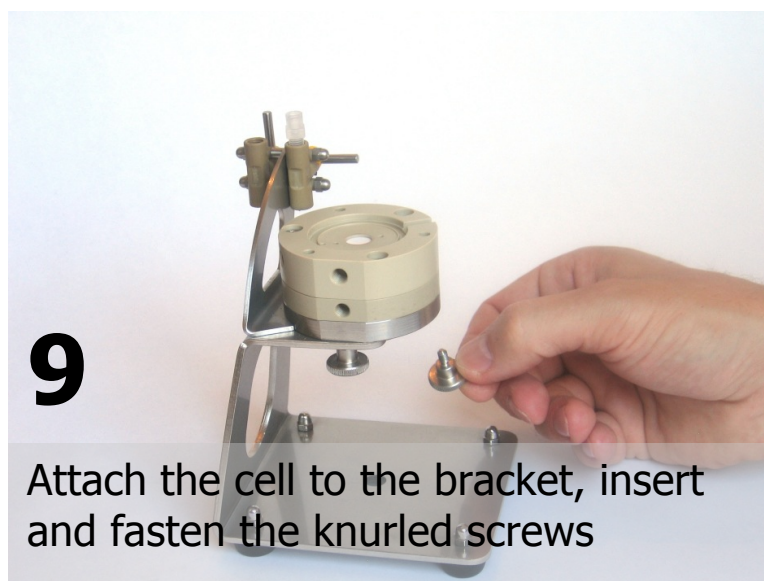
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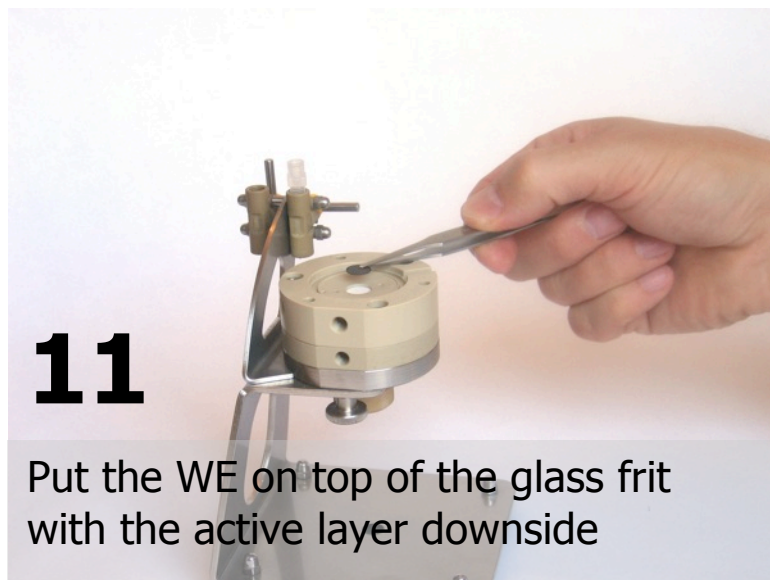
Put base flange on top, and turn the whole stack around



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Insert and fasten the screws (M4x25)







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Insert the O-ring seal



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Insert the membrane



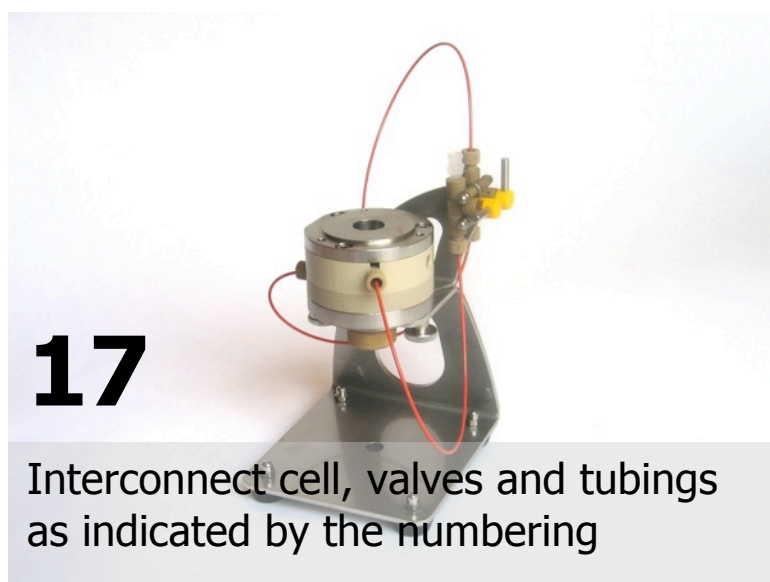
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Place the cover flange on top



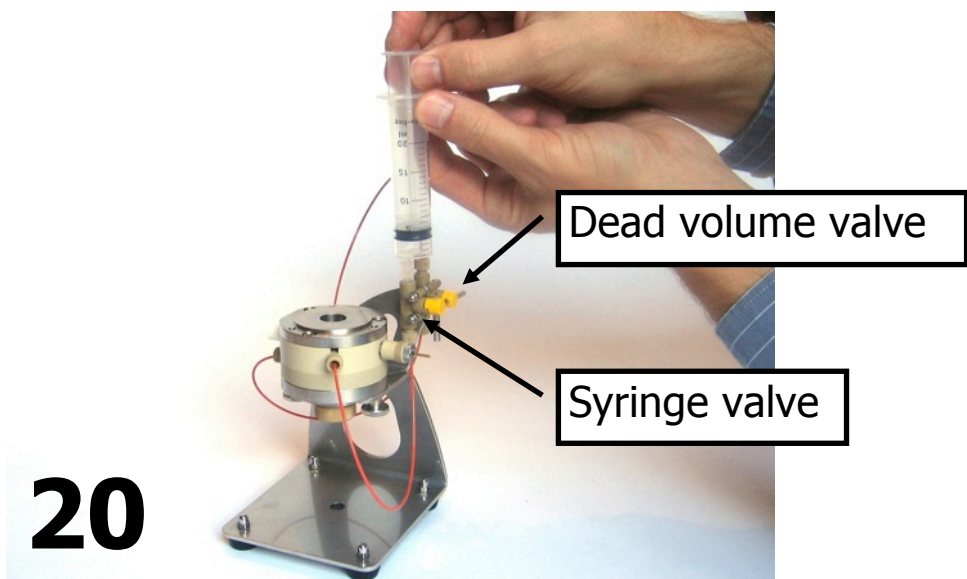
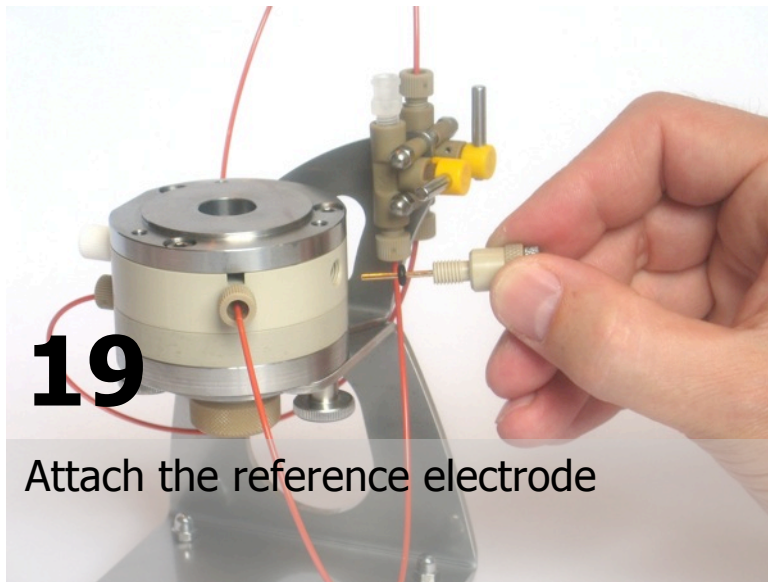
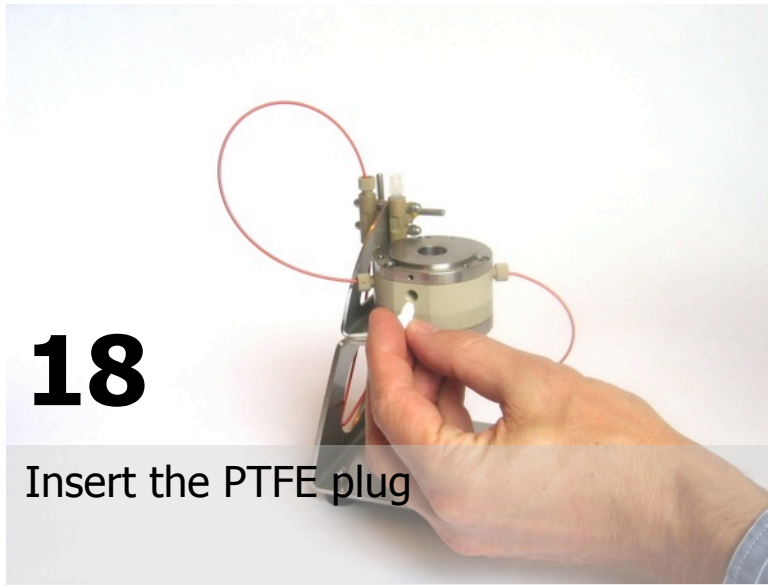
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Insert and fasten the screws (M4x30)



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Interconnect cell, valves and tubings as indicated by the numbering



Fill the cell with electrolyte according to the following procedure

1. Charge a 20ml syringe with ca. 3ml of electrolyte
2. Connect the syringe to the Luer adapter of the inner (syringe) valve
3. Open the syringe valve, and close the outer (dead volume) valve
4. Push the syringe plunger back to evacuate the cell. Hold the plunger a few seconds in the strained position.
5. Release the plunger to draw the electrolyte into the cell.
6. Repeat the two previous steps to complete filling.
7. Close the syringe valve, and open the dead volume valve

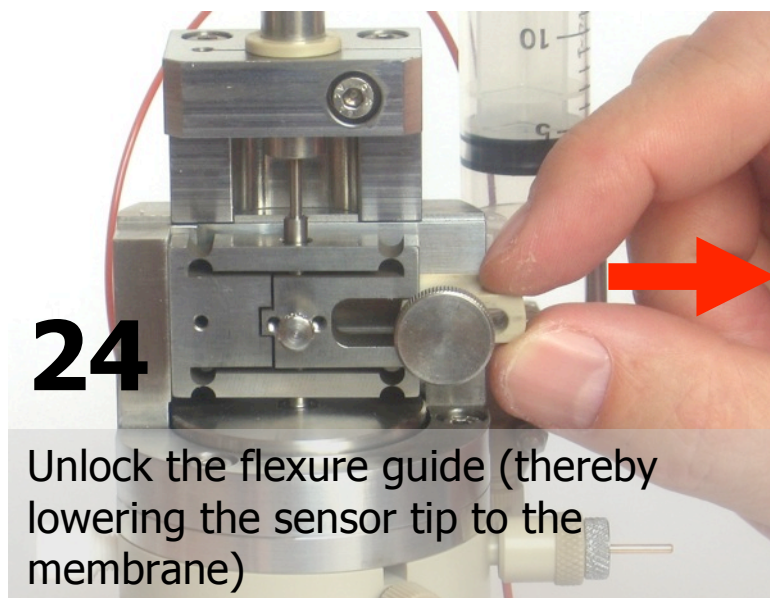
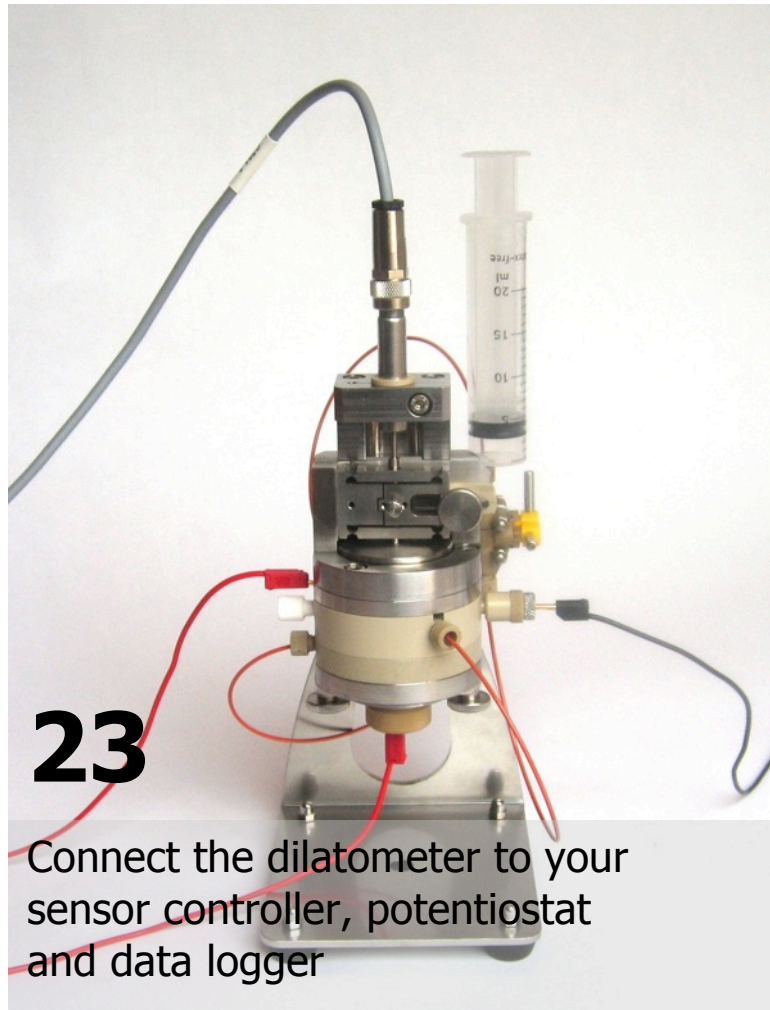
NOTE The cell is now filled and hermetically tight. If the handling so far was done in a glove box, all subsequent steps may be carried out in ambient atmosphere

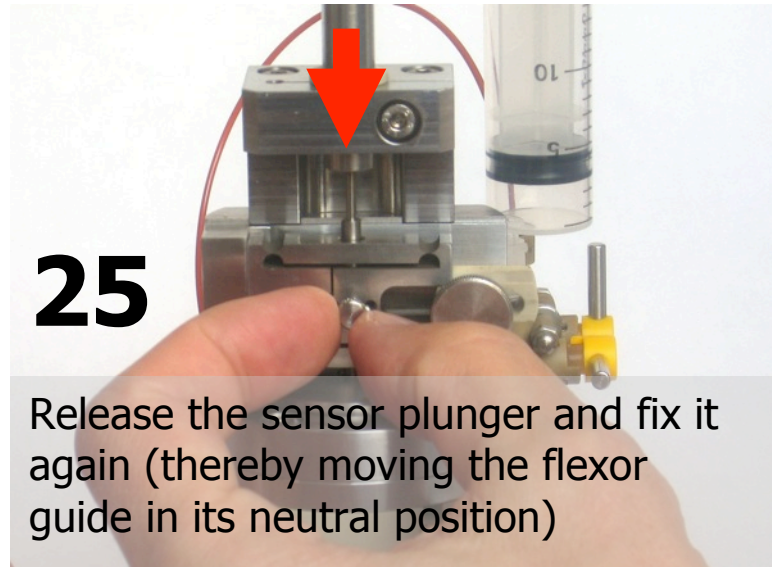
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Attach the sensor/load unit to the cell

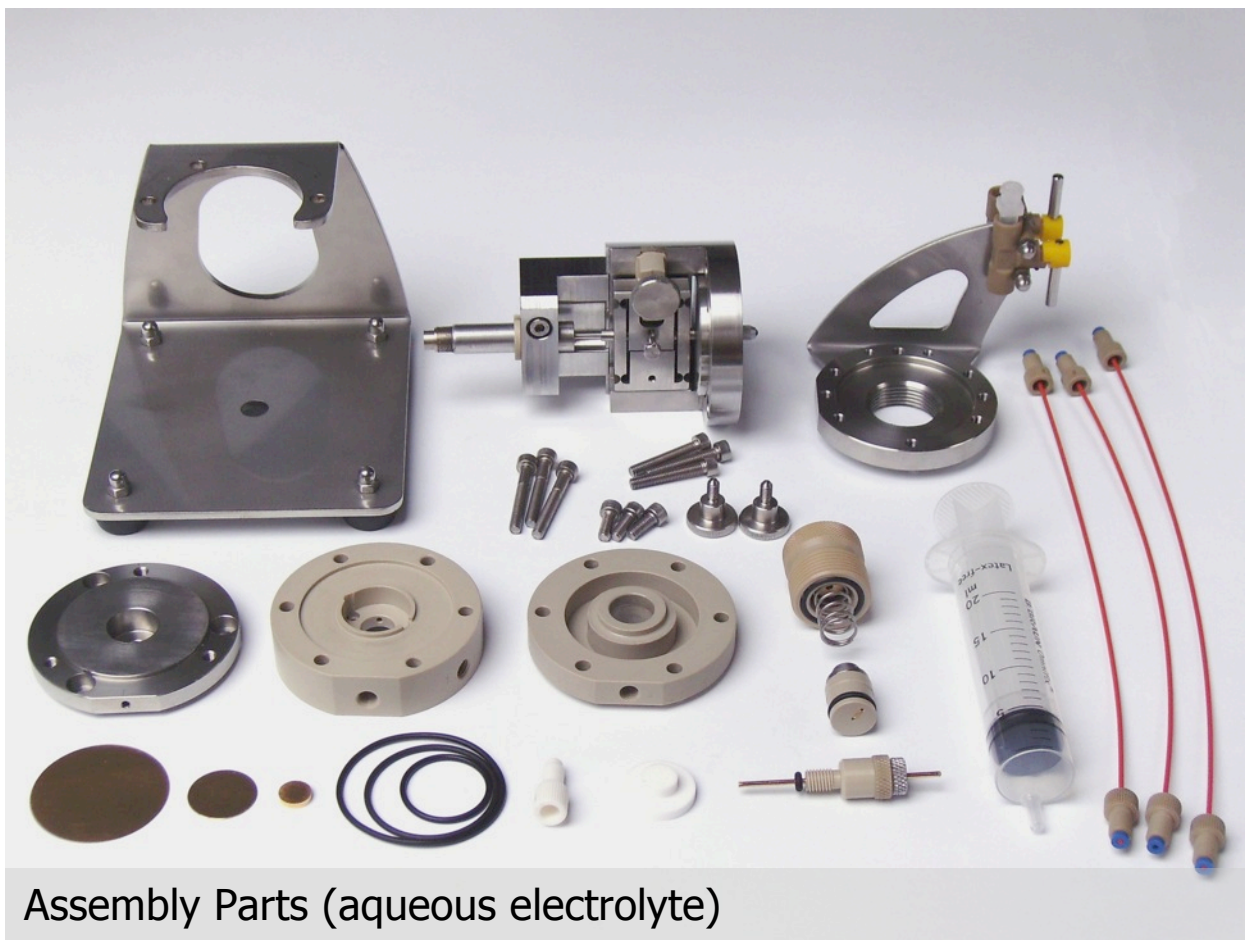
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Insert and fasten the screws (M4x10)





NOTE We recommend starting the measurement only after a settling period of at least 2 hours to allow for baseline stabilization. For optimal accuracy, tests should be performed in a temperature controlled chamber



For more detailed information please refer to the user manual