

Objective and Scope

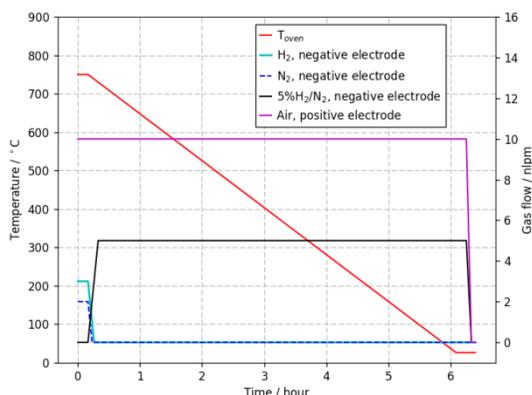
This test module deals with the shutdown procedures needed for termination of the SOC cell/stack operation and coming back to ambient temperature. The shutdown procedure normally should be given by the manufacturer. However, if there is no shutdown procedure available, a recommendation is given in this test module.

Main Test Input Parameters (TIPs)

Static TIP	Variable TIP
Rate of oven temperature change ($\Delta T_{oven}/\Delta t$)	Flow rates of inlet gases (f_{in})
Rate of the pre-heaters temperature change ($\Delta T_{PH,in}/\Delta t$)	Temperature of the oven (T_{oven}) and pre-heaters ($T_{PH,in}$)
	Pressure of outlet gases (p_{out})
	Composition of inlet gases ($x_{i,in}$)

Test Procedure

- Decrease/increase the current I (voltage V) stepwise to zero current (OCV) in a galvanostatic (or potentiostatic) mode if applicable, and disconnect/switch off the electronic load and power supply.
- Change the reactant flow $f_{neg,in}$ and $f_{pos,in}$ to nominal values and $x_{i,neg,in}$ and $x_{i,pos,in}$ to nominal composition.
- Decrease the reactant pressures (both at the same time) $p_{neg,in}$ and $p_{pos,in}$ to ambient pressure, if applicable.
- Set negative electrode and positive electrode to protection gas (e.g. 5 % H₂ in N₂) and air at $f_{neg,in}$ and $f_{pos,in}$ respectively.
- Reduce cell/stack temperature T_{cell} / T_{stack} by adjusting pre-heaters temperature (if applicable) and T_{oven} with pre-defined temperature changing rates to ambient temperature.
- At ambient temperature, reduce gas-flows of negative and positive electrodes to zero.



Example of changing of temperature (T_{oven}) and gas flows of a 5-cell stack during shutdown.

Critical Parameters and Parameter Controls

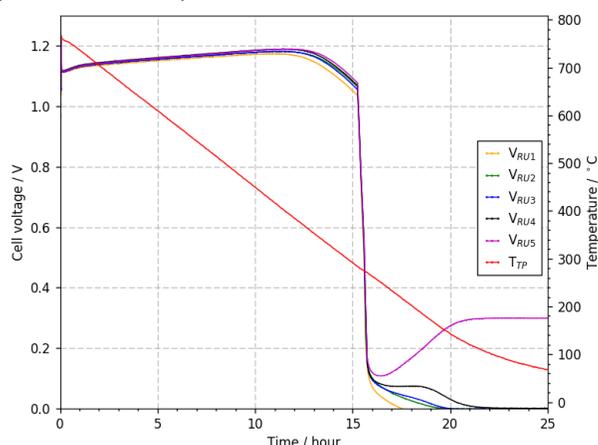
- During shutdown, the negative electrode gas is switched from H₂ rich gas to a diluted H₂ -mixture (protection gas, e.g. 5% H₂ in N₂).

Main Test Output Parameters (TOPs) and Derived Quantities

TOP	Derived Quantities
Voltage of cell/stack (V)	Average temperature of the stack (T_{av})
Temperature of gas streams at cell/stack inlet/outlet, temperature of cell/stack (T)	Maximum temperature difference during shutdown (ΔT_{max})

Data Post Processing and Representation

Representation examples of shutdown:



Stack temperature and RU voltages during shut-down of a SOFC 5 cell stack test (Shutdown from SOFC conditions).

