



NEUTRONS  
FOR SCIENCE

# 10 GPa Precision Control over wide Temp. ranges

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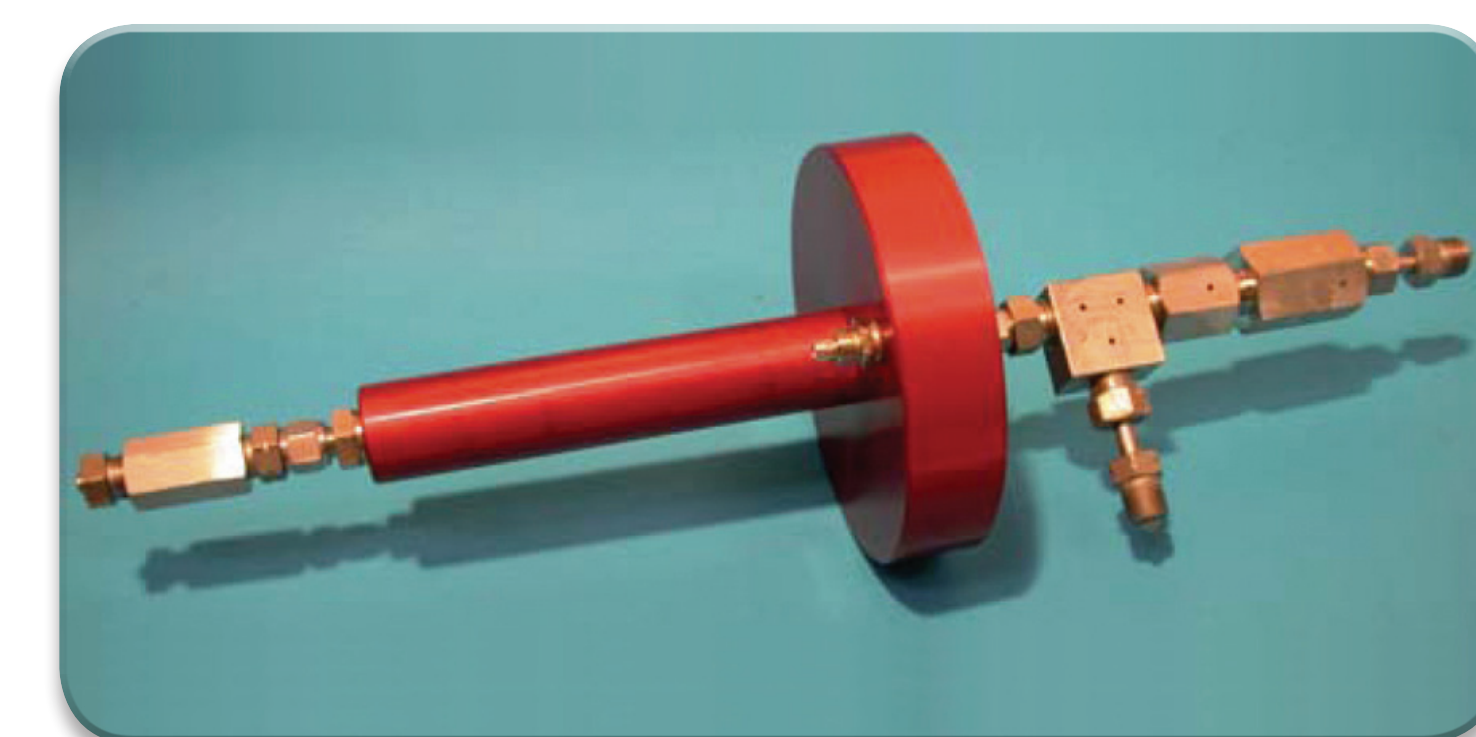
We present a rack for controlling remotely continuously loaded pressure cells and presses which is both fast and precise. It can charge the press with up to 200 MPa of helium gas in 20 minutes, control ramps at 3 MPa/min (30 bar/min) and maintain the pressure constant with variations around the set point of less than 200 mbar. It is mostly used with the VX-1 and VX-5 Paris-Edinburgh presses. Combined with a VX-5 press, it allows to regulate quickly and precisely the sample pressure up to 10 GPa at temperatures down to 3 K in our cryogen-free cryostat (20 GPa with smaller samples).



First non-magnetic CuBe  
VX-1 Paris-Edinburgh press

To achieve these performances, we use a 300 MPa compressor, two high-precision 200 MPa valves and a buffer. A Eurotherm controller maintains the gas in the buffer above the pressure required by the user and regulates the sample pressure by opening and closing the valves. One valve releases the pressure and the other injects the gas available in the buffer. For increasing (or decreasing) quickly the pressure in the press or cell, the controller disables the regulation loop and controls directly the compressor (or relief valve).

The innovative operating principle of the 200 MPa isolation valve is based on the elastic deformation of materials and is characterized by the absence of a stuffing box (O-ring). Indeed, the use of a flexible seal between the valve body and the needle stem is a source of many problems: leaks, pollution, and above all large friction effects requiring high force for opening/closing the valve and causing large hysteresis. The 200 MPa valve is operated by compressed air (6 bar). A licensing arrangement has been concluded with Autoclave Engineers France for marketing this device.



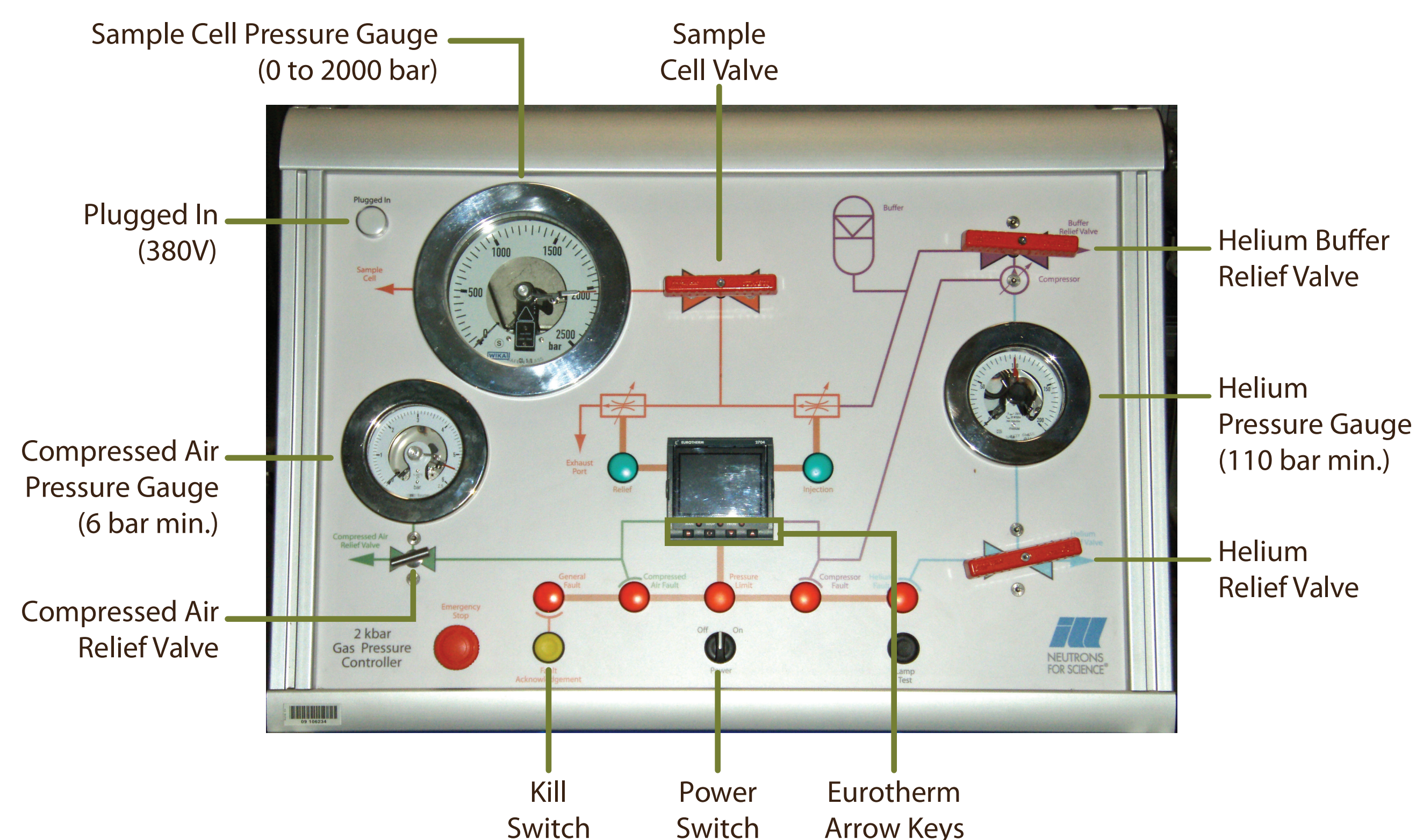
© CNRS high-pressure valve

To simplify the use of the rack on the instruments, efforts have been made to ease its installation and provide the very simple user interface shown on the right. After plugging the power and compressed-air lines, it only necessitates to connect the press or cell, switch it on and enter the set point. In case of power cut, overpressure or shutdown of the compressed-air line, the rack automatically stops and releases the pressure applied to the sample. This rack has been commissioned in 2010 and a second copy is under construction.



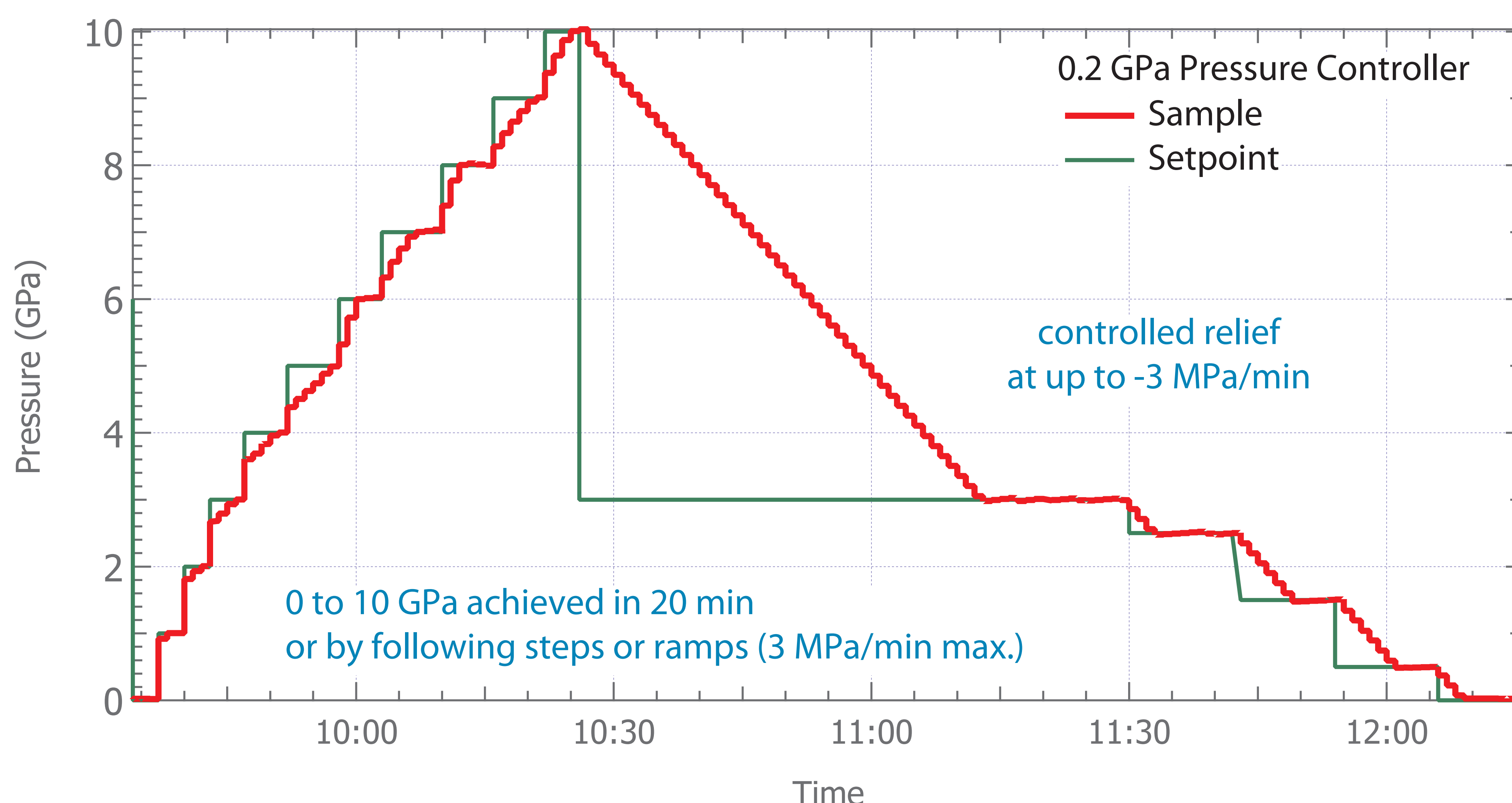
3 K Paris-Edinburgh cryostat

The synoptic of the controller shows at any time the status of the components. A safety loop checks permanently the components and releases the pressure automatically in case of trouble.

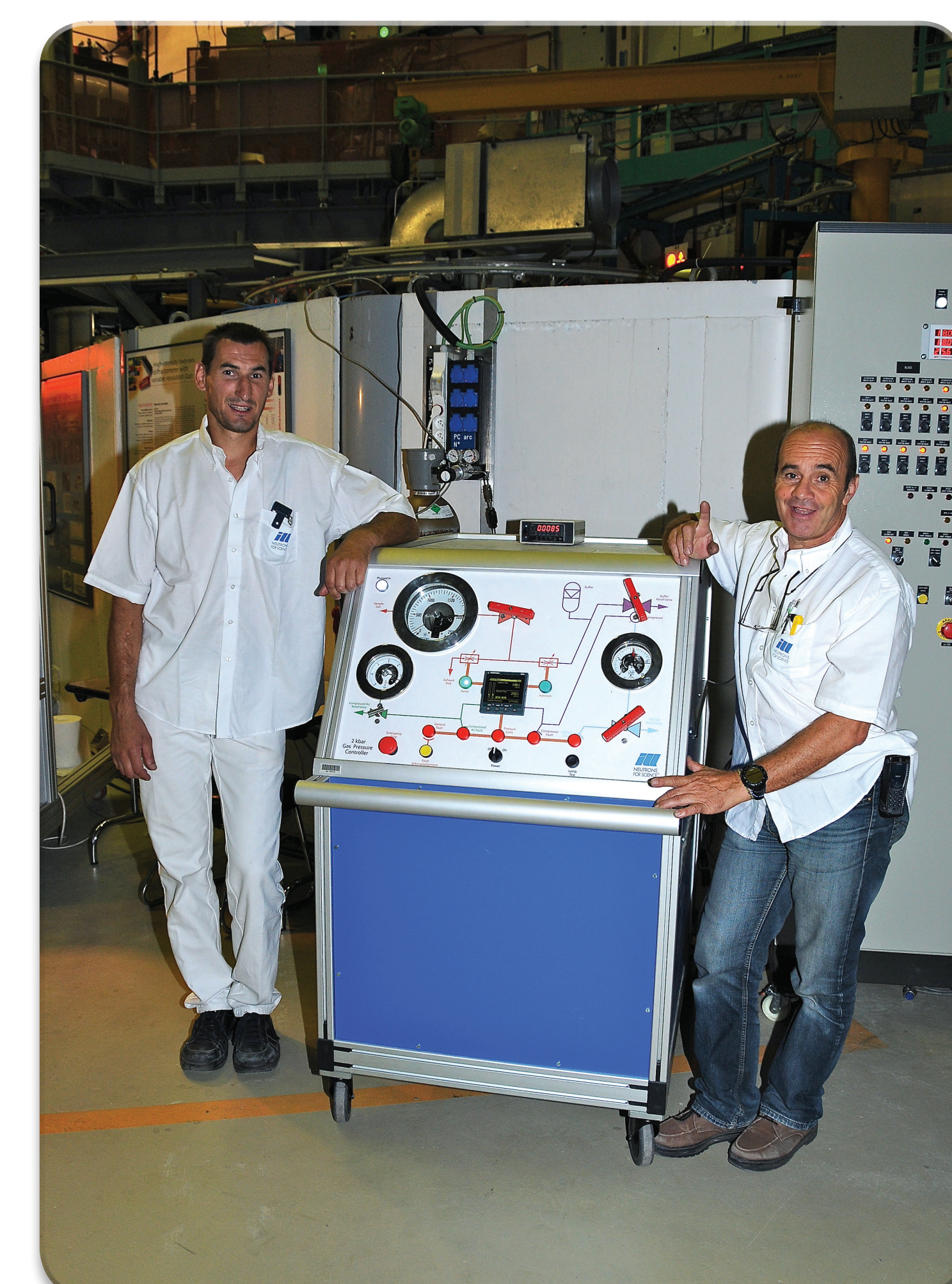


user interface panel of the high-pressure rack

We show below an example of the variation of the pressure applied on a sample mounted in a VX-5 Paris-Edinburgh press. When the setpoint is changed, the controller changes the pressure in the buffer for allowing the stabilization of the pressure applied to the sample. In order to protect the valves against abrupt pressure variations, e.g. generated by the compressor, the valves are actuated only when the compressor and the relief valve are not operated. This is revealed by the steps shown in red on the graph.



evolution of the pressure applied to the sample in the VX-5  
press after changing successively the setpoint



commissioning of the controller on  
the powder diffractometer D20

High Pressure Research **24** 1 (2004) 219, Patent CNRS n° 04 00 515

Valve distributed by Autoclave France under the licence number L0813 - <http://www.autoclave-france.fr>

Controller distributed by Eurotherm - <http://www.eurotherm.com>