

Customer Chamber and Stage Safety Validation

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FTA chambers and stages are intended for use in scientific experiments by personnel familiar with the risks involved and who will ensure that necessary precautions are taken to protect operators in case of a failure or accident. They are not intended to be operated under risky (temperature, pressure, etc.) conditions by the ordinary technician. Risks include the following (but this list is not exhaustive):

Interaction of sample with ambient: Samples may oxidize or interact with water or with a gaseous atmosphere you introduce into chambers. These reactions may occur rapidly at higher temperatures. No FTA chambers are intended for use with oxygen.

Pinching by stage movement: Automated stages can move at any time. All FTA systems have either an EPO (Emergency Power Off) switch activated by *pushing in*, or a mains power switch on the enclosure. Do not place yourself in the possible path of an automated stage without someone nearby who can turn off the machine in case you are caught by the stage.

High temperature: FTA chambers can reach very high temperatures. This does not mean it is safe to operate these chambers with any particular sample or ambient atmosphere. Because of the optical nature of the instrument, it is not possible to protect the operator from casual contact with hot metal surfaces that can cause serious burns. A large *Hot* warning sign is provided with each heated chamber (replacement signs available at no charge). Display this sign whenever a chamber is heated. This will warn the casual person who enters the room. It is the customer's responsibility to operate the chamber in a safe manner. Be aware that the chamber may be above the programmed or indicated temperature by virtue of failure of the temperature sensor or the thermal controller.

High pressure: Some FTA chambers can be pressurized above ambient. Because these necessarily contain optical windows, they can be extremely dangerous if a window fails and glass shards are thrown out. FTA can not guarantee any chamber is safe at elevated pressures. This is the responsibility of the customer's safety officer who should also establish a safe protocol for operating the chamber at pressure in the intended experiments. FTA will provide available design information upon request to assist in such an analysis. Most chambers are used in such a fashion that they must be periodically disassembled and cleaned. This requires care and attention as it is entirely possible to damage the windows so that they fail upon subsequent pressurization. Be particularly sensitive to scratches and nicks in windows. These can grow as the window is subjected to thermal cycles. Another factor to consider is that tubing carrying pressurized gas to the chamber may break or come loose from fittings, in which case it will swing wildly about. At the minimum, do the following:

1. Proof test the chamber above the intended operating pressure. This would be done in an environment where the chamber would be expected to fail without causing harm. Chambers are supplied with extra windows to facilitate such testing. Most chambers have several types of windows available, so one can choose the best for the intended purpose.
2. Establish and follow a safe operating protocol for operating at elevated pressure. This protocol must provide protection for personnel in case of unexpected failure.

Electrical wiring: Always visually check wiring for signs of insulation damage. Wiring may be subject to thermal cycles and to movement from motion axes or simple attachment and detachment from the instrument.