



SAFE USE OF STRESS AND STRAIN CELLS

This sheet describes important safety precautions for using the Razorbill Instruments stress and strain cells. The strain cell is one component which is designed to be installed as a part of a complete measurement system. In addition to the risks arising from use or misuse of the strain cell, there will be additional hazards associated with the complete measurement system. Furthermore, given the wide range of unique measurement systems into which the strain cell could be incorporated, it is not possible for Razorbill Instruments to foresee all possible risks or hazards which could arise. Safe installation and operation of the strain cell is ultimately the responsibility of the customer. The information in this sheet is intended assist you in building a safe and effective measurement system. If you have any doubt about the safety of the system, seek advice from an appropriately qualified person.



To minimise the risk of serious injury or death, all users should read and understand this safety sheet and the warnings in the datasheet which accompanies the cell.

INTENDED USE

The CS100 strain cell is designed to be used by an appropriately experienced researcher as a component of a cryogenic experimental system. The cell is intended to be used exclusively inside an electrically insulating or grounded metal cryostat. The intended purpose of the cell is to apply controlled uniaxial strains to sub-millimetre scientific samples at temperatures between room temperature and less than 1 Kelvin.



ELECTRIC SHOCK

The voltages required to operate the cell are high enough to cause serious electric shock. The single most effective precaution which can be taken to reduce the risk is to limit the power supply current to a few milliamps, either by choosing a suitable power supply initially, or by adding a series resistor.

Current limiting alone however does not make the strain cell intrinsically safe, as there can be significant stored charge in the capacitance of the piezoelectric stacks. Razorbill Instruments strongly recommends the following safety precautions:

- Connect the titanium chassis of the device to a low-impedance safety ground whenever the power supplies are connected.
- Only operate the strain cell within a grounded metal enclosure, or a suitable insulating enclosure. In many cases, this will be a cryostat.
- Do not operate the device when it is wet (e.g. covered in condensation after removing from a cryostat).
- Do not store the device in an environment where it may be contaminated by e.g. metallic dust or oil.
- Do not operate the device outside its rated temperature or voltage ranges.
- Always join the drive wires together when warming or cooling without drive electronics attached. If you forget to

do this, substantial charge may build up on the piezoelectric stacks. This can be discharged safely by connecting a 10 K Ω resistor across the stacks, but take appropriate precautions to avoid an electric shock while doing so.

Insulation integrity

If you have any reason to believe the wire may have been damaged, or if the cell has been dropped, or otherwise mishandled, you should visually inspect the wires. If there is any sign of cracking, abrasion, crushing, melting or other damage, the strain cell should not be used until appropriate repairs are made. In particular:

- The wires used in the device are flexible at room temperature, but not when cold. If they are bent when cold, the insulation may crack and fail. Small movements as the system cools will not be a problem, but if you want to mount the strain cell on a moveable or rotatable sample platform you will need to use a different type of wire.
- Avoid routing the provided wires through clamps or over sharp edges, as the PTFE insulation is vulnerable to damage. Even if it seems fine initially, damage can occur over time.
- The insulation can be softened or even melted by heat, such as when soldering with a soldering iron which is too hot.

If you are using the cell in a low pressure gas atmosphere (such as helium exchange gas) the hazards associated with insulation failure are particularly acute because the gas can sustain an arc in much the same way as a neon lamp. Take extra care in making and insulating wire joints for use in low pressure gas atmospheres, or limit the operating voltage to less than the Paschen law minimum for that gas (approx. 100 V for helium).



COLD BURNS

Avoid touching or operating the cell immediately after removing it from a cryostat. It is best to warm the cell gently to room temperature before removing it from the cryostat, but if ice forms on the cell, do not touch it until all ice has melted.



CONTAINS LEAD

Both the solder and the piezoelectric stacks in the cell contain lead. While the strain cell is used normally, the lead is fully contained and not a health hazard. If the cell is crushed, burnt or melted, lead may be released. When the strain cell reaches the end of its useful life dispose of it in accordance with local laws or contact Razorbill Instruments to arrange its return for recycling free of charge.

AVOIDING DAMAGE

In addition to the safety precautions described above, there are some additional steps you should take to decrease the chance of sudden failure and to improve the working life of the strain cell. We recommend the following:

- Avoid dropping or applying mechanical shocks to your strain cell.
- When mounting the cell, either to mount samples or in the cryostat, avoid applying forces that will bend or otherwise stress the piezo stacks.
- Do not use the full voltage range of the strain cell if you have mounted a sample which is stiffer than the recommended maximum spring constant.
- Always consider the influence of thermal contractions when mounting the cell in the cryostat, so that the cell is not stressed by the bracket holding it.
- Do not heat or cool the cell by more than 10 K per minute. Where convenient, cool and warm overnight to minimise thermal stresses.
- Do not immerse in liquid cryogenics, such as liquid helium or liquid nitrogen. If the cell becomes immersed by accident, warm through the boiling point of the cryogen slowly to allow trapped liquid to evaporate and escape.
- Always thoroughly purge the gas surrounding the cell before cooling. Even small amounts of ice or frozen air can affect the operation of the capacitor.