Detectors for Harsh Environments

Saint-Gobain Crystals produces a wide range of scintillation materials that are used to build detectors to measure radiation. Some scintillators are sensitive to moisture, others to ultraviolet light from fluorescent lamps and others to temperature gradients.

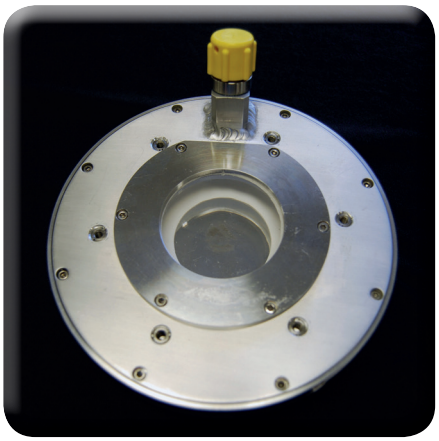
Most “standard” scintillation detectors are designed and built to operate under laboratory conditions. We define laboratory conditions as:

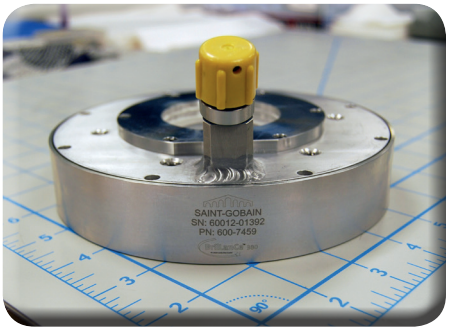
- +4°C to +43°C operating temperature range
- 8°C/hour thermal rate of change
- 1 atm pressure
- 90% or less relative humidity
- No shock or vibration exposure other than that incurred during shipment
- No immersion in a fluid

Environments that have one or more conditions outside of these are considered harsh. Standard detectors may not even operate, let alone work properly, in these environments. Therefore, when establishing detector specifications, it is important to identify the operating conditions your detector will face.

Examples of Harsh Environments–

- For operation at or below -30°C, we must select a resilient interface between the scintillator crystal and photomultiplier tube.
- For operation at reduced pressures, such as 100 to 200 mTorr, encapsulation materials with reduced out-gassing properties are used. The detector interior may be evacuated, and a bellows, pinch-off tube or vacuum valve may be added.
- For water immersion, the entire assembly must be waterproofed to prevent the voltage divider from shorting out. Waterproof connectors (or waterproof cable feed-throughs) are used.
- For detectors subject to vibration (or impact shock), we use special construction techniques and qualified components, including a ruggedized PMT.
- More complex environments require us to address several non-standard conditions at once. Our detectors for balloon- or satellite-borne experiments meet temperature, vacuum and mechanical requirements.
- Our MWD (measurement while drilling) detectors survive the extreme temperature variations, mechanical shock, and vibration encountered while drilling through underground rock strata.





Design Notes –

- Optional electronics – voltage divider or voltage divider/preamplifier combination and high voltage supply – can be integrated into the design of these non-standard detectors.
- In addition, we can space-qualify the components and subassemblies. Our resources also include design modeling and finite element analysis.

CRYSTALS

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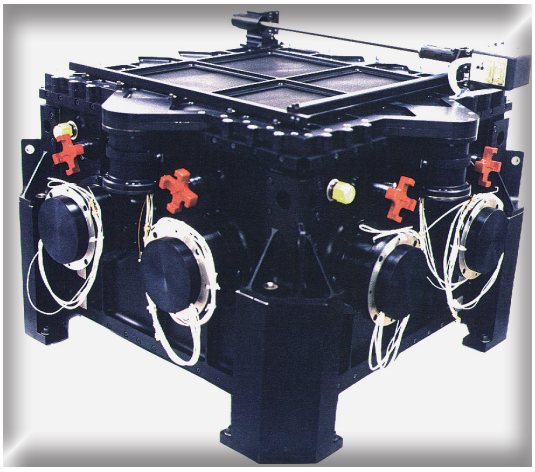
Pictured is the completed Structural/Thermal Mass Model for the SAX Satellite project. The model was built to qualify the mechanical structure of the crystal's assembly design. The picture below shows the main Phoswich Detector System built at SGC. It consisted of 4 NaI(Tl) and CsI(Tl) phoswich detectors



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