Protective Vents

The Impact of Temperature Cycling on Sealed Enclosures

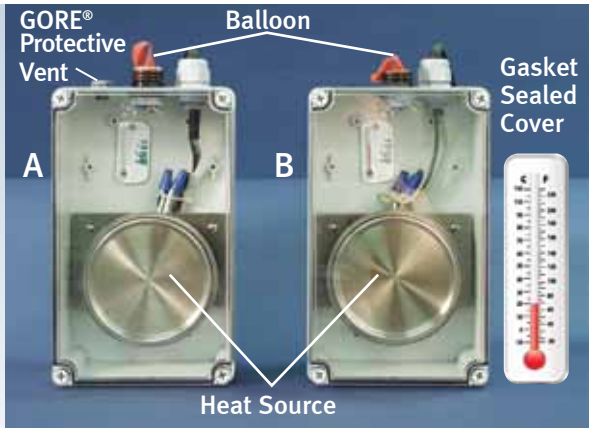
The Problem

Fluctuations in temperature create failures in electronic devices due to pressure differentials. Such pressure differentials can be caused by altitude (transporting cargo on an airplane), rapid changes in temperature (using a portable bar code scanner indoors and then outdoors), or internal temperature changes within a device (internal heat source). This constant heating and cooling cycling causes repeated pressure build-up (expansion) and vacuums (collapsing). When pressure is not dissipated, stress is continually placed on the housing seals. The stress causes gaps in the seals, allowing contaminants to enter the device and damage the components — ultimately affecting long-term performance. Gore application engineers simulated a rapid heating and cooling cycle to understand the effects of pressure differentials. This controlled test simulates a real world example. However, the following variables also need to be considered:

- sealed device size
- rapid/extreme temperature changes
- fluctuations in altitude
- fluid exposure
- rapid heating and cooling cycles

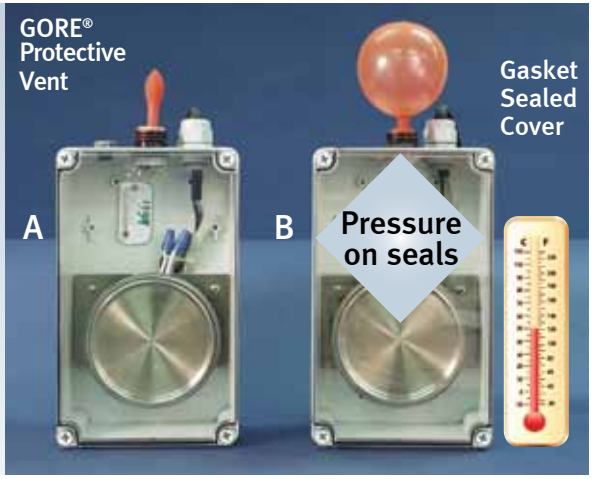
Step One: Sealed Enclosures in Identical Conditions

Identical enclosures were constructed with a heat source, gasket-sealed cover, and balloon. The balloon was positioned to show the negative and positive pressure differentials caused by the heating and cooling cycles. A GORE® Protective Vent was used on enclosure A.



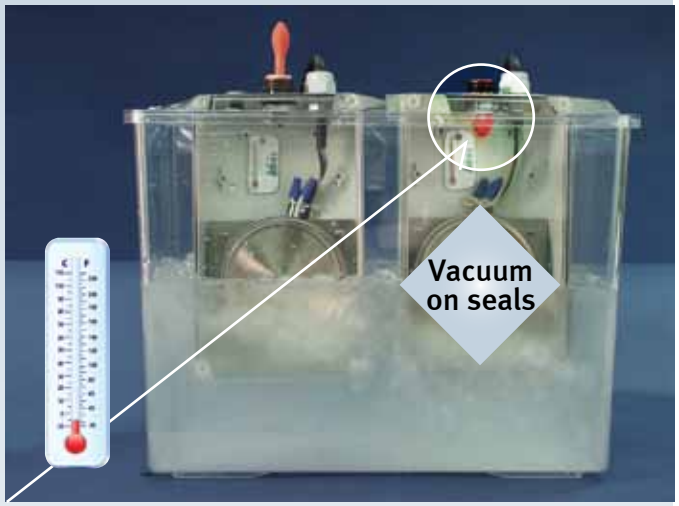
Step Two: Heating Cycle (Simulates Sunny Day)

Both enclosures are exposed to a temperature increase from 20°C (68°F) to 50°C (122°F) in a time frame of 90 seconds (control volume = 4000 cm^3). The heat increases pressure inside enclosure B; whereas, enclosure A remains unchanged, because air can pass freely through the GORE® Protective Vent. The air pressure inside enclosure B causes the balloon to inflate.



Step Three: Cooling Cycle (Simulates a Rain Shower)

Both enclosures are exposed to a 90-second, rapid-cooling cycle from an ambient 20°C (68°F) to -5°C (23°F) (control volume = 4000 cm^3). The decreased air pressure in enclosure B causes the balloon to deflate. Again, enclosure A remains unchanged due to the GORE® Protective Vent.



The drastic temperature change causes a vacuum, drawing the balloon into the enclosure. In a real-world situation, contaminants such as liquid, dirt and particles can be drawn into a device, causing failure to internal components.

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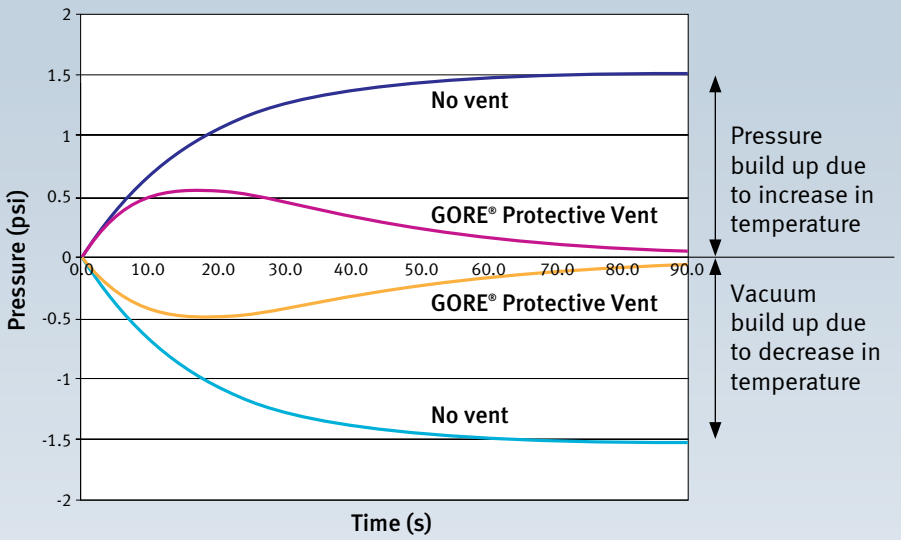
Minimal Pressure Loading with Vented Enclosures
4000 cm³ enclosure



When exposed to rapid heating and cooling cycles, the enclosure without a vent builds up pressure (see positive pressure build on graph) and a vacuum (see negative pressure build on graph). Conversely, an enclosure vented with a GORE® Protective Vent maintains equalized pressure with its environment.

The Solution

Installing a vent in a sealed enclosure allows air to flow freely into and out of the device, eliminating the impact of rapid changes in temperature and pressure that create a harmful vacuum.

GORE® Protective Vents enable pressure equalization, battery venting and acoustic protection solutions that let product engineers cost effectively solve design problems relating to condensation, pressure variability and harsh environment. These vents provide an effective barrier from dust and dirt and still allow the product to breathe in changing environmental conditions. This prevents pressure from building up and damaging enclosure seals, exposing sensitive components to water and debris. The result is unmatched protection for sensitive electronics.

Versatile Design Options

GORE® Protective Vents are available in a wide variety of sizes and with varied housing materials or adhesive backing. To ensure mechanical fastening, a threaded design was used in the balloon demo simulation. These screw-in vents offer durability for extremely harsh environments and provide quick venting recovery after liquid immersion.

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INTERNATIONAL CONTACTS

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Benelux	49.89.4612.2211	Scandanavia	46.31.706.7800
China	86.21.5172.8299	Singapore	65.6733.2882
France	33.1.5695.6565	South America	55.11.5502.7800
Germany	49.89.4612.2211	Spain	34.93.480.6900
India	91.22.6768.7000	Taiwan	886.2.8771.7799
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