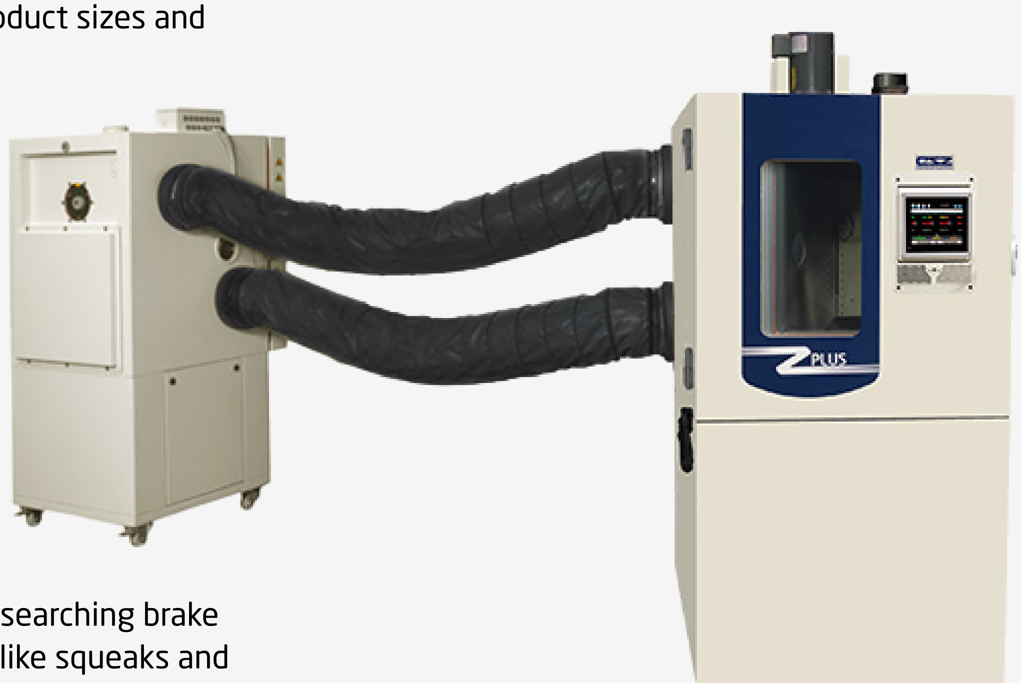
Cincinnati Sub-Zero

Remote Conditioning Systems for Flexible Testing

The landscape of environmental testing is vast, products requiring environmental testing span industries and sizes, from large automobiles to the smallest sensors and components. While having a dedicated environmental chamber designed to test a specific product is often ideal, this setup is not always economically or physically feasible. What happens when the size or location of a product puts conventional testing methods out of reach? That's where remote conditioners (RCs) step in, offering a versatile solution to meet the demands of dynamic testing environments.

Remote conditioners provide air through ductwork in a closed-loop configuration. By constructing insulated enclosures around their test items and utilizing Remote Conditioners (RCs) to supply conditioned air to these enclosures, a single environmental chamber can cater to wider range of product sizes and processes. Additionally, CSZ RC chambers can serve dual purposes, functioning either as remote conditioners or standalone temperature/ humidity chambers.



Certain automotive and electronic applications rely on remote conditioning setups. For instance, brake dynamometer testing often employs insulated hoods and remote conditioners for researching brake systems' performance factors like squeaks and stopping power. Instead of building dedicated dynamometer chambers, an insulated hood can encompass the wheelbrake assembly mounted on the dynamometer, with conditioned air supplied from an RC chamber..

While the advantages of remote conditioners are clear, selecting and utilizing them requires careful consideration of several factors.

HOOD CONSTRUCTION

The performance of an RC is only as good as the hood it's connected to. Adequate insulation, proper sealing of openings, and attention to details like insulation thickness and vapor-tight surfaces are essential for optimal performance. Sizing an RC correctly requires detailed information about hood construction, insulation, and the total load of the Device Under Test (DUT).

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Alternatively, manufacturers can provide compatible hoods based on application specifics.

AIR TEMPERATURE

Another key aspect is understanding that the air temperature in the chamber differs from that in the hood. An RC chamber uses a blower to provide airflow to the hood. Some manufacturers will quote the temperature in the chamber as the supply air temperature. However, because this temperature is upstream from the blower, you can expect a several-degree temperature increase at the blower outlet as the air moves across the blower motor.

When ordering an RC, it is essential to specify a “local/remote” temperature sensor. This ensures accurate temperature measurement, accounting for blower-induced temperature rise and heat picked up in hoses.

HUMIDITY

Humidity control presents challenges as humidity levels fluctuate relative to temperature changes. When air temperature increases, RH levels typically decrease, posing challenges in achieving desired humidity levels. For example, when operating at a lower temperature and humidity limit of 4°C and 95% RH, a 5°C temperature rise across the blower results in a decreased RH level to approximately 67%. This discrepancy highlights the need for additional measures to adjust humidity levels, such as introducing humidity downstream of the blower or directly into the hood.

Humidity control is also influenced by factors such as hood construction and the nature of the load within the hood. Materials with high water retention capacities, such as bare concrete floors or a device under test (DUT) that is large and dense, can impede the rapid achievement of desired humidity levels.

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A hood construction that traps condensation can cause problems with dehumidification. As the RC system lowers the humidity level in the supply air, any water collected in depressions on the floor or equipment will evaporate, maintaining a high humidity level high until virtually all water is gone.

To avoid these problems, the hood design must use adequate insulation (including the floor) to minimize condensation and provide a means to remove any accumulated condensation. Well-sealed doors and openings will prevent the vapor pressure caused by high humidity from forcing its way into or out of the hood.

AIRFLOW

Determining the capacity of a Remote Conditioner (RC) involves assessing both airflow and air temperature delivered to the hood, rather than relying solely on compressor horsepower. While the DUT releases heat based on the temperature disparity between itself and the surrounding air, the rate at which it dissipates heat depends on the airflow velocity.

Designing the hood and positioning the air supply relative to the DUT must account for the necessary airflow velocity over the DUT. Additionally, the amount of air supplied by the RC blower is inversely correlated with the pressure drop in the connecting hoses and hood.

To minimize pressure drop, it is essential to reduce hose length and the number of bends, while ensuring the hoses are sufficiently large to maintain low air velocity within them.

By navigating these considerations and understanding potential pitfalls, RC chambers offer unparalleled flexibility for diverse testing needs.

When a one-size-fits-all approach is unfeasible for your testing requirements, RCs enable users to conduct environmental testing in diverse settings that traditional testing methods cannot reach. These chambers are perfect for testing products of various sizes that cannot fit in a standard chamber workspace. This includes moving devices in special fixtures or irregularly shaped objects. Remote conditioning chambers are available either as a dedicated chamber specifically for remote conditioning of external workspaces or as a standard environmental chamber, utilizing the chamber's internal test space. This dual purpose functionality offers users a greater return on investment.

Whether serving as standalone chambers or supplying air to enclosed test items, RCs enhance testing capabilities, offering greater flexibility and efficiency.