Vector Technical Guide

Elevated Temperature Testing

Vector provides accurate strain measurements even at high temperatures. Testing inside an environmental chamber introduces additional factors to consider. To achieve accurate and repeatable results, adhere to the following guidance.

Summary

To achieve the best results, it is important to prepare both the equipment and the testing environment carefully:

1. How to Set Up Vector with a Chamber
2. How to Prepare Specimens for Elevated Temperature Testing
3. How to Prepare a Chamber for Non-Contact Extensometry

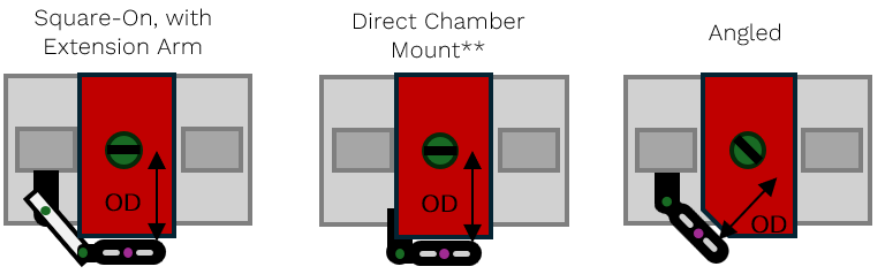
Each of these topics is described in detail below.

1. How to Set Up Vector with a Chamber

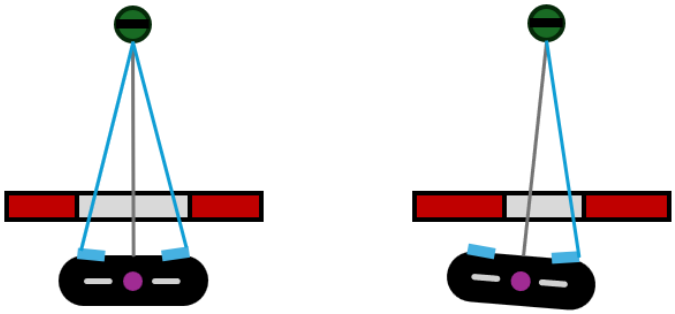
Mounting Vector to a Test Frame with a Chamber

1. Mount Vector onto the test frame or chamber. The mounting method must be stable and secure. When possible, adopt a Direct Chamber Mount approach. Example configurations on how to do this are depicted in the figure below.
2. Use mounting kit: stub axles, extension arms, or proprietary mounting accessories where available.
3. Position the Vector unit at the specified operating distance from the specimen. Operating distances are detailed in the Vector datasheet.
4. Verify that the Vector lighting is sufficiently illuminating the target specimen. This means there are no illumination warning messages from Vector. For best practice the chamber window should be >150mm. The minimum window width is 60mm.
5. Ensure Vector has “line of sight” of the specimen markings. If mounted sufficiently Vector should be able to detect and track specimen markings.

Setup Options



Positioning Vector



*Operating Distance (OD) = ~ 300 mm **

**Tolerances vary with Vector Variant*
***Available on request, contact supplier*

2. How to Prepare Specimens for Elevated Temperature Testing

Vectors standard marking kit is suitable up to 370˚C.

Marking materials must withstand the test temperature. Fading or colour change in markings will affect measurement quality.

1. Clean the specimen surface thoroughly using an alcohol-based cleaner to remove any oil, grease, or dirt. Contaminants may burn or discolour during testing, which degrades the marking quality.
2. Use the appropriate marking kit. The standard Vector marking kit is suitable for temperatures up to 370°C.
3. Apply the marking pattern using the guidance outlined in the Vector Marking Guide. Note: Single-ink white speckle patterns are not recommended. If speckles are needed for the application then use a white basecoat with black speckles.

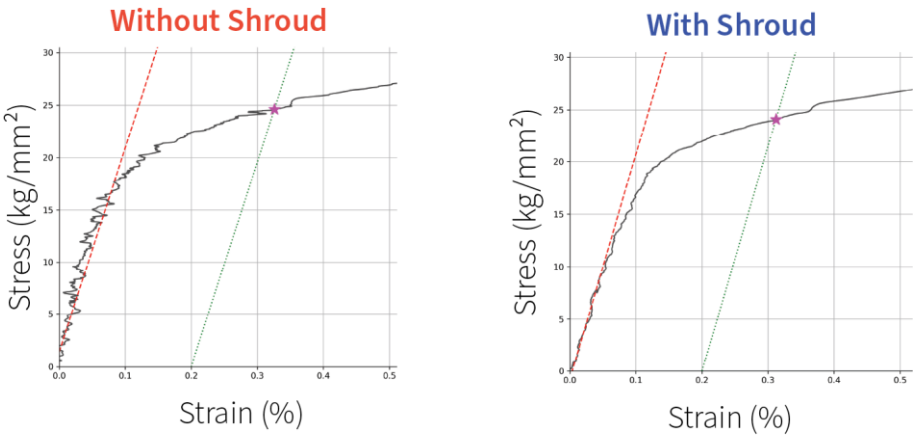
3. How to Prepare a Chamber for Non-Contact Extensometry

Minimise convection currents inside and outside of the test chamber. Convection currents occur when hot and cold air mix, causing visual distortion (heat haze). This visual distortion can result in measurement noise or detection issues with Vector.

i. Control External Air Flow between Vector and the Chamber or Furnace

The turbulent movement of air between the Vector and the chamber window or furnace can introduce noise. Minimise the effect of free air movement by:

- Shorten the distance between Vector and the chamber window, or
- Shroud the space between Vector and Chamber window with a suitable material. The shroud shall be sealed at both the chamber and on Vector.



Temp = 350°C, Gauge Length = 7.5mm

ii. Seal and Insulate the Chamber

- Verify that all chamber doors, seals, and openings (e.g., for load columns) are sealed. This prevents hot air from escaping and drawing in cold air, which creates convection currents in the chamber.

iii. Let the chamber reach thermal equilibrium

- Wait for the chamber, grips, and specimen to reach thermal equilibrium (a stable, uniform temperature) before initiating the test. This process may be longer for larger chambers or grips.
- When loading new specimens, wait for the chamber to return to thermal equilibrium before testing.
- Equilibrium can be identified by monitoring the force on the load cell and the strain of the specimen until they stabilise.

iv. Thermal Regulation

Adjust the fan speed settings to minimise internal convection currents. Set the fan speeds to a level that minimises air currents and does not hamper thermal equilibrium.

4. Data Processing

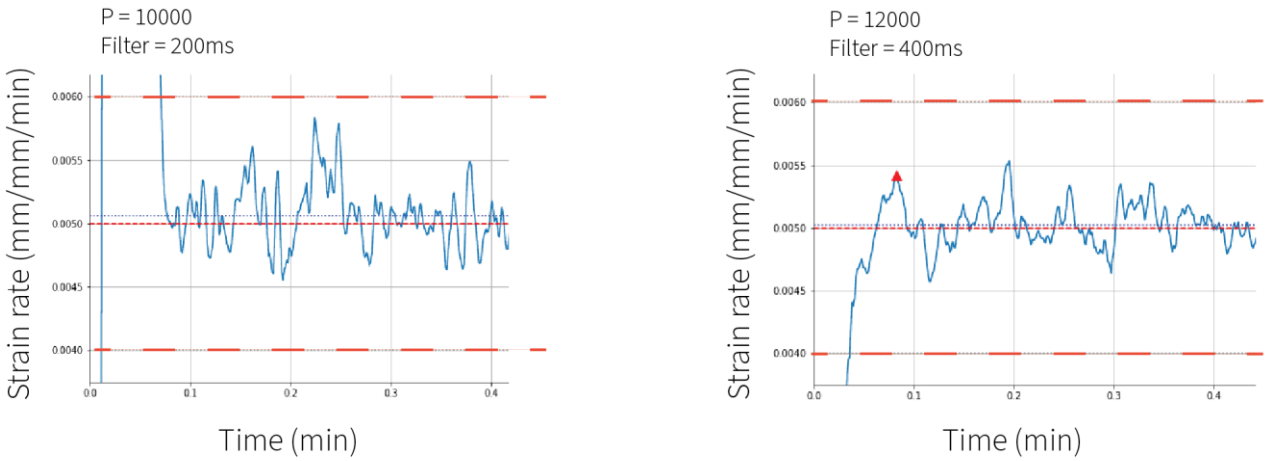
i. Apply a Suitable Level of Filtering

- Use the filtering methods provided by the test frame software to minimise noise created by convection currents. A minimum of a 200ms rolling average window filter shall be used. to maintain IS0 9513 class 0.5 / ASTM E83 class B-1 for all axial gauge lengths up to 350˚C. Controllers sampling below 1KH may require a larger filter window size.
- For transverse measurements at temperatures between >175˚C <350˚C consider increasing the filtering by a factor of 3x.

ii. Setting Proportional Gain Values for Closed-Loop Control

For strain rate control applications at elevated temperatures, gain settings must be adjusted from the values used at ambient temperature First-time users of Vector should establish good results at ambient before attempting strain rate control at elevated temperatures. Use the values at ambient as a basis:

- Proportional Gain: As a general guide, increase the gain by 5% for every 85˚C. This increase in gain is relative to the gain values set for ambient testing.
- Filtering: Signal filtering can be increased slightly to improve stability. It is not recommended to exceed a filtering level of 500ms



Temp = 350°C, Gauge Length = 50mm,

iii. Modulus calculation

A linear fit (e.g. least-squares regression) is recommended for the elastic region before calculating the modulus.