

Evaluation of material cleanliness with the particle emission tribometer (PET)

Materials used in cleanrooms must fulfil strict specifications regarding their cleanliness and contamination potential. Cleanliness suitability covers various contamination potentials from particle emission, outgassing, electrostatic properties and cleanability through to chemical resistance. Particulate contamination in particular plays a central role in the selection of materials and is dealt with exclusively in cleanroom suitability as part of cleanliness suitability.

Of particular interest is the number of particles present in a classified cleanroom (e.g. in accordance with ISO 14644-1:2015), as a high number of particles can be problematic in a wide range of applications (e.g. semiconductor technology, medical technology, etc.) and can lead to a reduction in the quality of a product or to a deterioration of a process. Figure 1 shows a picture of the analytical instrument with which the corresponding material samples can be measured.

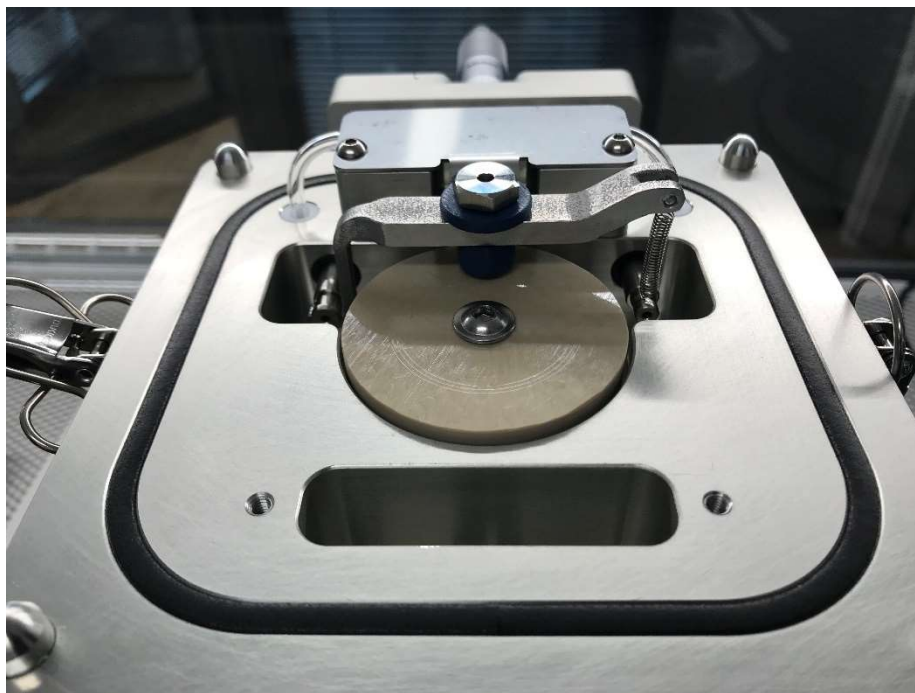


Figure 1: Partikel emissions triometers (PET) in the Materiales laboratory

Particles are usually created by the relative movement of two materials in relation to each other, which formally represents a tribological load situation. An analytical method for determining the quantity of particles produced in such processes is helpful to provide a corresponding assessment of the quality of the process.

In collaboration with the Competence Centre Tribology Mannheim, Materiales GmbH has developed the **particle emission tribometer** (PET) based on VDI 2083 Sheet 17, which can be used to test materials under

tribological stress to provide a comparable and reproducible basis for selecting materials for cleanroom environments.

The determination of particle emission and friction coefficients of a material pair under tribological load takes place in a defined closed volume to enable classification more reliable and easier. In contrast to similar systems, this test bench is therefore able to carry out measurements without a surrounding clean room and determine the particles per unit volume much more accurately.

The tests can be carried out with a ball-on-disc or a pin-on-disc measuring geometry. This has the advantage that test specimens can be easily prepared and thus theoretically any combination of materials can be tested. The test principle is simple and fast and allows comparative testing of many materials within a short time.

The counter body is fixed in a lever. Depending on the requirements, different measuring conditions can be selected by varying the load and speed to come as close as possible to the desired application. To prevent contamination from the outside, the tribometer is encapsulated with a cover. Compressed air is used to measure all particles generated during the process. The material samples are inserted into the upper part of the device in the form of a custom-made perforated disc.

Particle counting is carried out using a commercially available particle counter that records six different particle sizes ($>0.3 \mu\text{m}$, $>0.5 \mu\text{m}$, $>1.0 \mu\text{m}$, $>3.0 \mu\text{m}$, $>5.0 \mu\text{m}$ and $>10 \mu\text{m}$).

Due to its simplicity and variability, the PET offers the potential to compare and evaluate a wide variety of materials and material combinations in the shortest possible time. The test methodology allows contamination aspects to be considered in the material selection process for cleanroom applications and can therefore be a valuable tool for application-orientated material design in your developments. Do you have any questions? Please do not hesitate to contact us.