

## **Executive summary**

An European research project “Protective clothing for use in the manufacturing of electrostatic sensitive devices (ESTAT-Garments)” was running in March 2002 - February 2005 with an aim to supply the standards body IEC TC101 (Electrostatics) with a basis to qualify the effectiveness of clothing used for the ESD-safe handling (commonly named ESD-garments) of ESD (ElectroStatic Discharge) sensitive devices and to develop appropriate test methods for the characterisation of such ESD protective garments. The approach was aimed at achieving an understanding of the electrophysical processes regarding composite textile materials as well as the total system, including the sensitive devices. This means that the project also offered the following objectives: 1) a physical basis for understanding the electrostatic processes within composite materials at large (i.e. not just the ones used for ESD-garments preparation), 2) an understanding of the complete system (operator, ordinary clothing, ESD-garments, ESD sensitive electronics), 3) providing results for manufacturers of garments and yarns to give them an incentive for product improvements.

The main purpose of ESD-garments in electronics industry is to minimise risks of ESD failures to sensitive electronics due to charged operator's clothing. Any good test method for ESD protective garments should assess garment's ability to provide ESD protection. A lot of effort was paid for the assessment of risks for ESD damage of electronic components with reference to garments. In addition to the study of failure mechanisms and thresholds for damage of novel electronic devices, electrostatic processes on and in ESD fabrics, related to electrostatic discharges, were studied. The studies resulted in a list of potential factors which should be taken into account when evaluating test methods for ESD garments as well as for garment fabrics.

Existing test methods for ESD garments and garment fabrics were evaluated in the project. The results showed that current resistance based standard test methods do not satisfactory characterise the protective performance of modern ESD garments. That launched the second phase of the project: development of new test methods and modification of potential existing test methods. The development work lead to interlaboratory (round robin) tests where the reproducibility and repeatability of the new and/or modified test methods were studied. Totally 9 laboratories took part in the interlaboratory tests.

The results of the project were summarised in a written document "Recommendations for the use and test of ESD protective garments in electronics industry" (VTT Research report BTUO45-051338, available at <http://estat.vtt.fi>, as well as all the other project publications). The report has been submitted to IEC TC101 experts to support TC101 standardisation projects.

In brief, the following test methods are recommended by the ESTAT-Garments project team for further consideration as international standardised test methods for ESD garments in electronics industry:

- the conventional point-to-point resistance measurement method
- the ESTAT-Garments system level test method: Measurement of the charge decay time of ESD protective garments
- the EN 1149-3 Method 1 for the measurement of chargeability of garment material.
- the EN 1149-3 Method 2 for the evaluation of garment material's electrostatic shielding performance, and
- the ESTAT-Garments test method: Measurement of a direct discharge from an ESD protective material, such as an ESD garment / fabric.

Two of the five test methods were developed in the ESTAT-Garments project.