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Micro injection moulding process validation for high precision manufacture of thermoplastic elastomer micro suspension rings

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Abstract

Micro injection moulding (μ IM) is one of the most suitable micro manufacturing processes for flexible mass-production of multi-material functional micro components. The technology was employed in this research used to produce thermoplastic elastomer (TPE) micro suspension rings identified as critical component in micro acoustic applications (e.g. phono cartridges, see Figure 1a). The suspension ring holds in place the preassembled aluminium cantilever, magnet and diamond tip seen (see Figure 1b and 1c). The specific damping properties of the TPE material reduces vibrations differently depended on the frequency in order to improve the signal quality and assure acoustic reproduction fidelity. Production quality of the TPE rings drastically influence the product functionality.

In the present study, a procedure for μ IM TPE micro rings production optimization has been established. The procedure entail using the tool geometry as reference calibrated artefacts to establish optimal process operating conditions, enabling production of parts within specification. The μ IM process window with respect to the target tolerances and dimensions has been verified (see nominal dimensions in Figure 1d) with respect to 3 main μ IM process parameters (melt temperature, injection speed, packing pressure) using the Design of Experiment statistical technique. Measurements results demonstrated the importance of calibrating mould's master geometries to ensure correct part production and effective quality conformance verification.

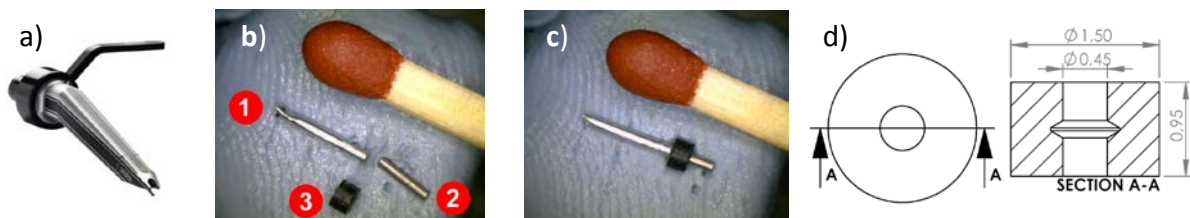


Figure 1: a) High performance phono cartridge; b) 1 - aluminium cantilever with diamond tip, 2 - magnet rod, 3 - rubber suspension ring; c) assembled micro components; d) suspension ring nominal dimensions.