Specification and measurement of extrusion die dimensions in ISO 11443 Plastics - Determination of the fluidity of plastics using capillary and slit-die rheometers

The standard ISO 11443 specifies that capillary dies shall be made to an accuracy of ± 0.007 mm in diameter and ± 0.025 mm in length, and that slit dies shall be to an accuracy of ± 0.007 mm in thickness, ± 0.025 mm in length and ± 0.01 mm for width. These tolerances shall be adhered to along the entire length of the die.

Methods of calibrating and checking capillary die dimensions are varied. For capillary dies the internal bore of the die can be calibrated along its entire length using split ball probes, for example see www.diatest.com. The split ball probes can themselves be calibrated using calibrated setting rings. It is necessary to calibrate the probe using at least two setting rings that are larger and smaller in diameter than the die bore to be measured. This method however is restricted to dies of diameter typically 0.5 mm and above.

The use of go/no-go gauges alone does not provide a calibration fully compliant with ISO 11443 - it does not ensure that the diameter along the entire length of the bore is within tolerance. The use of go/no-go gauges will not identify whether the diameter of the bore away from its ends is within the upper limit of diameter. They will only confirm that the bore is greater than the lower diameter limit along its entire length, and that at its ends the bore's diameter is less than the upper limit. The use of go/no-go gauges are however very useful in provide a quick and easy check of the diameter of the die bore. Similarly optical methods of calibration, using for example a travelling microscope or microscope with moveable stage will only permit the determination of the die bore at its ends.

Replicating fluid, pumped into the bore of the die, allowed to set and then withdrawn thereby producing a mould of the bore of the die, can be used in conjunction with optical microscopy to determine the diameter of the bore along its entire length. However, there is need to check the shrinkage behaviour of the replicating fluid and correct for it as appropriate. This method has been used for 0.25 mm diameter dies.

Replicating fluid is available, for example, available from Struers www.struers.com - "RepliSet-F5" a fast curing two-part silicon rubber compound for flexible high-resolution replicas.

Slit dies are generally easier to calibrate using, for example, Vernier callipers and/or micrometers, depending on the construction of the die.

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