

# CONSIDERATIONS ON THE PRODUCTION OF MICRO AND PRECISION PIM PARTS

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An important influencing factor in powder injection moulding effecting considerably the applicability of the whole manufacturing technique is the achievable part precision after sintering.

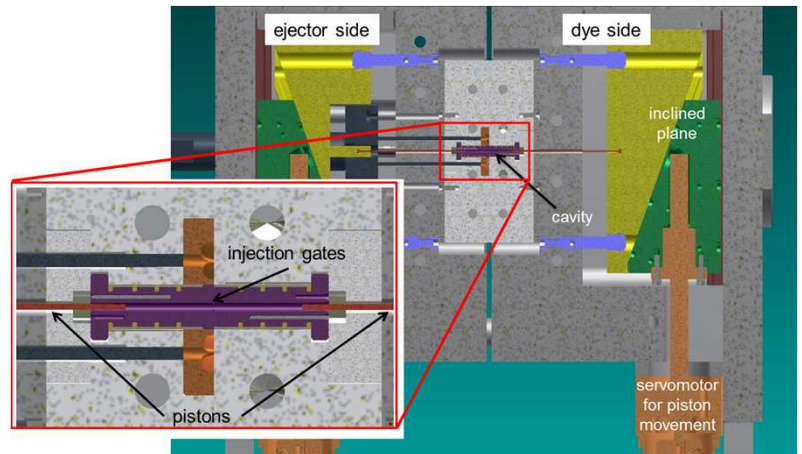
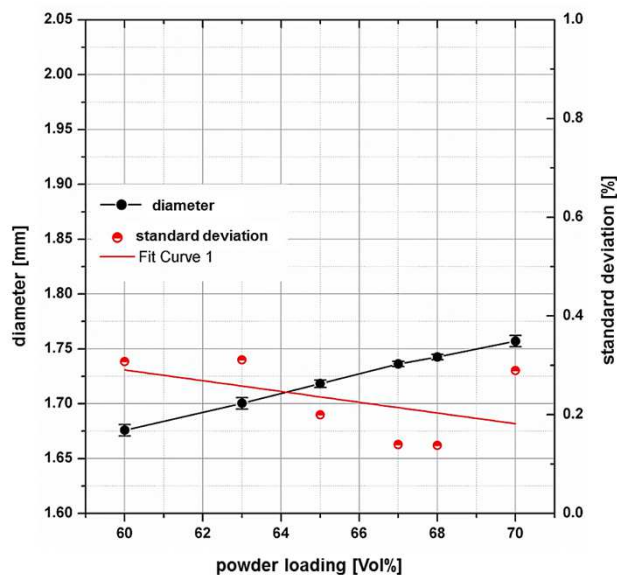
To investigate interactions of parameters and influences of process conduct a research tool with two movable pistons had been build. One result was that the powder loading showed a positive effect on accuracy up to about 68Vol% for a typical 17-4 PH feedstock. Crossing this boarder influence became detrimental.

Further trials showed that subsequent compression by piston movement led to significantly smaller membrane thicknesses compared to cavity filling by injection only.

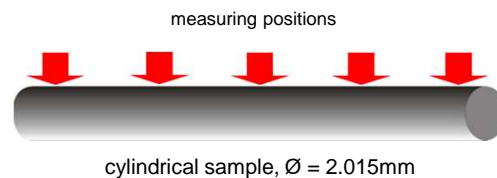
## Influence of powder loading

For these trials a simple cylinder geometry which can be regarded as a quasi full material sample had been chosen.

As feedstocks different formulations containing 60Vol% to 70Vol% 17-4PH steel powder ( $d_{50}$  ca.  $4\mu\text{m}$ ) mixed with a typical MicroPIM binder system had been used.



schematic drawing of twin-piston tool



cylindrical sample,  $\varnothing = 2.015\text{mm}$

Experiments revealed that best accuracies can be reached if the injected feedstock pushes back the piston in a quasi balanced force state.

To investigate influence of the powder loading the mean diameters and standard deviations had been determined as a function of the powder content: Diameters increased whereas S.D. decreases. If powder loading approaches 70Vol% accuracy drops down. i.e. a critical filler content has been reached here.

## Parts with thickness variation

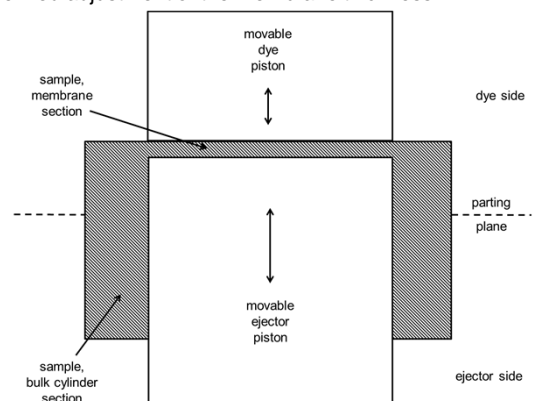
To investigate filling behaviour and dimensional accuracies a new samples design had been created: A massive cylindrical ring with a thin membrane on the top. The challenge was to produce membranes as thin as possible and investigate the square sections and reproducibility of thickness profiles. The pistons enabled a subsequent compression of the feedstock in the membrane cavity and a defined adjustment of the membrane thickness.

The process conduct had been defined like that:

- Pull back the piston to provide a relatively wide membrane cavity
- Fill this cavity by injection of feedstock
- Push the piston forward up to the final small membrane thickness

Results of the first trials showed that:

- Membrane filling only by injection is possible down to thicknesses of ca.  $400\mu\text{m}$
- Using the injection+compression process smallest membrane thicknesses reached so far are in the range of  $250\mu\text{m}$  after sintering.



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