Micro-Moulding
Battenfeld Injection Molding

Part volume:
0.00065 cm³
(Shot volume 0.07 cm³)

the innovative solution for microprecision parts
Microsystem

Micro-Moulding

the innovative system solution for moulding of micro precision parts

Too small for conventional injection moulding machines

Quelle/Source: Battenfeld, Horst Scholz GmbH & Co. KG
Microsystem

contents

1. Market
2. Concept Microsystem
3. Injection process
4. Basic modules
5. Options
6. Mould technology
7. Materials
8. Applications
9. Benefits / Summary
Microsystem

Market
Microsystem

market trend: reduction of part weights < 0.1 g

micro precision parts

Why downsizing products?
- less weight
- smaller dimensions
- with more functions
- less energy consumption
- new products
- needs high precision
Microsystem

which markets need micro parts

- Automotive
  - Micro switch, sensors, ABS-Systems
- Computer
  - Head of an ink-jet printer
- Telecommunication
  - Mobile phone, MID
- Connectors
  - Plug connectors, opto couplers
- Electronics
  - Micro parts on circuit boards
- Micro-equipment
  - Valve technology
- Medical technology
  - Hearing aids, implants, biodegradable
- Sensors
  - Airbag sensors, sensor disk
- Micromechanics
  - Micro motors, rotors
- Optics
  - Lenses, displays
- Watches
  - Gear wheels, latches, micro transmissions
- Glass fiber conductors
  - Ferrules, connectors
- Microstructure
  - Lab on the Chip, data carrier
- Precise suppliers
  - Various parts
- Special materials
  - PIM (MIM / CIM), PTFE
- Institutes, Universities
  - Material-, technology research
Comparison of different studies from 1996 to 2000:
(Source: research center Karlsruhe)
Concept Microsystem
Microsystem

Battenfeld MICROSYSTEM 50
concept solution for the micro moulding market

- complete manufacturing cell
- designed and optimized for part weights < 1g
- B4 fully closed loop control
- closed clean-room production cell
- all electric servo drives
- high dynamic process
- fast cycle
- optimized mould technology
- modular design:
  - injection module
  - clamp module
  - rotary table module
  - automatic part handling module*,
  - optical quality control module*,
  - clean-room module*,
  - storage packing module*
  - and various other options

*optional

Quelle/Source: Battenfeld
Microsystem

time line Battenfeld MICROSYSTEM 50

- project start March 1997
- first study presentation June 1998
- K98 3 machines running Oct. 1998
- customer trials Feb. 1999
- revision, Marketing Aug. 1999
- selling release FAKUMA 99 Oct. 1999
- optimization until Jan. 2000
- first sold MICROSYSTEM Feb. 2000
- 100 sold MICROSYSTEMS in more than 20 countries worldwide June 2006
Microsystem

production lines with Microsystem 50 (D, UK)
Microsystem

different approaches to produce micro parts

standard technology
- slow process
- large moulds
- large sprues
- high energy consumption
- part free falling
- quality check afterwards
- peripheral technology oversized

micro technology
- high dynamic process
- optimized mould technology
- small sprues
- efficient energy consumption
- integrated part handling
- automatic quality assurance
- adjust peripheral technology
### Microsystem

**single step system**  
standard technology – down scaled technology  
standard injection mould machines for small pieces

<table>
<thead>
<tr>
<th>manufacter + type</th>
<th>clamping force [kN]</th>
<th>injection unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arburg GmbH &amp; Co. KG Allrounder 170 U</td>
<td>123 – 180</td>
<td>Screw diameter 15 mm</td>
</tr>
<tr>
<td>Battenfeld Kunststoffmaschinen GmbH HM 250 Micromelt</td>
<td>250</td>
<td>Screw diameter 14 mm</td>
</tr>
<tr>
<td>Dr. Boy GmbH &amp; Co. KG Boy 12 A</td>
<td>129</td>
<td>Screw diameter 12 mm</td>
</tr>
<tr>
<td>Demag Ergotech GmbH IntElect 50</td>
<td>500</td>
<td>Screw diameter 14 mm</td>
</tr>
<tr>
<td>Engel Austria GmbH E-Motion (X-Melt)</td>
<td>550</td>
<td>Precompression of the melt</td>
</tr>
<tr>
<td>Krauss-Maffei-Kunststofftechnik GmbH KM 35-55 CX</td>
<td>350</td>
<td>Screw diameter 15 mm</td>
</tr>
<tr>
<td>Mitsui Machine Tool – Fanuc Roboshot S-2000i 5A</td>
<td>50</td>
<td>Screw diameter 14 mm</td>
</tr>
<tr>
<td>Sumitomo Plastics-Machinery SE18D</td>
<td>180</td>
<td>Screw diameter 14 mm</td>
</tr>
<tr>
<td>Toshiba Machine Co. EC20P-0.4</td>
<td>200</td>
<td>Screw diameter 16 mm</td>
</tr>
</tbody>
</table>

Quelle/Source: FZ Karlsruhe
Microsystem

single step system
standard technology – down scaled technology

thermal separation of sprue and melt cushion, creates each cycle a cold material slug at on the nozzle tip

- large melt cushion
- cold material slug on the nozzle
- long flow length
- 1 mg shot weight needs 0,0056 mm stroke on a 14 mm screw
- difficult to control small shot weight
two step system
semi micro technology - split plasticizing and injecting
screw-piston-machines for microparts

<table>
<thead>
<tr>
<th>manufacturer + type</th>
<th>clamping force [kN]</th>
<th>injection unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cronoplast, sl bzw. ICH- Christmann Babyplast 6/10</td>
<td>62</td>
<td>Preplastification 1 Piston 10/12/14/16/18 mm</td>
</tr>
<tr>
<td>Ettlinger Kunststoffmaschinen GmbH D-I-M</td>
<td>100</td>
<td>1 Extruder 16/20 mm 1 Piston 6/8/10 mm</td>
</tr>
<tr>
<td>Ferromatik Milacron GmbH K-TEC</td>
<td>&gt; 400</td>
<td>1 Extruder 18 mm 1 Piston 7/9/11 mm</td>
</tr>
<tr>
<td>Kunststoff-Zentrum Leipzig GmbH formicaPlast M2</td>
<td>10</td>
<td>Piston-Preplastification 1 Piston 3 mm</td>
</tr>
<tr>
<td>Sodick Plustech Co., Ltd. TR05EH</td>
<td>49</td>
<td>1 Extruder 14 mm 1 Piston 12 mm</td>
</tr>
</tbody>
</table>

Quelle/Source: FZ Karlsruhe
Microsystem

two step system

semi micro technology - split plasticizing and injecting

thermal separation of sprue and melt cushion, creates each cycle a cold material slug at on the nozzle tip

- large melt cushion
- cold material slug on the nozzle
- injection of thermal inconsistent material
- long flow length
Microsystem

three step system
micro technology - split plasticizing, dosing and injecting
screw–piston-machines for precise, small micro parts

<table>
<thead>
<tr>
<th>manufactor + type</th>
<th>clamping force [kN]</th>
<th>injection unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battenfeld Kunststoffmaschinen GmbH</td>
<td>50</td>
<td>1 Extruder 14 mm</td>
</tr>
<tr>
<td>Microsystem 50</td>
<td></td>
<td>2 Pistons 5 (3) mm</td>
</tr>
</tbody>
</table>

Quelle/Source: FZ Karlsruhe
Microsystem

three step system
micro technology - split plasticizing, dosing and injecting

- very small melt cushion
- no cold material slug
- injection of thermal homogeneous material
- very short flow length

The Microsystem 50 is the only system which is designed and optimized for part weights below 100 mg
Microsystem

comparison melt cushion

**standard technology**

- sprue: 0.9 cm³
- melt cushion: 5.2 cm³
- slug: 0.15 cm³

**micro technology**

- sprue (melt cushion): 0.13 cm³

melt cushion + slug + sprue: 6.25 cm³

**melt cushion ratio**

\[
\frac{\text{standard}}{\text{micro}} \approx \frac{48}{1}
\]
Microsystem

comparison sprue size

standard technology
sprue weight: 1.000 – 2.500 mg

micro technology
sprue weight: 50 - 200 mg

sprue weight ratio = \( \frac{\text{standard}}{\text{micro}} \) \approx \frac{20}{1}
Microsystem

sprue dimension of the Microsystem 50

Quelle/Source: Battenfeld
Microsystem

comparison injecting process

standard and semi micro technology optimization only on machine side disadvantage:
- Large melt cushion
- Cold material slug on the nozzle
- Long flow length

micro technology optimization of machine and mould advantage:
- very small melt cushion
- no cold material slug
- very short flow length
Injection process
Microsystem

development philosophy

standard injection molding screw combines all functions in one

MICROSYSTEM is splitting the functions for the most ideal solution per function without any compromise
Microsystem

injection process

- nozzle
- mounting plate
- sprue
- moulded part
- pressure sensor piston
- dosing sleeve
- extruder screw
- shut-off valve
- injection piston
- heater
- mould
- Machine
Microsystem

injection process
# Microsystem

## comparison switch - over time

<table>
<thead>
<tr>
<th>Machine type</th>
<th>Dimensions Ø mm</th>
<th>Injection velocity</th>
<th>Switch –over time till complete stop</th>
<th>Deceleration-stroke</th>
<th>Deceleration-volume</th>
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<tr>
<td>Hydraulic machine</td>
<td>14 screw</td>
<td>250 mm/s</td>
<td>40 ms</td>
<td>5,0 mm</td>
<td>770 mm³</td>
</tr>
<tr>
<td>Elektric drive Microsystem</td>
<td>5 plunger</td>
<td>250 mm/s</td>
<td>6 ms</td>
<td>0,75 mm</td>
<td>15 mm³</td>
</tr>
<tr>
<td>Elektric drive Microsystem with forecast pressure control (closed loop control)</td>
<td>5 plunger</td>
<td>250 mm/s</td>
<td>forecast pressure control system: Control deceleration to target pressure without over shooting target pressure</td>
<td>0 mm</td>
<td>0 mm³</td>
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</table>
# Microsystem

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### Diagram Description:

- **Velocity injection motor** 250 mm/s
- **Forecast pressure control system Microsystem**
- **Start for pressure control**
- **Cavity fillet**
- **Cavity start fill**
- **Mould pressure** 800 Bar
- **Target mould pressure**
- **Deceleration injection motor**
- **End pressure control**
- **Switch – over time till complete stop** 6 ms = 0.006 second

Quelle: Battenfeld
## Microsystem

### comparison switch - over time

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<td>0 mm³</td>
</tr>
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![Graph showing injection speed vs. injection volume for Mikrosystem 50 and Hydraulic machine.](image-url)
Microsystem

micromechanical parts

- part: Housing
- material: POM
- Wall thickness: 0.08mm
Microsystem

benefits injection module

- All standard granulate sizes are possible because of the 14 mm screw
- Stress free plasticization and dosing in a low pressure area (max. 1.1 cm³)
- Each shot new dosing with new raw material and an accuracy of 1 mm³
- Material acceleration to end speed before injection (max. 760 mm/sec.)
- Shortest runners and gates => process conditions near the cavity
- Rigid injection system without “pumping“ in the injection process
- Injection of thermal homogeneous material
- Deceleration volume of the injection unit approx. 2 mm³ (at 250 mm/sec.)
- High processing security and excellent reproducibility results
- Minimum of pressure lost (max. 2500 bar)
- Cycle time dry from 1.5 sec. (standard projects between 2 and 5 sec.)
Microsystem

Size of injection unit, plasticizing and injection components

Quelle/Source: Battenfeld
Microsystem

Size of Microsystem plasticization screws:

- 14 mm PIM screw Microsystem 50
- 14 mm MICROMELT
- 14 mm standard screw Microsystem 50
- 12 mm special powder application Microsystem 50
Basic Modules
Microsystem basic modules

- **injection module**
  Four-level servo-electrical and mechanical combination

- **clamping module**
  Clamping force 50 kN
  Positioning precision 0.01 mm

- **rotary table module**
  Parallel function of injecting and ejecting
Microsystem

UNILOG B4 controller – strong and flexible

- screen:
  large, high-resolution 10.4" color screen

- operation:
  universal Windows™-style user platform for all machine models

- quality assurance:
  detailed process documentation and monitoring

- storage of data:
  on 3½“ floppy disk

- safety:
  password system
Options
Microsystem extract from optional modules

**Handling module**
Parts deposit separated cavity by cavity, velocity 2 m/sec.

**Clean-room module**
Until ISO class 100 in the working area

**Storage packing module**
Blister strap with protective foil or trays with automatic changer

Quelle/Source: Battenfeld
Microsystem

Production with Microsystem

Micro-Gear part weight 0,0008 g material POM
Microsystem

Video-quality control system

**hardware**
- separate CPU
- LCD-Touch screen
- UPS electric supply
- special I/O-card
- 1 up to 4 cameras
- camera high resolution
- objective (Lens)
- lighting
- installation
- connection with B4

**software**
- sherlock 32
- IMAGING technology
- optical high speed-quality control system

*Quelle/Source: Battenfeld*
Mould Technology
Microsystem

mould technology for micro parts
Microsystem

Micro mould for Microsystem 50

2-cavity mould, changeable insert system, Test bar

Quelle/Source: Battenfeld
Microsystem

Micro mould for Microsystem 50

Quelle/Source: Battenfeld
Microsystem

Micro mould for Microsystem 50
### Injected* materials on the Microsystem 50

<table>
<thead>
<tr>
<th>STANDARD</th>
<th>OPTICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>• PP Polypropylene</td>
<td>• PC Polycarbonate</td>
</tr>
<tr>
<td>• PE Polyethylene</td>
<td>• PMMA Polymethylmethacrylate</td>
</tr>
<tr>
<td>• PS Polystyrene</td>
<td>• COC Cycloolefin Copolymer</td>
</tr>
<tr>
<td></td>
<td>• PSU Polysulfone</td>
</tr>
<tr>
<td></td>
<td>• SAN Styrene-Acrylnitril</td>
</tr>
<tr>
<td></td>
<td>• PETG Polyethylene terephthalate</td>
</tr>
<tr>
<td>TECHNICAL</td>
<td>POWDER</td>
</tr>
<tr>
<td>• POM Polyoxymethylene</td>
<td>• MIM Metal Injection Molding</td>
</tr>
<tr>
<td>• PA Polyamide</td>
<td>• CIM Ceramic Injection Molding</td>
</tr>
<tr>
<td>• ABS Acrylnitrid-Butadiene-Styrene</td>
<td></td>
</tr>
<tr>
<td>• PBT Polybutyleneterephthalate</td>
<td>MEDICAL</td>
</tr>
<tr>
<td>• PPS Polyphenylensulfide</td>
<td>• PDLL Bio lactate</td>
</tr>
<tr>
<td>• LCP Liquid Crystal Polymer</td>
<td></td>
</tr>
<tr>
<td>• PEEK Polyetheretherketone</td>
<td></td>
</tr>
<tr>
<td>• ETFE Ethylene / Tetrafluorethylene</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ELASTOMER</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• TPE Thermoplastic Elastomere</td>
<td></td>
</tr>
<tr>
<td>• TPU Thermoplastic Urethane</td>
<td></td>
</tr>
</tbody>
</table>

* Extract

Quelle/Source: Battenfeld
Microsystem Applications
## Micromechanical parts

<table>
<thead>
<tr>
<th>Part</th>
<th>Material</th>
<th>Mold</th>
<th>Part volume</th>
<th>Shot volume</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Locking lever</strong></td>
<td>POM</td>
<td>2-cavity, 3-plate gating</td>
<td>0,00070 cm³ / 0,70 mm³</td>
<td>0,093 cm³ / 93 mm³</td>
<td>Micromechanical, micro</td>
</tr>
<tr>
<td><strong>Latch</strong></td>
<td>POM +15% GF</td>
<td>2-cavity, 3-plate gating</td>
<td>0,0026 cm³ / 2,6 mm³</td>
<td>0,100 cm³ / 100 mm³</td>
<td>Watch-industry</td>
</tr>
<tr>
<td><strong>Catch wheel</strong></td>
<td>PA +20% GF</td>
<td>4-cavity, 2-plate gating</td>
<td>0,0053 cm³ / 5,3 mm³</td>
<td>0,112 cm³ / 112 mm³</td>
<td>Micro switch</td>
</tr>
</tbody>
</table>
Micro system

**Micro gear wheel**

<table>
<thead>
<tr>
<th>Part</th>
<th>Dented wheel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material: POM</td>
<td>4-cavity, 3-plate gating</td>
</tr>
<tr>
<td>Part volume: 0.00042 cm³ / 0.42 mm³</td>
<td>0,136 cm³ / 136 mm³</td>
</tr>
<tr>
<td>Shot volume:</td>
<td></td>
</tr>
<tr>
<td>Application: Watch industry</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part</th>
<th>Rotor with gear wheel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material: POM</td>
<td>4-cavity, 3-plate gating</td>
</tr>
<tr>
<td>Part volume: 0.0007 cm³ / 0.7 mm³</td>
<td>0,132 cm³ / 132 mm³</td>
</tr>
<tr>
<td>Shot volume:</td>
<td></td>
</tr>
<tr>
<td>Application: Watch industry</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part</th>
<th>Gear wheel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material: POM</td>
<td>x-cavity, 3-plate gating</td>
</tr>
<tr>
<td>Part volume: 0.040 cm³ / 40.0 mm³</td>
<td>--- cm³ / --- mm³</td>
</tr>
<tr>
<td>Shot volume:</td>
<td></td>
</tr>
<tr>
<td>Application: Micro gear</td>
<td></td>
</tr>
</tbody>
</table>

Quelle/Source: Battenfeld, Rolla Micro-Synthetics AG, Horst Scholz GmbH & Co. KG
Micro system

Micro gear wheel

<table>
<thead>
<tr>
<th>Part</th>
<th>Spur wheel</th>
<th>PA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material:</td>
<td>x-cavity, x-plate gating</td>
<td></td>
</tr>
<tr>
<td>Part volume:</td>
<td>--- cm³ / --- mm³</td>
<td></td>
</tr>
<tr>
<td>Shot volume:</td>
<td>--- cm³ / --- mm³</td>
<td></td>
</tr>
<tr>
<td>Application:</td>
<td>Electrical technology</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part</th>
<th>Spiral gear</th>
<th>PPT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material:</td>
<td>x-cavity, x-plate gating</td>
<td></td>
</tr>
<tr>
<td>Part volume:</td>
<td>--- cm³ / --- mm³</td>
<td></td>
</tr>
<tr>
<td>Shot volume:</td>
<td>--- cm³ / --- mm³</td>
<td></td>
</tr>
<tr>
<td>Application:</td>
<td>Electrical technology/metrology</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part</th>
<th>Worm wheel</th>
<th>PPT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material:</td>
<td>x-cavity, x-plate gating</td>
<td></td>
</tr>
<tr>
<td>Part volume:</td>
<td>--- cm³ / --- mm³</td>
<td></td>
</tr>
<tr>
<td>Shot volume:</td>
<td>--- cm³ / --- mm³</td>
<td></td>
</tr>
<tr>
<td>Application:</td>
<td>Electrical technology/metrology</td>
<td></td>
</tr>
</tbody>
</table>
Micro filter / medical industry

Part:
Micro filter 40µm mesh size
Material: POM
Mold: 2-cavity, 3-plate gating
Part volume: 0.00056 cm³ / 0.56 mm³
Shot volume: 0.091 cm³ / 91 mm³
Application: Medical industry, acoustics

Part:
Micro filter 80µm mesh size
Material: POM
Mold: 2-cavity, 3-plate gating
Part volume: 0.00063 cm³ / 0.63 mm³
Shot volume: 0.092 cm³ / 92 mm³
Application: Medical industry, acoustics

Part:
Micro filter
Material: POM
Mold: 2-cavity, 3-plate gating
Part volume: 0.0039 cm³ / 3.9 mm³
Shot volume: 0.288 cm³ / 288 mm³
Application: Medical industry, hearing aid
Microsystem

Mould insert for a 40µm filter
Microsysstem

Micro parts for medical industry

Implantable clip
Part: Implantable clip
Material: bio-degradable
Mold: 1-cavity, 3-plate gating
Part volume: 0,011 cm³ / 11,0 mm³
Shot volume: 0,037 cm³ / 37 mm³
Application: Medical industry

Bearing shell / bearing cap
Part: Bearing shell / bearing cap
Material: PEEK
Mold: 1+1-cavity, 2-plate gating
Part volume: 0,006 / 0,013 cm³
6,0 / 13 mm³
Shot volume: --- cm³ / --- mm³
Application: Medical industry

Sensor housing implantable
Part: Sensor housing implantable
Material: POM
Mold: 2+2-cavity, 3-plate gating
Part volume: 0,0037 cm³ / 3,7 mm³
Shot volume: 0,159 cm³ / 159 mm³
Application: Medical industry, hearing aid

Quelle/Source: Battenfeld, Aesculap AG & Co. KG, Horst Scholz GmbH & Co. KG
Microsystem

Micro parts for medical industry

Part: Impeller
Material: PEEK
Mold: 1-cavity, 3-plate gating
Part volume: --- cm³ / --- mm³
Shot volume: --- cm³ / --- mm³
Application: Medical
intercardial pump system

Part: vascular clamp
Material: bio-resorbable
Mold: 4-cavity, 3-plate gating
Part volume: 0.005 cm³ / 5 mm³
Shot volume: 0.124 cm³ / 124 mm³
Application: Medical clamp

Quelle/Source: Horst Scholz GmbH & Co. KG
## Micromechanical parts

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<th>Mold</th>
<th>Part volume</th>
<th>Shot volume</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating pin</td>
<td>LCP</td>
<td>4 and (8)-cavity, 2-plate gating</td>
<td>0.012 cm³ / 12.0 mm³</td>
<td>0.077 cm³ / 77 mm³ (0.125 cm³ / 125 mm³)</td>
<td>Micro switch</td>
</tr>
<tr>
<td>Gear plate</td>
<td>POM</td>
<td>x-cavity, x-plate gating</td>
<td>--- cm³ / --- mm³</td>
<td>--- cm³ / --- mm³</td>
<td>Motive power engineering</td>
</tr>
<tr>
<td>Sleeve</td>
<td>PEEK</td>
<td></td>
<td>0.15mm</td>
<td>0.001gr</td>
<td></td>
</tr>
</tbody>
</table>
Microsystem

Multicolor micro parts / Insert micro parts

Part: Coax plug / switch MID
Material: LCP / LCP (two-color injection molding)
Mold: 8-cavity, 2-plate gating
Part volume: 0.051 cm³ / 51 mm³
(0.03 cm³ / 3 mm³)
Shot volume: 0.529 cm³ / 529 mm³
(0.141 cm³ / 141 mm³)
Application: Mobile phone

Part: Plate
Material: POM
Mold: 4-cavity, 3-plate gating
Part volume: --- cm³ / --- mm³
Shot volume: --- cm³ / --- mm³
Application: Lifestyle

Part: Aseptic expendable precision blade
Material: XXX
Mold: x-cavity, x-plate gating
Part volume: --- cm³ / --- mm³
Shot volume: --- cm³ / --- mm³
Application: Medical industry
Micro connectors

- **SIM Card Connector**
  - Material: LCP
  - Mold: 4-cavity, 3-plate gating
  - Part volume: 0.072 cm³ / 72.0 mm³
  - Shot volume: 0.418 cm³ / 418 mm³
  - Application: Mobile phone

- **30-pin Connector**
  - Material: LCP
  - Mold: 4-cavity, 2-plate gating
  - Part volume: 0.026 cm³ / 26 mm³
  - Shot volume: 0.155 cm³ / 155 mm³
  - Application: Mobile phone

- **28pin-TL2 Micro Sub-connector**
  - Material: POM
  - Mold: 2-cavity, 2-plate gating
  - Part volume: 0.003 cm³ / 3 mm³
  - Shot volume: 0.098 cm³ / 98 mm³
  - Application: Medical industry, hearing aid
Mould inserts for a micro connector
Microsystem

**Optical micro parts**

<table>
<thead>
<tr>
<th>Part:</th>
<th>IR - Window</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material:</td>
<td>PC</td>
</tr>
<tr>
<td>Mold:</td>
<td>4+4 -cavity, 2-plate gating</td>
</tr>
<tr>
<td>Part volume:</td>
<td>0,058 / 0,053 cm³</td>
</tr>
<tr>
<td></td>
<td>58 / 53 mm³</td>
</tr>
<tr>
<td>Shot volume:</td>
<td>0,735 cm³ / 735 mm³</td>
</tr>
<tr>
<td>Application:</td>
<td>Mobile phone</td>
</tr>
</tbody>
</table>

Quelle/Source: Battenfeld, Perlos Oy
Microsystem

Micro structured micro parts

Part:
Material: PC
Mold: 1-cavity, 3-plate gating
Part volume: 0,153 cm³ / 153 mm³
Shot volume: 0,296 cm³ / 296 mm³
Application: Motive power engineering, sensor technology

Sensor disk structure 0,8µm
**Microsystem**

**Micro - PIM / MIM + CIM**

**Part:** Meander  
**Material:** MIM  
**Mold:** 1-cavity, 2-plate gating  
**Part volume:** 0,010 cm³ / 10 mm³  
**Shot volume:** 0,065 cm³ / 65 mm³  
**Application:** Micromechanics

**Part:** Gear wheel  
**Material:** MIM  
**Mold:** 1-cavity, 3-plate gating  
**Part volume:** --- cm³ / --- mm³  
**Shot volume:** --- cm³ / --- mm³  
**Application:** Micromechanics

**Part:** Test bar  
**Material:** MIM  
**Mold:** 1+ 1-cavity, 2-plate gating  
**Part volume:** 0,00045 / 0,00015 cm³  
0,45 / 0,15 mm³  
**Shot volume:** 0,10265 cm³ / 102,65 mm³  
**Application:** Trials
Microsystem

Stirrup material: high-grade steel 316L

Source: Fraunhofer IFAM Bremen, Krämer EngineeQuelle/ring
### Part: Microsystem

#### SM - Ferrules 125 µm diameter

<table>
<thead>
<tr>
<th>Material:</th>
<th>LCP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mold:</td>
<td>1-cavity, 3-plate gating</td>
</tr>
<tr>
<td>Part volume:</td>
<td>0,050 cm³ / 50,0 mm³</td>
</tr>
<tr>
<td>Shot volume:</td>
<td>0,260 cm³ / 260 mm³</td>
</tr>
<tr>
<td>Application:</td>
<td>Ferrules</td>
</tr>
<tr>
<td></td>
<td>Single mode &lt;= 1.0µm, Multi mode tolerance &lt;= 3.0 µm</td>
</tr>
</tbody>
</table>

### Part: Multi fiber, single mode Ferrules, development projects

<table>
<thead>
<tr>
<th>Material:</th>
<th>LCP</th>
</tr>
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<tr>
<td>Mold:</td>
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<td>Application:</td>
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</tr>
<tr>
<td></td>
<td>Single mode &lt;= 1.0µm, Multi mode tolerance &lt;= 3.0 µm</td>
</tr>
</tbody>
</table>
Micromechanical parts

Part: Housing
Material: LCP
Part weight: 0.0022g
Application: Micro switch
Microsystem

Benefits / Resume
Microsystem

The worldwide unique solution for micro precision parts:

1. **min. double quality** compared to conventional moulding
2. designed and optimized for part weights **below 100 mg**
3. **up to 80% material savings** due to sprue and part relation
4. **2/3 of energy savings** compared to conventional moulding
5. **350 times faster injection** than conventional moulding
6. **generally half the cycle time** compared to conventional moulding
7. advanced production cell due to **optimized mould technology, small footprint, all-in-one solution**

Quelle/Source: Battenfeld
Microsystem

MICROSYSTEM 50

An easy and secure way into the growing market of MST
Many things that seem obvious now were an impossible dream not too long ago.

And many things that seem impossible today might be reality soon.
Many thanks for your attention

More information under www.battenfeld-imt.com