| EUROMAP 5 | Injection moulding process<br>Determination of important production data<br>Manufacturing Report |
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(6 pages)

This **recommendation** has been prepared by the Technical Commission of EUROMAP.

## 1 Scope

In this recommendation procedures are described for the determination of important production data for the injection moulding process.

The important production data are mould related plasticizing flow, mould related injection capacity, specific mould related electric energy consumption and the output. These data are depending from all elements of the injection moulding process; mainly: moulding material, mould, injection moulding machine, ancillaries.

The manufacturing report provides the list of data to be recorded in order to ensure the reproduceability of the results.

## 2 Definitions

### 2.1 Mould related plasticizing flow

The mould related plasticizing flow (g/s) is the shot mass (g) divided by the plasticizing time (s).

### 2.2 Mould related injection capacity

Mould related injection capacity (g/s) is the shot mass (g) devided by the filling time (s) (without holding time).

### 2.3 Specific mould related electric energy consumption

The specific mould related electric energy consumption (Ws/g) is the total amount of electric energy (Ws) consumed by the injection moulding machine and all of its ancillaries, e.g. dryers, robots, hot-runners during one cycle divided by the shot mass (g).

2.4 Output

Output is the number of pieces moulded within one hour and is calculated according to:

$$0 = \frac{3600[s]}{\text{cycle time}} \cdot \text{number of cavities in the mould} \quad \text{(parts / h)}$$

## 3 Measuring method

The measurements shall be taken when the injection moulding machine and the mould have reached stable running conditions and the requested specifications of the moulded parts are met. The shot mass, the plasticizing times, the injection times and the energy consumed shall be determined over a continuous period of time of at least 15 minutes comprising at least 25 cycles. The arithmetic mean shall be found from the individual measurements.

## 4 Manufacturing report for injection moulding parts

| | **Description** | **Explanation** | **Unit** |
|---|---|---|---|
| **1.** | **Injection moulded part** | | |
| 1.1 | Description | e.g. cog-wheel, housing, lid, cup; drawing or in certain circumstances photograph of the part | |
| 1.2 | Shot mass | Mass of the total shot, including the sprue | g |
| 1.3 | Mass of the moulded part(s) | Mass of the moulded part(s) after removal of the sprue, produced in one cycle | g |
| 1.4 | Wall thickness<br>from..... to..... | Wall thickness of the moulded part(s) at its thinnest and thickest points | mm |
| 1.5 | Average wall thickness | The wall thickness most frequently occuring, estimated | mm |
| 1.6 | Maximum flow path | Distance from the feed gate to the most distant part of the moulded part(s) | mm |
| 1.7 | Ratio of flow path to wall thickness | $= \frac{\text{maximum flow path (1.6)}}{\text{average wall thickness (1.5)}}$ | |

| | Description | Explanation | Unit |
|---|---|---|---|
| **2.** | **Moulding material** | | |
| 2.1 | Chemical description | e.g. ABS, HDPE, LDPE, PMMA, POM, PS, rigid PVC | |
| 2.2 | Trade names | Full details of suppliers(s) | |
| 2.3 | Granulation | Shape, size and size distribution of the moulding material particles | |
| 2.4 | Colour | e.g. precoloured, by masterbatch, by powder or liquid | |
| 2.5 | Other information | e.g. additives, heaped density, K-value, melt index, pre-drying, charge number | |
| **3.** | **Injection mould** | | |
| 3.1 | Number of cavities | | |
| 3.2 | Type of sprue | e.g. stalk, hot runner, tunnel, plenum chamber | |
| 3.3 | Length of sprue | From the breaking-off point in the nozzle to the feed gate | mm |
| 3.4 | Type of feed gate | e.g. point, multi-point, slot | |
| 3.5 | Feed gate | Section of the sprue channel at the entry of the cavity | $mm^2$ |
| 3.6 | Injection surface | The largest area of the cavities and sprue channels projected in a plane perpendicular to the axis of the clamping unit | $cm^2$ |
| **4.** | **Injection moulding machine** | | |
| 4.1 | Manufacturer | | |
| 4.2 | Type | | |
| 4.3 | EUROMAP size indication | In accordance with EUROMAP 1, e.g. 600 H - 135 | |

| | Description | Explanation | Unit |
|---|---|---|---|
| 4.4 | Diameter of injection piston and/or screw | | mm |
| 4.5 | L/D ratio | according to EUROMAP 1 | |
| 4.6 | Check valve | yes / no | |
| 4.7 | Type of screw | e.g. mixing screw, double flighted screw | |
| 4.8 | Type of nozzle | e.g. shut-off nozzle, open nozzle | |
| 4.9 | Orifice of the nozzle | Diameter of the orifice of the nozzle at the transition to the mould | mm |
| **5.** | **Operating conditions** | | |
| 5.1 | Mode of operation | e.g. semi-automatic, automatic (fully automatic) | |
| 5.2 | Screw rotation speed | Number of rotations per minute | $min^{-1}$ |
| 5.3 | Temperatures | | |
| 5.3.1 | Feeding zone | | °C |
| 5.3.2 | Zone 1 ) | | |
| 5.3.3 | Zone 2 ) | | |
| 5.3.4 | Zone 3 ) | Actual temperatures in the heating and cooling zones of the plasticizing unit | °C |
| 5.3.5 | Zone 4 ) | | |
| 5.3.6 | Zone 5 ) | | |
| 5.3.7 | Nozzle ) | | |
| 5.3.8 | Moulding material | Temperature of the material in the hopper | °C |
| 5.3.9 | Mould - fixed part ) | Actual temperatures of the cooling/heating fluids (inlet and outlet) for all circuits | °C |
| 5.3.10 | Mould - moving part ) | | |
| 5.3.11 | Heat exchanger for the hydraulic system | Inlet and outlet | °C |
| 5.4 | Times (related to one cycle) | | |

| | Description | Explanation | Unit |
|---|---|---|---|
| 5.4.1 | Filling time | Time required to fill the sprue channel and the mould cavities completely | s |
| 5.4.2 | Holding time | Is the time when the holding pressure is applied. It start when filling time ends. | s |
| 5.4.3 | Injection time | Filling time plus holding time | s |
| 5.4.4 | Plasticizing time | Screw rotating time | s |
| 5.4.5 | Cooling time | It starts with the end of the holding time | s |
| 5.4.6 | Cycle time | Time during which one cycle takes place | s |
| 5.5 | Pressures | | |
| 5.5.1 | Filling pressure | Max. melt pressure during filling time calculated by dividing the max. theoretical injection force by the screw/piston section area | MPa |
| 5.5.2 | Holding pressure | Melt pressure(s) which is/are applied during holding time(s) calculated by dividing the max. theoretical holding force(s) by the screw/piston section area | MPa |
| 5.5.3 | Back pressure | Melt pressure(s) which is/are applied during plasticizing time calculated by dividing the max. theoretical force(s) by the screw/piston section area | MPa |
| 5.6 | Clamping force | Actual force applied to the mould after closing | kN |
| 5.7 | Total electric energy consumption | Electric energy consumption per cycle, including all ancillaries, e.g. dryers, robots, hotrunners | Ws |
| 5.8 | Cooling water consumption | | |
| 5.8.1<br>5.8.2 | - for machine )<br>- for mould ) | per cycle | $dm^3$ |

# EUROMAP

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