Machine Specification
Ever-Q

Albin Burghofer
ENGEL Machine Specification EVER-Q

ADVANTAGES BY EVER-Q

- Machine ability proof according to ISO 9001 (element 9 - process control)
- prevents mould provings and productions with wrong data
- prerequisite for the employment of statistic methods for process optimization (e.g. Expert Control)
- enables quality assurance via process data
- facilitates the data exchange between the machines
- early recognition of machine errors and wear
- important decision basis for necessary maintenance

Figure: Quality assurance in the injection moulding process.

The injection moulding process for manufacturing an injection moulded part is mainly influenced by the raw material, by the mould with temperature control system, and by the injection moulding machine. Useful quality assurance concepts comprise all fields and factors, which have and/or can have influence on achieving a requested quality. The mechanisms and interfaces of quality assurance are described comprehensively in the ISO 9001. The demands on a quality management system are to design the systems and processes so that a continuous quality improvement can be reached and assured.
For assuring the requested quality of the injection moulded part often the statistic process control (SPC) for product properties and the continuous process control (CPC) for relevant process data are used. Assuring the quality also means to preserving the state which had led to the once desired quality. Therefore it must be ensured that by a well-planned maintenance of the production, equipment wear does not lead to a displacement of the operating point. Quite especially when quality-relevant process parameters of the machine are used for quality control, a cyclic check of the machine sensors is necessary. In this sense EVER-Q has been developed. EVER-Q offers the possibility to document the process capability of the injection moulding machine already at the purchase during the acceptance tests and to check it later again at a certain moment, e. g. in a 3 year period.

For the program-part of EVER-Q a CAT (Computer Aided Testing) system has been developed, which enables a partial automatic control of the fixed test sequence. The machine set-up, measured value recording as well as the processing of the measured values are supported. Some of these functions are only possible with a certain ebias and system version.

PC-supported test and measuring system for establishing the machine specification CAT - system

![Diagram of the CAT system](image)

- Actual values from the machine -> <- Machine setting and control

- Calibrated thermal furnace
- Calibrated sensors for pressure and stroke
- Printout in form of tables and graphics "Certificate"

- Production of calibrated values.
- Recording of the measured values via serial interface and/or by additional transducers.
- Storage of the data in certain form and order.
- Evaluation with standard software (Excel).
All the examinations are based on rules created by ENGEL in cooperation with an external institute, which are uniform basics for the preparation and execution of the measurements. They further include indications of the conditions under which the measurements shall take place. The kind of execution as well as the condition under which the measurements shall take place are modelled on the recommendation of the EUROMAP10. Primarily it is provided to determine the accuracy of the measuring system of the control system including the sensors. This is achieved by a comparative measurement utilizing a calibrated measuring device. (calibration of the measuring chain). Afterwards the relevant technical features of the individual structural units and/or sequences are determined practice-oriented. (structural unit examination)

**STEPS TO THE MACHINE SPECIFICATION**

**MACHINE**

Machine specification

**EVALUATION**

Measuring accuracy, tolerance indication

**EVALUATION**

Accuracy, tolerances

**MEASURED VALUE DISPLAY**

external

**MEASURED VALUE DISPLAY**

screen of the control unit

**EXTERNAL MEASURING EQUIPMENT**

**MEASURING CHAIN**

Control system
Sensors

**STRUCTURAL UNIT**

Mechanics, Hydraulics
Heating

**MEASURING EQUIPMENT**

Control system
Sensorics

**MACHINE SETTING**

Setting according to defined measurement instruction

**SET VALUE**

Setting machine parameters in the control unit

**CALIBRATION OF THE MEASURING CHAIN**

**STRUCTURAL UNIT EXAMINATION**
Example for the "calibration of the measuring chain":

The actual value deviation and the linearity of the display are checked. This examination is done for all process relevant measuring chains.

Example for "Structural unit examination"

The correspondence of the actual value to the set value is proven. This examination is done for all process relevant machine parameters.

The reproducibility for each of the relevant parameters is determined.
The difference between the standard function control every machine has to go through and EVER-Q is that the sensors of the machine are checked. Measurements are made with material as well and the results are documented (compared with tolerance limits) and processed graphically to be able to see the difference when you do the same test again e.g. 3 years later once.

### SUMMARY OF AN EVALUATION

<table>
<thead>
<tr>
<th>Description</th>
<th>Actual Value Display</th>
<th>Tolerance</th>
<th>In Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1 Measuring chain cylinder temp.</td>
<td></td>
<td>3.00 °C</td>
<td>YES</td>
</tr>
<tr>
<td>Measuring chain oil temperature</td>
<td></td>
<td>3.00 °C</td>
<td>YES</td>
</tr>
<tr>
<td>Measuring chain traverse temp.</td>
<td></td>
<td>3.00 °C</td>
<td>YES</td>
</tr>
<tr>
<td>1.3 Cylinder temperature</td>
<td></td>
<td>2.00 °C</td>
<td>YES</td>
</tr>
<tr>
<td>2.1 a) Measuring chain clamping force</td>
<td></td>
<td>2.00 %</td>
<td>YES</td>
</tr>
<tr>
<td>2.1 b) Clamping force</td>
<td></td>
<td>3.00 %</td>
<td>YES</td>
</tr>
<tr>
<td>2.2 Clamping force</td>
<td></td>
<td>3.00 %</td>
<td>YES</td>
</tr>
<tr>
<td>2.3 Mould platen parallelism</td>
<td></td>
<td>0.10 mm</td>
<td>YES</td>
</tr>
<tr>
<td>3.1 Measuring chain screw stroke</td>
<td></td>
<td>0.20 %</td>
<td>YES</td>
</tr>
<tr>
<td>3.2 a) Measuring chain hydr. pressure</td>
<td></td>
<td>1.00 %</td>
<td>YES</td>
</tr>
<tr>
<td>3.2 b) Injection pressure</td>
<td></td>
<td>2.00 %</td>
<td>YES</td>
</tr>
<tr>
<td>3.3 Holding pressure</td>
<td></td>
<td>2.00 %</td>
<td>YES</td>
</tr>
<tr>
<td>3.4 Holding pressure</td>
<td></td>
<td>0.50 %</td>
<td>YES</td>
</tr>
<tr>
<td>3.5 Speed</td>
<td></td>
<td>2.00 %</td>
<td>YES</td>
</tr>
<tr>
<td>3.6 Speed</td>
<td></td>
<td>1.00 %</td>
<td>YES</td>
</tr>
<tr>
<td>3.7 Stroke switchover</td>
<td></td>
<td>0.05 %</td>
<td>YES</td>
</tr>
<tr>
<td>4.1 a) Metering stroke</td>
<td></td>
<td>0.20 %</td>
<td>YES</td>
</tr>
<tr>
<td>4.1 b) Back pressure</td>
<td></td>
<td>1.00 bar</td>
<td>YES</td>
</tr>
<tr>
<td>4.1 c) Screw speed</td>
<td></td>
<td>1.00 %</td>
<td>YES</td>
</tr>
<tr>
<td>4.1 d) Plasticizing time</td>
<td></td>
<td>5.00 %</td>
<td>YES</td>
</tr>
<tr>
<td>4.1 e) Hydraul. pressure switchover</td>
<td></td>
<td>3.00 %</td>
<td>YES</td>
</tr>
<tr>
<td>4.1 f) Shot volume</td>
<td></td>
<td>0.50 %</td>
<td>YES</td>
</tr>
<tr>
<td>4.2 Non-return valve</td>
<td></td>
<td>0.10 mm/s</td>
<td>YES</td>
</tr>
<tr>
<td>4.3 Back pressure</td>
<td></td>
<td>2.00 bar</td>
<td></td>
</tr>
</tbody>
</table>
EVER-Q
Werksprüfzeugnis
Specific test report

Gegenstand / Object: Spritzgießmaschine
Hersteller / Manufacturer: Fa. Engel Maschinenbau GmbH
Type / Type: ES1300/250
Maschinenummer / Machine Number: 17746
Auftraggeber / Orderer: Fa.
Auftragsnummer / Order Number: 10338/018
Seitenanzahl / Number of pages: 27

Die Prüfungen erfolgen auf der Grundlage genau definierter Messvereinbarungen. Dieses Werksprüfzeugnis dokumentiert die Rückführbarkeit der Maschinensensorik auf nationale Normale und dokumentiert die Maschinenfähigkeit. Für die Einhaltung einer angemessenen Frist zur Wiederholung der Messungen ist der Benutzer verantwortlich.

The tests occur on exactly defined measurement agreements. This Certificate documents that the machine sensorics can be traced back to national standards and documents the machine capability. For observing a reasonable period for repeating the measurements the user is responsible.

Leitung ENGEL Qualitätswesen
Management ENGEL Quality Assurance

Prüfer
Inspector

Ing. H. Schönberger

Engel Maschinenbau Gesellschaft m.b.H.
Ludwig-Engel-Str. 1
A-4311 Schwertberg, Austria

TEL. +43 72 62 620 -0
FAX +43 72 62 620 6009