CAVITY EYE

INTELLIGENCE IN MOLDING

English

Contents

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Expert

“INTELLIGENCE IN MOLDING”

The purpose of Cavity Eye is to optimize the production-parameters with the help of measuring pressure inside the mould. It is important to see these internal processes because they define the quality of the product, thus the name: Cavity Eye. We can only understand these processes if we examine the conditions of the injection with adequate instruments. Later we can use the acquired information to properly set up the injection-moulding machine.

The Cavity Eye production-monitoring system uses built-in pressure- and temperature-sensors inside the mould to show us what really happens inside the cavities where the product is created. If this product is eligible the client pays for it, if not it is an expense for the manufacturer.

Even the latest injection-moulding machines and their most experienced operators have production losses if they don’t have enough information of the production. The precision of one machine setup will be defined more by luck than by intention. If you think that your injection-moulding technology is unstable, has hidden errors, the product-quality is varying and causes customer complaints or production blocks, than we are your partners!

The Cavity Eye Team consists of experienced machine operators, mould designers and engineers who aimed to create a user-friendly, easy-to-use system. Spend your nights peacefully knowing that everything is going on the right way!

We give you a solution to reduce the production time, the proportion of bad parts and customer-complaints and most important of all, to improve your company’s efficiency!!

The Cavity Eye Team

Technology

The set up of a moulding machine is frequently based on the intuitions of the operator. During setup he watches the product-quality but this is not enough, beacuse he does not know anything about the processes within the mould which ultimately determine the quality. Due to this kind of approach the machine needs different setups from clamp to clamp, and the production-parameters can even change during the production resulting loss, bad parts and dissatisfied customers.

The modern injection-moulding machines provide a wide variety of parameters for setup. Measuring and observing screw-speed, pressure, temperature, etc. is useful, but these parameters with this kind of inspection do not give information of the mould. In this way there isn't a feedback from the cavities. It is very much like flying a plane without the proper instruments. It is possible, but not advised.

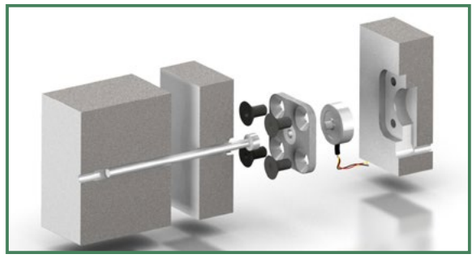
This is especially true in case of multi-cavity moulds. During a machine cycle the inspection parameters do not give information of the internal processes of the cavities. Without such information the experts often meet unexplainable errors. Cavity Eye gives answers in these situations allowing fast and effective intervention which contribute to a cost-effective and stable production.

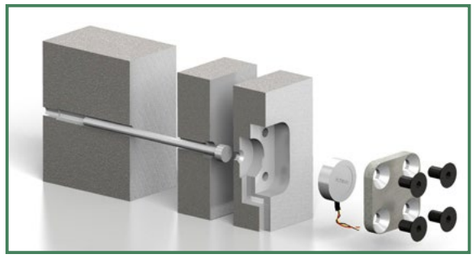
The measurement of mouldpressure is well known but not widespread technology. The sensors have been vulnerable, their use have often had more difficulties than advantages. But not anymore...

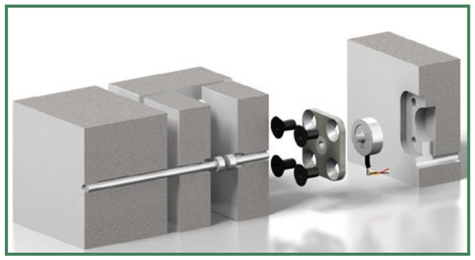
The goal of the Cavity Eye R&D Team was to create an easy-to-use and effective system which boosts the productivity of our partners and clients.
The main qualities of our sensors:

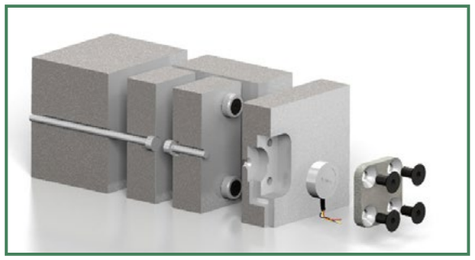
- **Waterproof;**
- **Robust shockresistance;**
- **A lifetime for ten million cycles;**
- **Easy installation into any mould.**

We use measuring pins in our system which can be a static pin or an ejector pin. The tolerance of the pins and the sensors correspond to the tolerance of the mould.









Technology

What are the advantages of measuring mould-pressure?

The setup of an injection-moulding machine is an incredibly hard task, a lot of parameters have to be set that interact with each other. The target is always the same: filling the cavities steadily and equally. The companies spend a lot to ensure this, they uphold laboratories or sort the parts manually.
The injection-technology consists of the following steps:

- **Filling;**
- **Packing;**
- **Holding;**
- **Cooling.**

The moulding machine gives very few or not gives any information at all on these processes. The Cavity Eye is meant to fill this void.
The pressure and the temperature inside the cavities defines the quality of a product. If anything change in the base materials, the production parameters can affect the conditions within the cavity, which will indirectly affect the product itself.

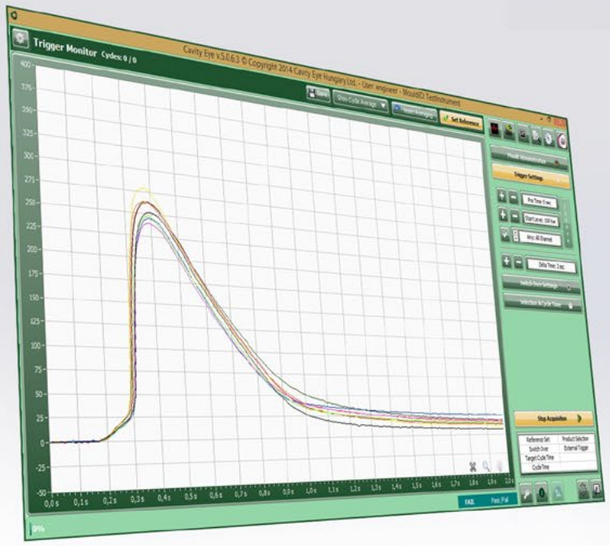
Cavity Eye helps in:

1. **Optimization** of the technology's analysis and the optimization of the production-parameters by assessing the mould-pressure. Our system can extend the technological window and stabilize the machine-operation. Have you ever thought about adjusting your mould to your production-method and not otherwise? Cavity Eye makes it possible. It allows you to simplify your methods and avoid overcomplicated procedures. Simplicity is what renders your moulding machine effective and allows a reliable and repeatable production-cycle.

2. **Part separartion.**The Cavity Eye system communicates with the built-in memory unit of the mould and the injection-moulding machine. It constantly monitors the production. The system beyond helps the work of the machine-operators, also prevents the continous stopping and restarting of the moulding machine, it gives a thorough feedback on faulty and possibly erroneous products and depending on the system-setup it can intervene or even stop the production in case of critical errors and dangerous situations.

3. **Datastoring and analyzing.** Cavity Eye stores all its measurements' datas. This applies for the whole lifespan of the mould and allows you to analyze the production for years back if required. Do you know the down-time of your machines last saturday night? Or monday afternoon? Maybe sorted by shifts? What was your cycletime four years ago? How much time took the change of a mould consume? Does your hot runner system work right? Even if you don't know the answer to these questions, Cavity Eye does! Optionally, you can choose to store all your data in a central database (CDB) so you can always access them anywhere, anytime. You can know the exact amount of waste, the number of cycles, maintenance-time, etc. Cavity Eye monitors all of these and the optional ASR module, designed specifically for analysis, can largely boost the effectiveness of the evaluation procedure.

4. **Soft setting of machine parameters.** Cavity Eye can communicate with the injection-moulding machine from the lowest to the highest levels and can intervene in the different processes (switch over according to mouldpressure, valve controls, etc.).



Products

Pressure sensors

- D15 mm (1 kN and5 kN)
- D26 mm (15 kN)

Temperature sensors

- J-type thermocouple
- Digital temperature sensors

Accessories

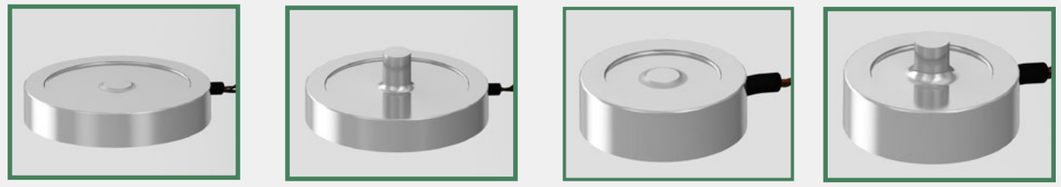
- Cabels
  - Measuring cable
  - Control cable
  - Screw terminal
  - Compensation cable for thermocouple
- Plugs

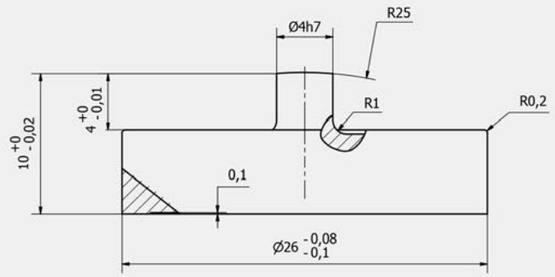
Measuring instruments

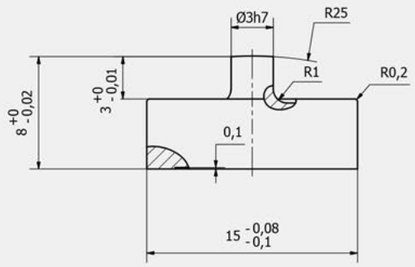
- Basic Box
- Advanced Box
- Mobile Stand
- Cycle-counter

Software

- Cavity Eye Basic
- ASR module (Analysis, Statistics, Report)
- CDB module (Central DataBase)







D26mm Item code	kN	Maximum mould temperature	Suggested measuring pin diameter	Note
PC15-1-AA	1	100 °C	6-10(max 12) mm	with / without pin
PC15-3-AA	3	100 °C	6-10(max 12) mm	with / without pin
PC15-5-AA	5	100 °C	6-10(max 12) mm	with / without pin
PC26-20-AA	20	100 °C	6-10(max 12) mm	with / without pin

Pressure sensors

The pressure sensors of Cavity Eye are the results of many years development, designed deliberately to the requierements of the industry. They are waterproof, highly resistant to shock and they are also calibrated for a lifetime of more than ten millions of cycles. During their production the sensors pass numerous tests, calibrations and a final testing. Due to this rigorous control, every sensor has a one year exchange warranty. In case of malfunctioning we replace them immediately and conduct a thorough investigation about the possible cause.

The sensors have a simple disc-shape with a diameter of fifteen or twenty-six milimeters. They are made of a specially manufactured alloy. The monitoring point of the sensor is placed in its center under a small pin. This is one of the main reasons why the sensor is so easy to install. The other reason behind its flexibility is that we always use a pin to relay the force between the cavity and the sensor. The greatest advantage of this structure is its precision. It makes the sensor more durable against errors originating in contamination or in inaccurate shaping.

Every sensor have a one metre long cable that can be cut to the ideal length and connected to the main plug with the provided special tools.
Our standard sensors can withstand heat up until 90°C. If this is not enough we recommend the High Temperature variant whose limit is at 250°C.
The sensors have three different loadability: 1, 5 and 15 kN. They have a completely linear characteristic, their non-linearity is under 1%. Depending on the mould we offer the 1 kN sensors to work with a measuring pin with a diamater stretching from 0,8 to 2,5 mm. The 5 kN sensor is usually used with diameters between 2,5 and 5 mm, over this we recommend the 15 kN sensors with a pin-diameter of 26 mm. Using long ejector pins with less than 0,8 mm diamater is not advised.

The PC15-5-AA type sensors suit the majority of injection moulds. Naturally, when choosing the appropriate set up and instrumentation of the moulds our team of experts is always at the disposal of our clients.

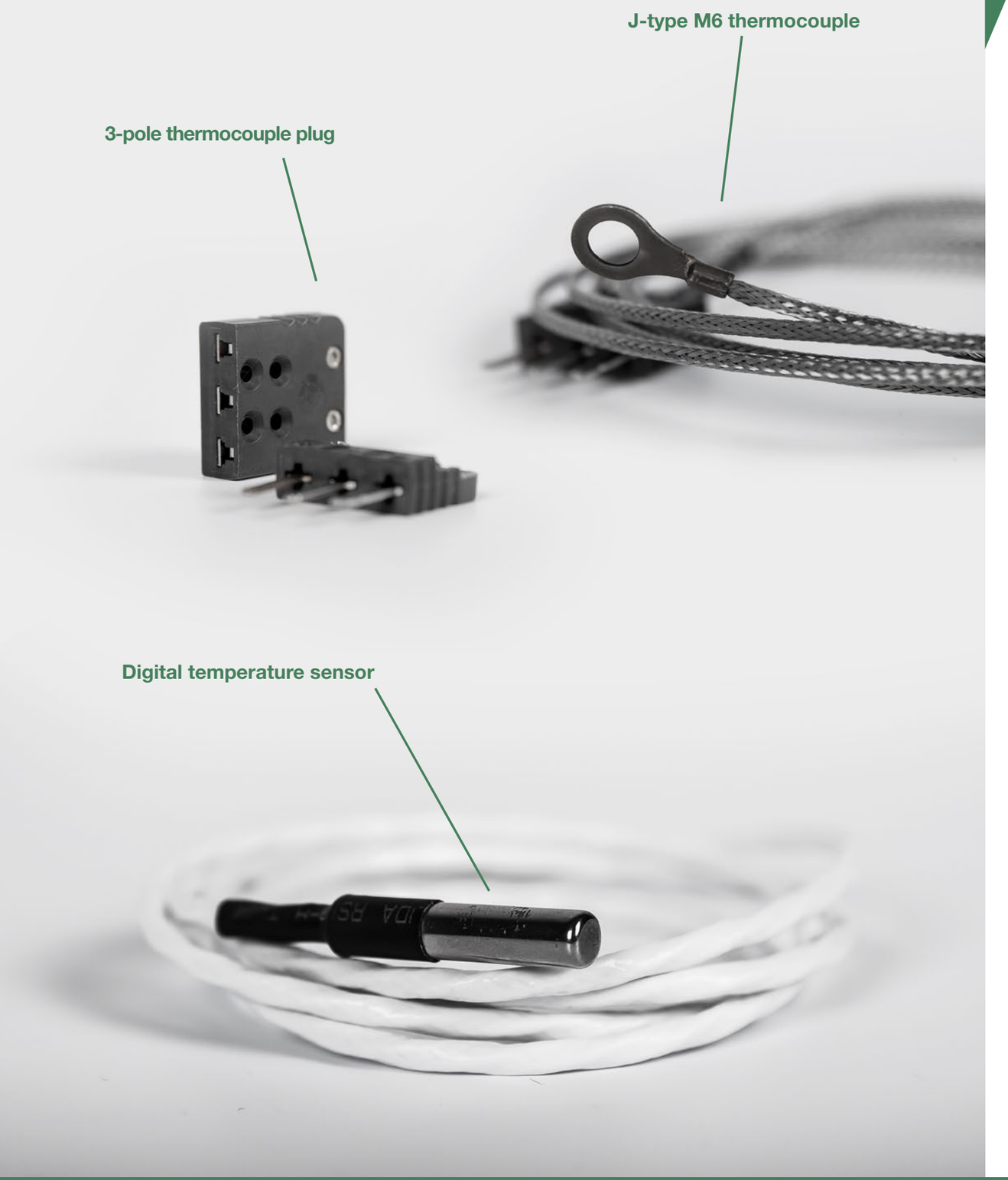
Sensor Codes:

PC15-5-AA(HT)

PC15: P-Cell diameter 15 mm

- 5: maximum load in kN
- AA: production ID
- HT: High temperature (max: 250°C)

Every sensor has a unique ID on its back and its cable. This code contains all the characterestics typical to the sensor like its calibrational values. The sensors are identified by this code.



Sensors

Temperature sensors

These sensors are used to monitor the temperature inside the inserts of the mould. The tempering system is measuring and controlling the temperature of the tempering fluid which is not the same as the temperature of the inserts. Cavity Eye can also monitor these values for you.

Cavity Eye uses two types of temperature-sensors:

J-type M6 thermocouple

Article number: TCM6A
Wire-length: 2 m

The long lifetime and the high accuracy (0.1 °C) of these sensors are supported by documents. The sensor must be placed inside the insert close to the cavity.
We offer a unique plug and a compensational wire for this type of thermocouple.

3-pole thermocouple plug

Article number: TP1A
Dimensions: 25x24x8 mm
Temperature-tolerance: from -50 ° C to + 210 ° C

Digital temperature sensor

Article number: DTS
Wire-length: 1 m (tailorable)

A bus-based, 3-line digital temperature sensor that has the capacity for unlimited cascading.

Accessories

Mould-plug

The pressure and temperature sensors are connected to this main plug of 20 poles. These poles can handle up to eight sensors. In case of more sensors, more plug is necessary. The wires are fastened by bolts inside the plug.

Item code: MPM8A

Each mould needs a **MASTER** plug which hosts the in-built memory-module, containing the following informations:

1. Name of the mould;
2. Name of the product;
3. Current value of the cycle-counter;
4. Type, position and sensitivity of the sensors;
5. Diameter of the measuring pins;
6. Tolerance and other software settings.

Item code: MPS8A

This is the so called **SLAVE** plug which does not contain a memory. It is for the additional sensors. To function properly it always needs the MASTER plug.

Thermocouple Compensational Cable

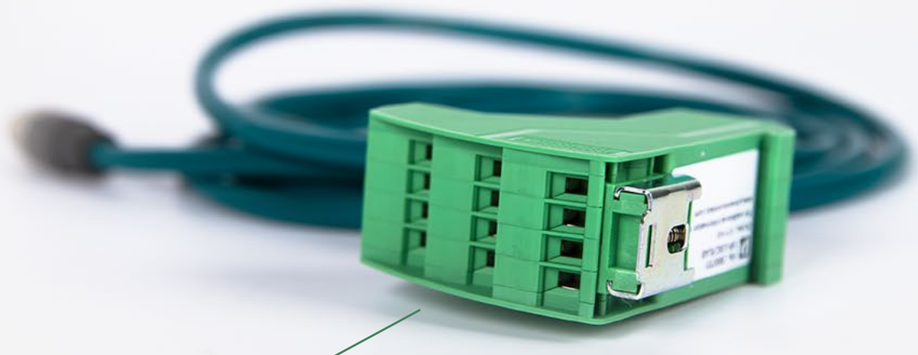
Item code: TCC1-A
Wire-length: 5 m

The J-type thermocouples can not use regular extension wires, they require compensational cable.

Measuring cable

Item code: MC8-AA for 8 sensors
Item code: MC16-AA for 16 sensors(Y-cable)
Item code: MC32-AA for 32 sensors(Y-cable)
Cable-length: 5 m

The measuring cable provides connection between the mould and the measuring instrument. They can handle 8 sensors, one-, two, or four times.



Machine Control Accessory
(Machine Cable + Terminal Box)

Maintenance Toolkit

Accessories

Machine Control Accessory

- **Machine Cable**

Item code: MC-A
Cable-length: 5m

This cable supports the communication between the measuring instrument and the injection-moulding machine with the terminal box.

- **Terminal Box:**

Item code: TB-B

Maintenance Toolkit

Item code: SET1

The proper instrumentation of the moulds and the attachment of the cables require appropriate tools. The Cavity Eye Team assembled the necessary toolkit from well-tested, good-quality tools. Regular maintenance and the proper use of the toolkit highly improves the effectiveness and punctuality of the system.

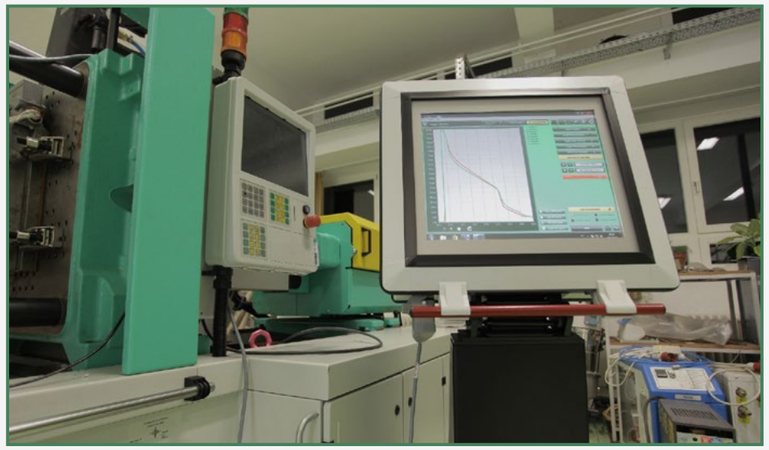
Contents of the toolkit:

- 1 x crimping tool
- 1 x ferruling tool
- 1 x stripping tool
- 100 x crimp pins
- 100 x ferrules
- **2 m heat shrink tube**

Basic Box

Advanced Box

Mobile Stand



Basic Box

Item code: BB8AA

The Basic Box is our simplest measuring instrument which can handle up to eight channels. This device is not suited for process-control or intervention, it is usable when measuring pressure or temperature is enough to solve your problems.
Due to its small size it is highly mobile and it can be assembled swiftly in an industrial environment. It is used with portable computers. We recommend it mainly for mould-testing and optimizing.

Advanced Box

Item code: AB8-AA for 8 sensors
AB16-AA for 16 sensors
AB32-AA for 32 sensors

The Advanced Box is a complex, multipurpose system that is fitted for measurement, data-acquisition and process-control.
It communicates with the moulding machine by analogue 24 V and digital signals. The Box goes into the control case and the monitor is fixed on the exterior of the moulding machine. The system has 8-, 16- and 32-channel versions. The monitor and the data-processing computer are also the part of the system. The Advanced Box is recommended for optimization, continuous production-monitoring and selection.

Mobile Stand

item code: MS16AA

This is a massive, movable industrial instrument designed for measurement, data-acquisition and process-control. It communicates with the moulding machine by analogue 24 V and digital signals. Besides the moulding machine it can be attached to other peripheries. Its 19” touchscreen ensures easy usage.

The Mobile Stand can be upgraded with the following options:

- Hot runner shut off valve control,
- Numerous other low- or high-voltage control tasks can be integrated into the Stand.

Measuring instruments

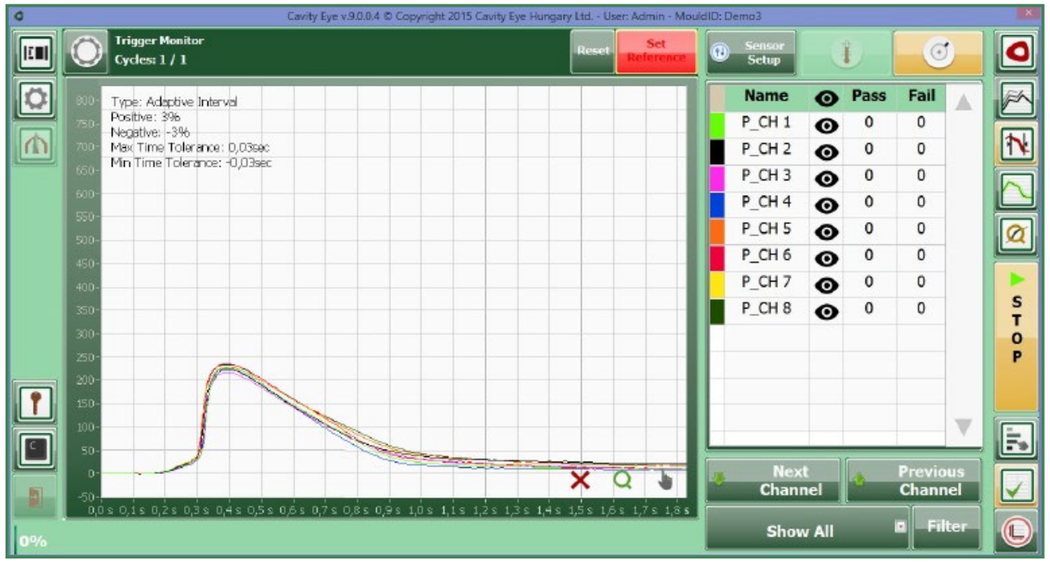
Cycle-counter

Item code: CCA

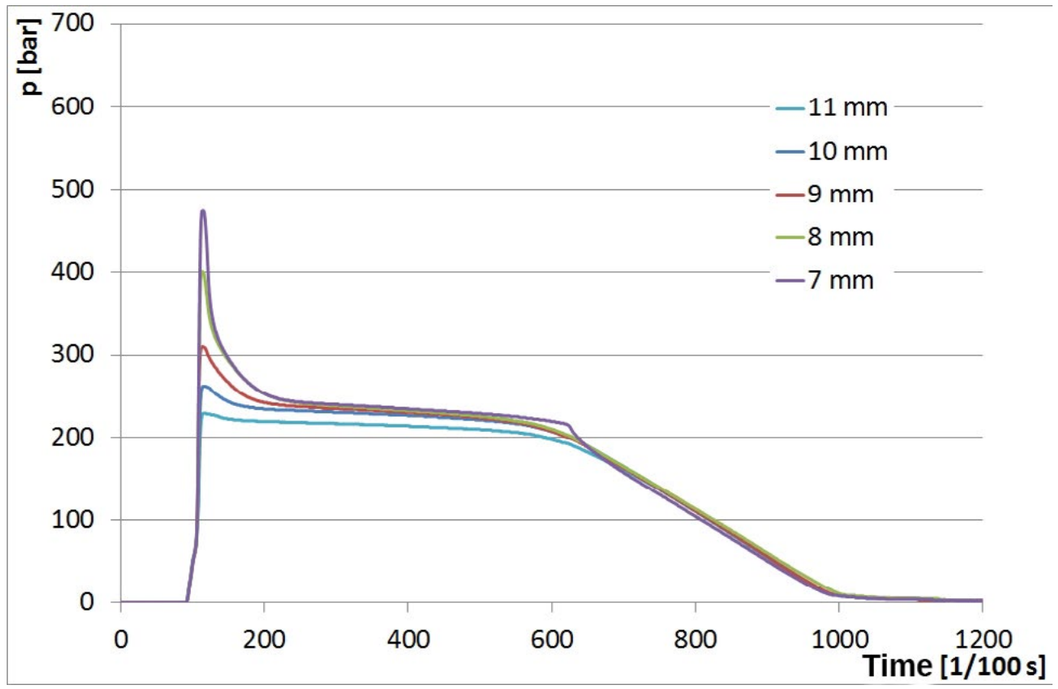
We recommend the Cycle-counter when the instrumentation of moulds is not necessary but the monitoring of the injection-moulding machine and the production is still required. The memory unit built into the mould identifies the mould and the clamp, it counts both the setup and the production cycles. The system also receives signals from the moulding machine to identify perfect and defective parts, so you can analyse the effectiveness of your production.

The system stores the production-data in the central database (CDB), therefore you can acces and evaluate all the data online, sitting at your desk or even with your smartphone by using the ASR module.

Software interface



Effect of switch over to cavity pressure



Cavity Eye Software

The software provides a clean and integrated surface to control the Cavity Eye system. It manages the modified moulds, processes and displays the data coming from the sensors and the injection-moulding machine. The Cavity Eye Software is in contact with the two most important elements of the system: the evaluation and the datastorage.

The **Mould Manager** feature enables you to modify and review the following contents of the memory: the name of the mould and the product, sensors and their corresponding codes, names and positions, etc.

The software unifies many panels or views to offer the most appropriate methods for the different aspects of production and the system. One of the most significant considerations during the design of the user interface was the smooth review and setup of the production parameters.

The most important parameters can be accessed anytime during the setup of the moulding machine: Switch Over Settings, Product Selection and Trigger Settings for defining shots.

On the **Trigger Monitor** of the software the separated shots can be followed up. With the given tools you can define a Reference shot that determines the basic caracteristics of your production.

Evaluation is carried out by the **Interval Graph**. Here you can assign the acceptance parameters that define an eligible product.

The **Log Monitor** is responsible for saving the current data and displaying older production data.

All these elements together guarantee a swift and automatized monitoring. With the use of the inbuilt memory, the stored data and settings the Cavity Eye Software can initilize and set up itself as a mould is reconnected to the system. Starting the monitoring procedure is really just one click.

The software has two extensions: the **ASR** and the **CDB** modules.

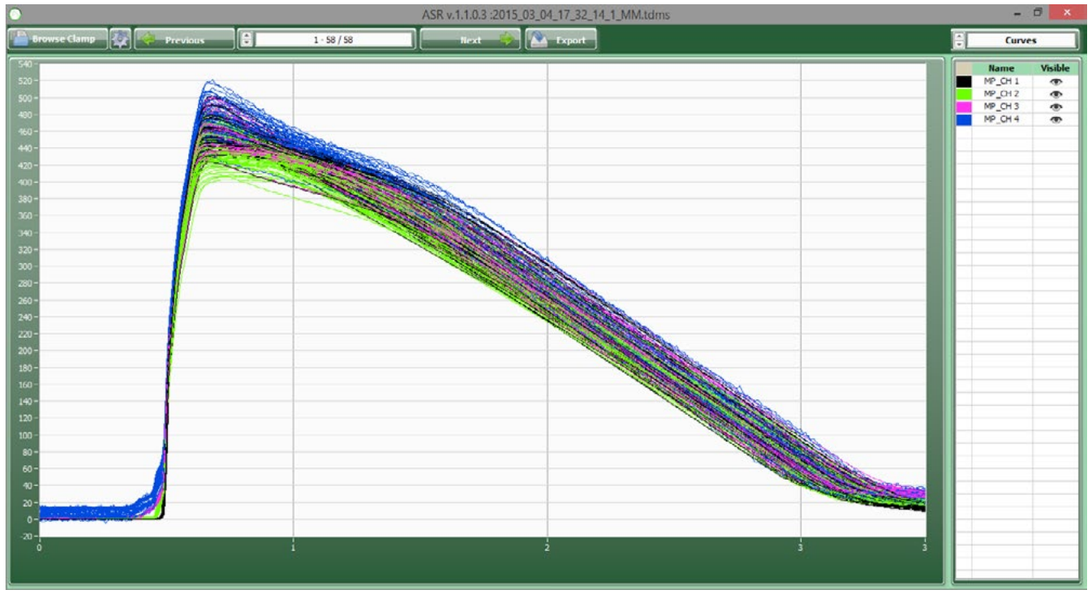
CDB - Central Database module

This unit connects the separated Cavity Eye systems. Every system in one or more factories can upload here all the gathered data. Every authorized user can access them anywhere, anytime and look back at their entire production.

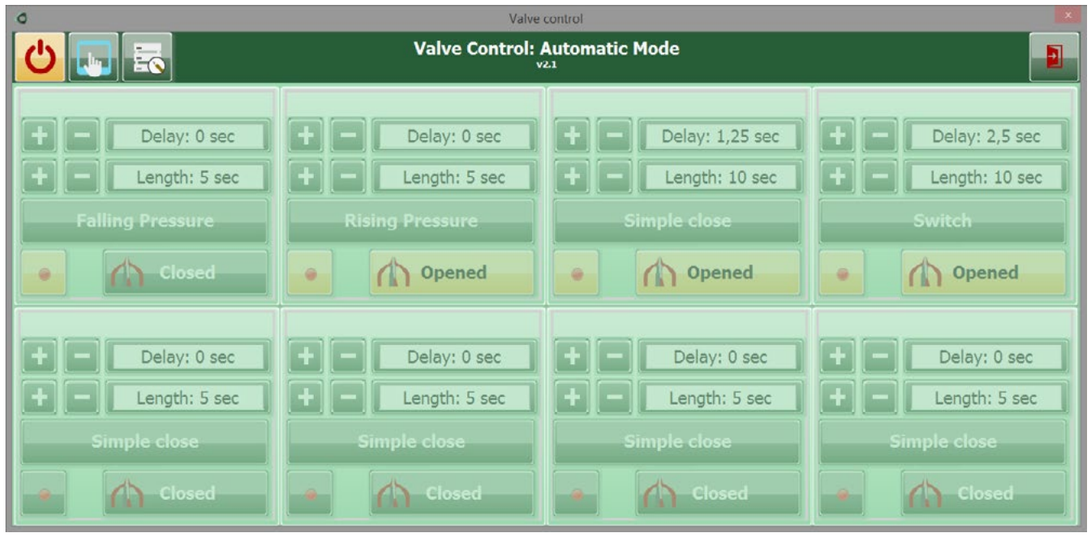
The contents:

- The time of clamp;
- Number of setup cycles;
- Start of sorted production;
- During continuously monitored production:
- Exact time of every cycle
- Pass/fail qualifications
- Pressure curves and temperature values

Cavity pressure curves of 58 shots



Valve control interface



Software options

ASR - Analysis, Statistics and Report module

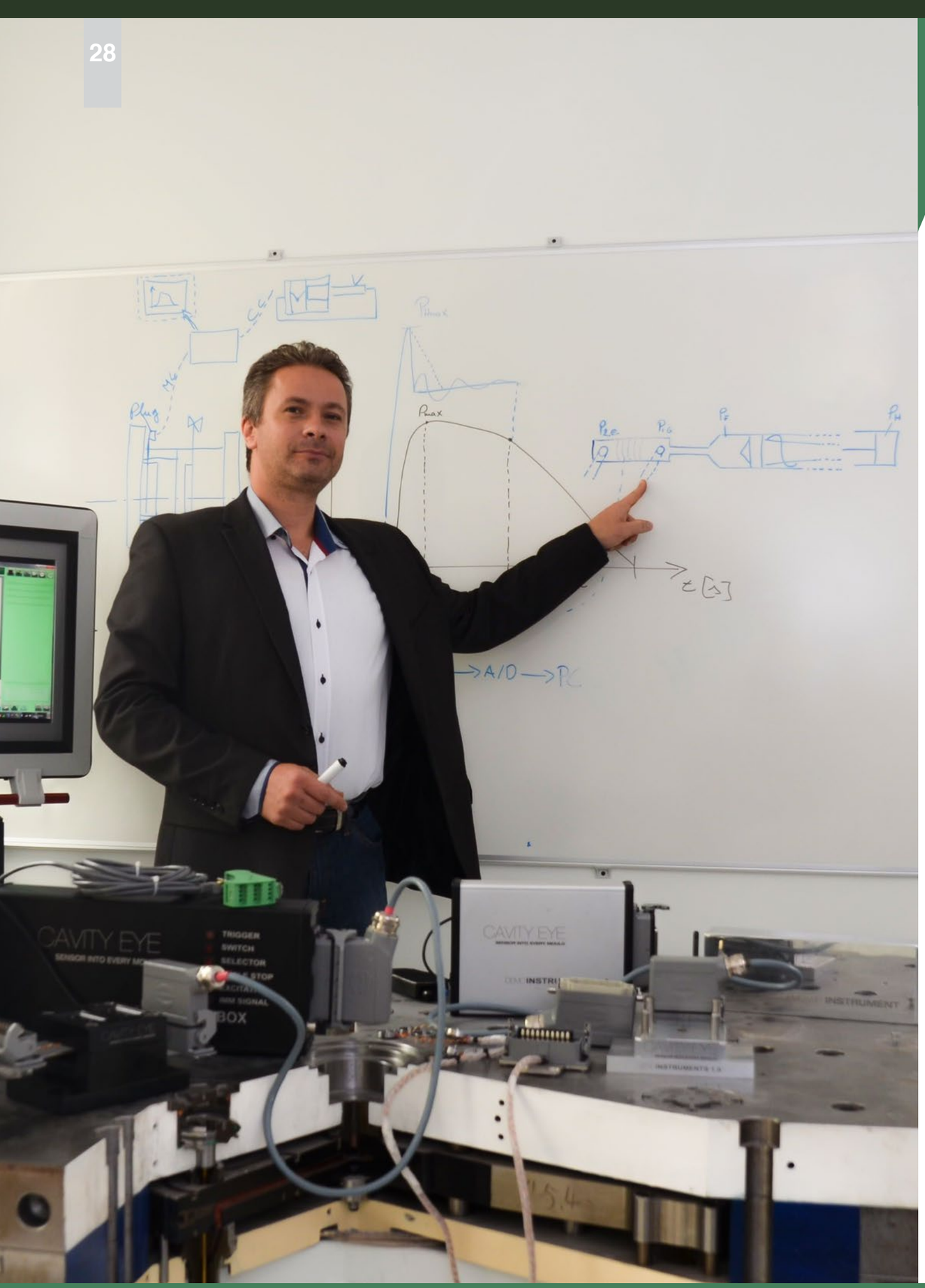
This stand-alone software helps to organize and clarify the data stored in Cavity Eye database. Mould based production planning and analyzing of machine efficiency becomes child's play with the ASR.

VCU (Valve Control Unit)

The Cavity Eye Valve Control Unit (VCU) controls the opening and closing function of valves (pneumatic, hydraulic) based on elapsed time or in cavity pressure.

Advantages:

- 0,01sec timer resolution;
- automatic filling-control of the cavities;
- automatic control of cascade injection;
- the VCU provides and improves the stability and the quality of the production.



Services

Trainings

- Basic injection-moulding training: The participants learn the operation of the moulding machine, the preparation of production and the replacement of the mould. Exoteric (15 days).

- Injection-moulding machine setup training: Recommended for experienced engineers and operators. The training focuses mostly on the theoretical background and enhances the capability of the participants to solve practical problems (4 days).

- 3. Injection-moulding in practice: This is a practical training based on the one above. The classes are held at the certain factory (4 days).

- Advanced injection-moulding (R&D): The training is recommended for engineers and experienced operators who wish to attain extensive knowledge in polymer physics, measurement technologies, matter analysis and problem analysis (3 days).

- Injection-moulding in the office: This training provides basic learning on the injection-moulding technology for those who work in the injection-moulding industry but not directly with the machines: office-employees, salesmen and production managers (2 days).

- Cavity Eye mould instrumentation training: The subjects of this training are the analysis of processes inside the mould, the instrumentation of the mould and the optimization of existing technologies (3 days).

Services

Pilot Programme

The head of every company is skeptical about new investments. Numbers of salesmen convinced them to buy “extremely useful” devices that ended up on the shelf after a few months. Unsuccessful investments usually generate tension between the management and the technological division. No one is confident in such situations. Cavity Eye’s main company policy is to provide and ensure gainful products to its clients. That is why we offer a pilot program to our future partners to help you assess the real value of the Cavity Eye systems and experience its beneficial effects.

The programme contains the following services:

1. **Support for mould redesign;**
2. **Support for mould manufacturing;**
3. **Support for mould instrumentation and dry test;**
4. **Support for optimization of technology.**
5. **Provision of instruments and sensors for 4 weeks.**

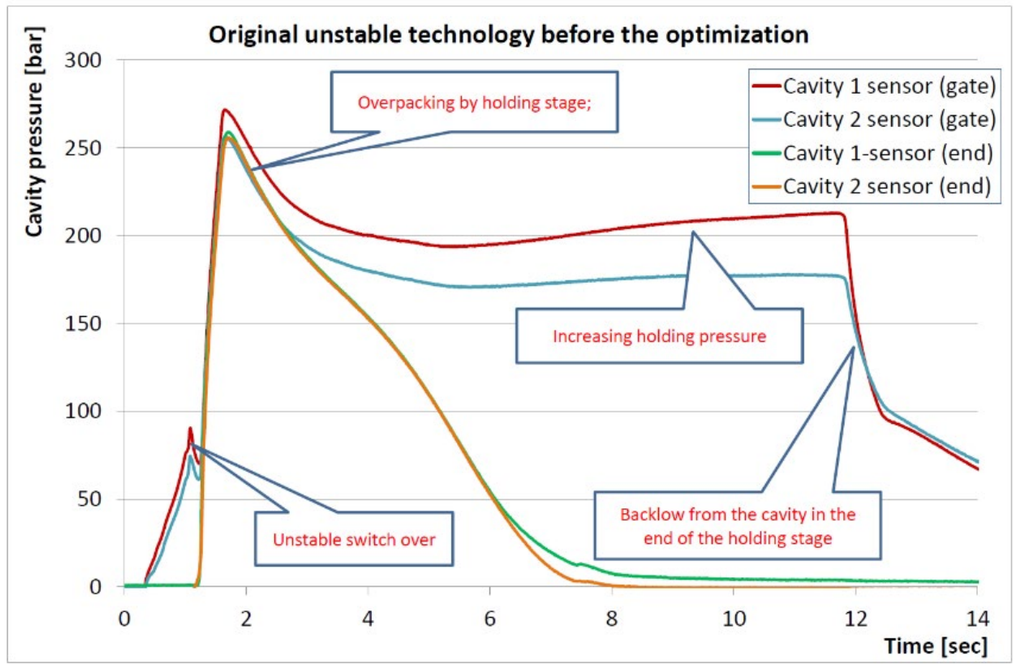
The pilot programme starts with 3 days of field-work to review the basics of the system followed by the testing period. According to our experiences this time should be enough to make the right decision of purchasing. Succeeding a successful pilot programme we integrate 60% of its cost into the selling- price of the system(s), resulting satisfaction in the bosom of engineers and financial decision-makers.
The Cavity Eye System is needed with all of its advantages, it is well shown by the successful pilot programmes which ended with purchasing in more than 95% of the cases.

After Sales Support

The connection with our partners does not break off with the vent of a Cavity Eye system. We provide full scale product support for later development and instrumentation on demand.
“What guarantees the reliability of the sensors?” we frequently hear. The sensors are the accomplishments of many years of R & D work. The rigorous production is followed by a long testing procedure, then the sensors undergo calibration and testing again. The multi-stage quality control procedure secures the shipping of the highest quality sensors. If a sensor malfunctioning, we replace it immediately. In this case the error will be investigated and the affected partner will receive an official form describing the background and the details of the malfunction. All information and know-how regarding the development and production of the sensors is the intellectual property of Cavity Eye, we will not release any details.

Each of our products comes with 12 months of guarantee.
Buying an instrument automatically involves one year of software tracking. Software upgrade happens according to the customer requests. We release the newer versions two times a year. The software tracking period can be elongated by one additional year.
We also carry out the preparation of the injection-moulding machine and other devices to communicate with the Cavity Eye system or the training and education of your experts.

Case Study



Client 1

Automotive company

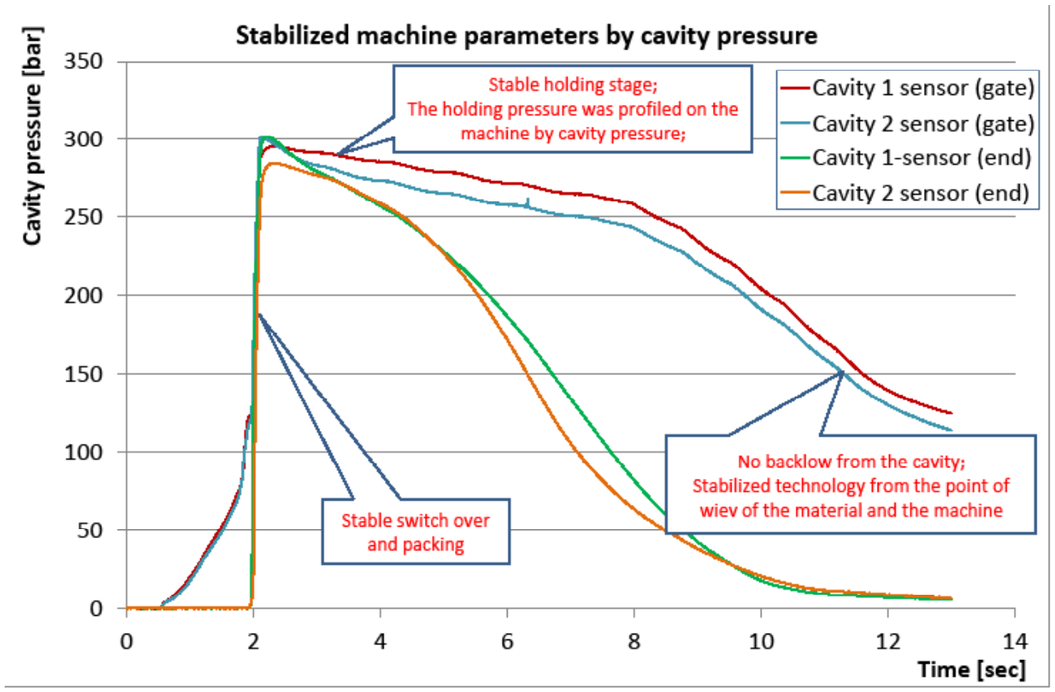
Mould type: 2-cavity-mould with hot runner
Quantity of products: cca 1000 pieces/day
Cycle time: 50 sec

Problem: dimension and quality fluctuation in both cavities

Solution:
2 sensors / cavity (one to close to the gate and one to the end of the flow length)
„Fine tuning" of the following parameters by using Cavity Eye:

- velocity profile of injection speed program
- determination of switch ower position
- profile of holding pressure
- determination of time of holding pressure

Results: stability of part dimension



Client 2

Automotive company

Moulds type: 8-cavity-mould
Quantity of moulds: 2 pieces
Quantity of products: cca 100.000 pieces/day
Cycle time: 7,5 sec

Problem: Short shot, partial filling of cavities
poor mechanical properties

Solution:
1 sensor/each cavities
fine tuning of machine parameters

Results: 0% scrap product (0 ppm)

CAVITY EYE
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