
# APC (Adaptive Process Control)
## Stabilize your processes and maximize profits

*Engineering Passion*

KraussMaffei

# External factors impede end product quality
# APC protects systems from unwanted factors

Numerous external factors can impede component quality. Factors that unfortunately cannot be prevented include environmental factors such as temperature and humidity, fluctuations in material quality and flow resistance and human factors.

**Possible external factors**

**Changing environmental conditions**
- Seasons
- Day and night
- Temperature and fluctuations in humidity

**Fluctuating flow resistance**
- Hot runner mold
- Mold cooling and heat-balancing of hot runner
- Shut-off nozzle of non-return valve

**Safety reserves for settings**
- Back pressure
- Barrel temperature
- Mold temperature
- Cycle time

**Human factors**
- Availability
- Qualifications
- Start-up after standstill
- Intervention into process deviations

**Material quality fluctuation**
- Batch fluctuations
- Additives (recyclate amount, masterbatch)
- Contamination

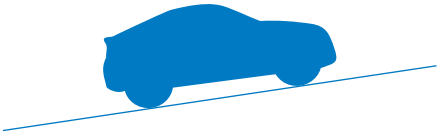
# Cruise control for your injection molding processes
## APC keeps processes stable

APC operates in a similar way to cruise control for vehicles. Cruise control systems automatically control the supply of fuel to the engine so that the vehicle does not drop below or exceed a speed defined by the driver, even in changing road and wind conditions. The speed of the vehicle remains constant, even if outside conditions change.

Similarly, APC keeps the weight of the finished part specified by the mold setter consistent during ongoing production if parameters change due to outside factors. Therefore, you and the entire process benefit from consistent component quality.

**Consistent speed = robust process**

Consistent speed on a horizontal segment

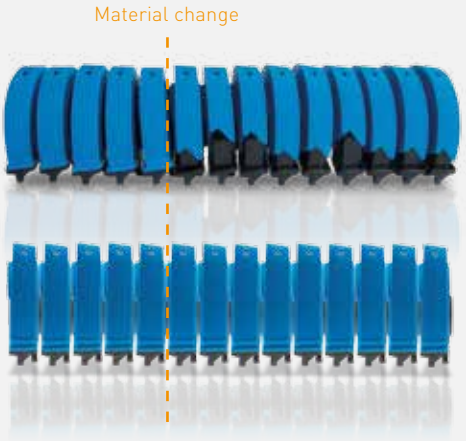


Consistent speed on a slope

Process Control by APC

**APC = cruise control for the machine**
The mold setter configures the ideal process. APC detects deviations and repeatedly changes the actual status back to the target status. All faults are eliminated and you retain consistently high end product quality.

**APC – your path to zero-defect production**

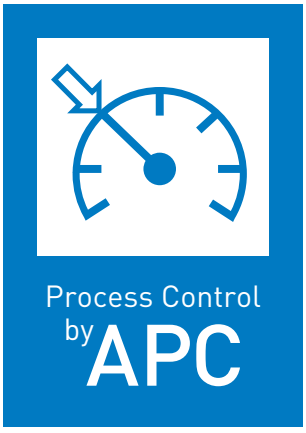



**WITHOUT APC:**
Significant fluctuations in component quality after material change

**WITH APC:**
No fluctuations in component quality after material change

# Quality assurance by the machine
## Intelligent control of critical process parameters

Thanks to years of experience and intensive research, KraussMaffei has reached the next level in consistent component quality. The patented APC technology analyzes and continuously regulates the injection molding process, and can be used for all thermoplastic series.

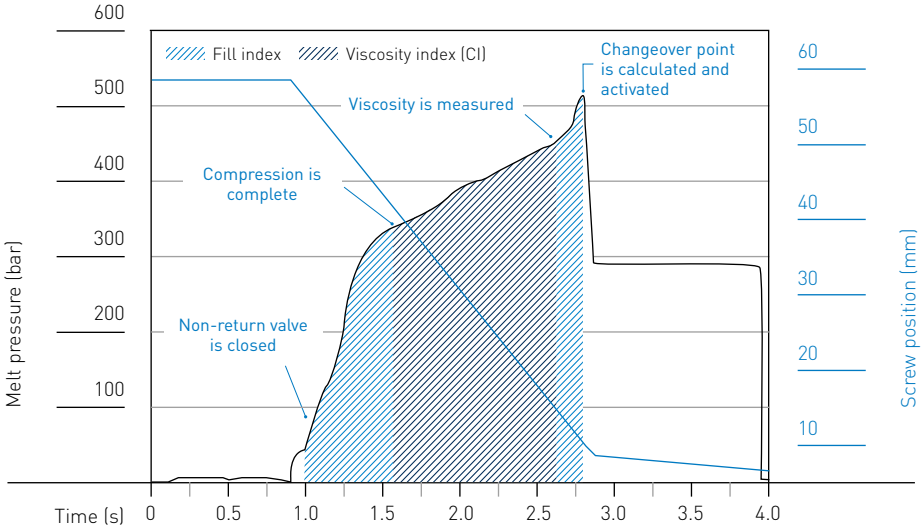



### Just two steps to consistent component quality

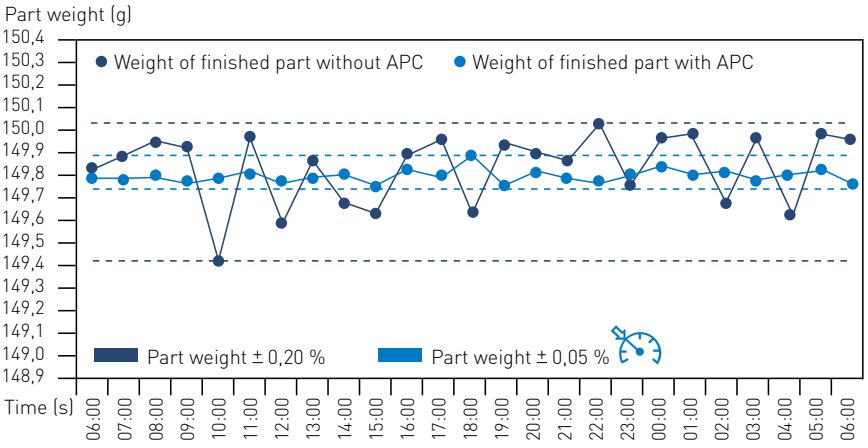
#### Step 1: Analysis

APC analyzes the current process status. This enables the machine to keep a configured process consistently stable if the external factors (such as batch fluctuations) change the viscosity of the material or the flow resistance in the mold. These changes are detected by recording specific key parameters, such as the melt pressure curve of the machine.

**Melt pressure curve over time:**
APC records the behavior of the non-return valve, the flow characteristics and the viscosity of the melt during injection.



## Higher process stability with APC

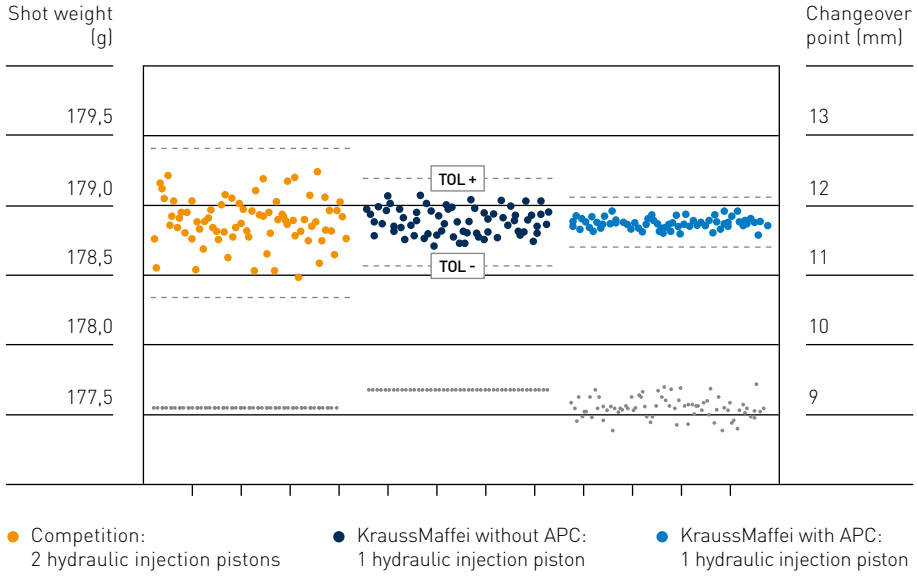



This graphic illustrates fluctuations in component weight, which are greatly diminished when APC is used. This improves the process capability significantly and reduces the expected scrap rate substantially.

### Step 2: Control

Through clever evaluation of the process data gathered in step 1, the machine can respond to the current process state within the specified limits. APC adjusts the changeover point and the holding pressure profile to the existing melt viscosity and current flow resistance in the mold. This makes it possible to compensate for deviations online and in the same shot. Among other benefits, this results in a significantly more robust production process.

## Shot weight consistency: the best results with KraussMaffei




### Consistent part quality

As a result, APC produces uniform shot weights within a very small tolerance. This leads to the consistent component quality that can already be seen in various customer projects. In this process, the process capability was measured before and after activation of APC. In each case, significant improvements were made.

# Revolutionize your manufacturing process
## Advantages that speak for themselves

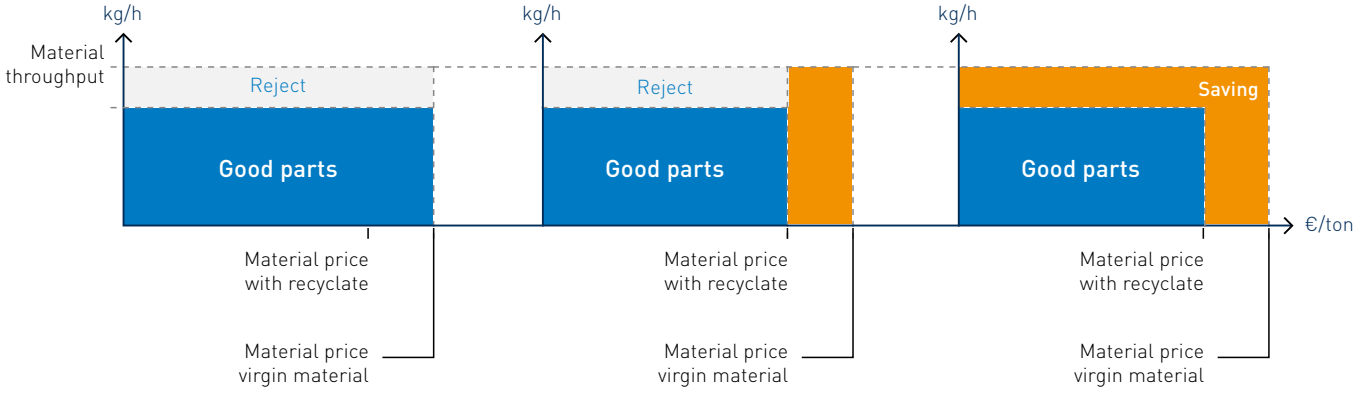
Consistently high quality is a vital factor in maintaining good customer relations. With APC, you can protect this important commitment!

### Zero-defect production

Efficient manufacturing is vital to attaining the highest possible margins, particularly when manufacturing a high volume of units. Thanks to APC, production processes are significantly more stable, ensuring more consistent component quality. Scrap rates are drastically reduced, eliminating unnecessary material losses.

**Your benefits:**
- Substantially lower scrap rates
- Consistently high component quality
- Lower quality assurance costs

### Cutting costs with APC




**Costs without APC**
Cutting costs and boosting margins presents operational challenges to every business.

**Cutting material costs**
With APC you can increase the proportion of recyclate used much more easily, and thus reduce material costs.

**Reduce scrap with APC**
You will waste substantially less scrap material and have completely new opportunies to save further costs.

**Your benefits:**
- Enormous cost reduction potential
- Easy use of a significantly higher proportion of recyclate


Users bear great responsibility in the manufacturing process – APC supports them in this process and simplifies operation.

### Easy handling

The demands placed on modern manufacturing are constantly increasing: it must be flexible and as cost-effective as possible. Therefore, downtimes, lengthy start-ups and fluctuations in production must be reduced to a minimum. The APC system enables the user to start up machines faster and rely on a stable process-regardless of potential interference factors.

### Saving energy and shortening cycle times

To produce as little scrap as possible, it is normal practice to configure process settings with process reserves. This is actually not necessary. Unnecessary increases in cycle times and excessive temperatures are a waste of resources. With APC, you can always execute optimum processes with optimum energy consumption and optimum cycle times.

**Your benefits:**

- Lower standstill costs
- Lower setup costs
- Simplified operation and quicker machine start-up
- Significantly lower energy costs
- Increased production output

# Less scrap – more productivity
## Adaptive Process Control (APC)

The newly developed APC machine function from KraussMaffei immediately compensates for fluctuations in the injection molding manufacturing process. Processors will benefit from a uniformly high component quality, lower scrap and material costs and the simplified use of recyclate. Furthermore, the implementation of APC increases energy efficiency in injection molding production.

APC is offered for all series from KraussMaffei.

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