

# The All-Electric Tailor-Made Suit

## *KraussMaffei Presents the PX Modular All-Electric Injection Molding Machine*

Electric injection molding machines are renowned for precision and efficiency – though also for their restricted range of equipment options. For hydraulic machines, modular systems have been available for many years, but purchasers of electric machines usually have just a simple choice of either a high-end or a low-budget machine. With the new PX, KraussMaffei presents the first ever all-electric injection machine series with an emphasis on flexibility. It starts with clamping forces from 500 to 2000 kN.

Along with the modular principle for the clamping and injection unit, the design of PX also incorporated ergonomics, space for the parts logistics, and good accessibility

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What are my manufacturing needs currently? What could they look like in future? So far, purchasers of electric injection molding machines have had hardly any opportunity to address questions such as these. Usually, they were only able to choose between two differently equipped product lines – with nothing in between. Anyone who required only one option from the higher quality model was forced to purchase the entire system, even if they were also buying other expensive performance features that they did not need. KraussMaffei Technologies GmbH, Munich, Germany, is now taking a different path and has dedicated its new all-electric PX series (Title fig-

ure) to flexibility. With a wide range of purchasing and retro-fitting options, the user can continually adapt the machine to his individual production conditions.

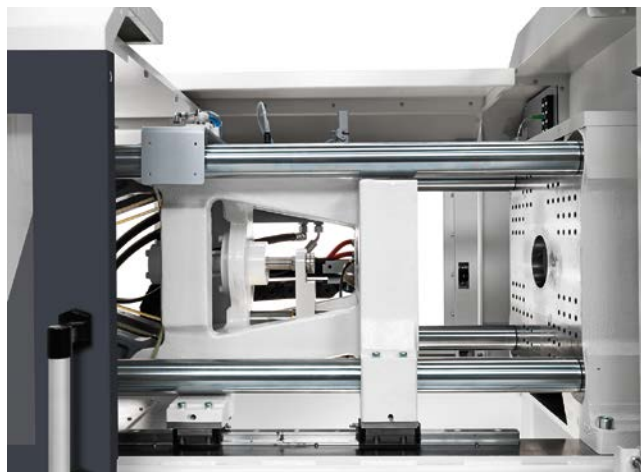
International market research during the three-year development phase showed that plastics processors' main concern is flexibility, because their customers request ever smaller batch sizes. The consequence is frequent mold exchanges between widely different projects. A second trend, functional integration, has so far only been strong in Europe. In the USA, it is variable, and still somewhat weak in Asia. As a result, a modular system was created that (according to the manufacturer) offers users

more configuration options than any other all-electric machine on the market, for the entire lifetime.

For example, larger platens, faster injection rates or a higher ejector force are available. During production, an appropriately designed machine bed offer space for the parts logistics (Fig. 1); all the parts of the machine are easily accessible. Retrofitting options include core pullers, needle valves or mold temperature-control equipment, for which all the technical criteria are already in place. Like a tailor-made suit, the PX fits perfectly to different production environments, and can also be tailored specifically to different industries or technologies.



**Fig. 1.** The machine bed of the PX offers space for the easy integration of conveyor belts (© KraussMaffei)



**Fig. 2.** The wide support of the movable platen on linear guides ensures precise plane parallelism (© KraussMaffei)

### *Variable Combinations of Clamping Unit and Injection Unit*

The high adaptability is illustrated by two key features of the series: The injection unit and clamping unit can be individually combined from a large number of variants; at the same time, versions of the PX with the large-sized platens of the respective next higher clamping unit are available as standard. For example, each clamping unit can be fitted with five injection units of different capacities, which in turn can have three to four different screw diameters.

For example, with low shot weights, it is advisable to use a small plasticizing

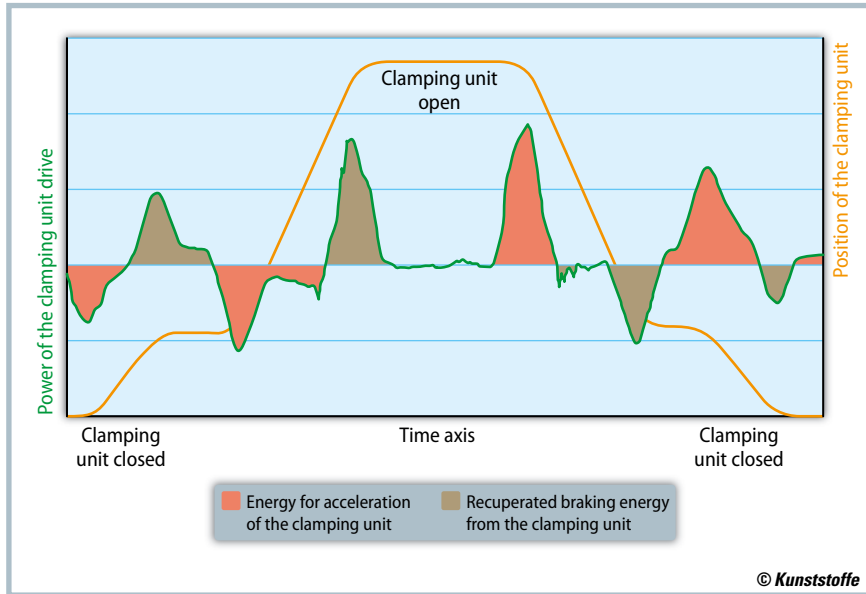
unit, so that the residence times for the material are not unnecessarily long. Low clamping forces in turn result in low investment and operating costs – and less wear and tear on the mold during manufacturing. Because of the split machine bed with the optimum length for the injection and clamping unit, the PX only takes up as much production space as it really needs.

If the clamping force is not sufficient for an application, but the mold requires more mounting space, one of the PX intermediate models can be used, which are designated with odd numbers. For example, the PX 81 with 800 kN clamping force and the platen dimensions of the

1200 kN machine. The larger clear width involves a higher maximum mold weight, in this case 1000 kg instead of 750 kg. To put it in a nutshell, if the mold fits in the machine, the clamping unit is also designed for the higher weight. The wide support of the movable platen on linear guides, and the stiff bed ensure precise plane parallelism (**Fig. 2**).

### *All-Electric – with Integrated Servohydraulics*

The desire for flexibility is met by the basic properties of all-electric machines, since electric motors operate independently of one another, permitting »



**Fig. 3.** Recuperative operation of the PX with the example of the clamping unit: Braking energy is recovered, stored, used on different axes or fed back into the mains supply (source: KraussMaffei)

**Fig. 4.** The injection unit with two moving cylinders operating in parallel builds up the nozzle contact pressure rapidly and symmetrically

(© KraussMaffei)

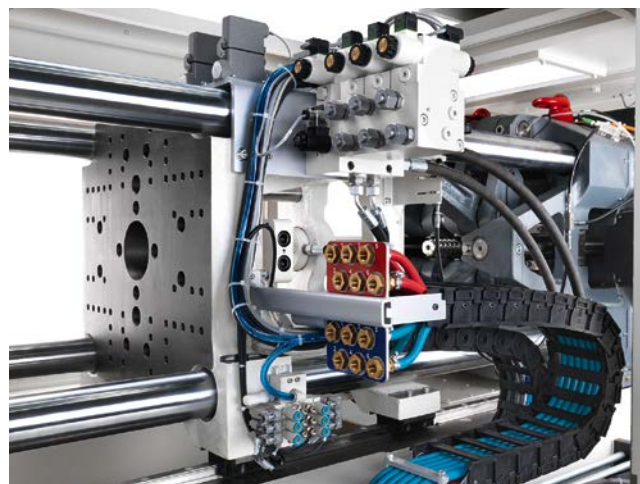


an arbitrary number of processes to operate in parallel. The three principal axes of the PX for injection, plasticizing and the clamping unit, are driven by efficient servo motor, which makes the PX very economical as regards energy and water con-

sumption. In “recuperative operation”, the servo motors convert braking energy back into electricity, which is stored in an intermediate circuit of the machine. From there, it can be used on other axes, or, if there is a surplus, fed back into the mains supply (Fig. 3). In this way, up to 60% of the energy can be recovered.

The secondary axes, i.e. those responsible for the movements of the injection unit and ejectors, are servohydraulic in the standard version. The former takes place via two moving cylinders operating in parallel, because this allows the nozzle contact pressure to be built up absolutely symmetrically – unlike with only one electric spindle drive at one side (Fig. 4). For design reasons, the velocity is higher than with purely electric drives, but can be additionally increased if needed. The nozzle contact pressure, too, can be increased – for example for the use of extended nozzles. If a particularly high material throughput is required, e.g. when manufacturing parts with low wall thicknesses or long flow paths, the PX customer can more than double the injection velocity. For applications with greater torque requirement, more drive performance is available for the screw. The unit is also available in a pivoted design to make it easier to replace the non-return valve or exchange the screw.

In the standard PX model, the ejectors are also driven via the integrated servohydraulics. This is for the sake of robustness: electric drives are sensitive to the mechanical impacts that occur when plastic parts are demolded by means of vibrating plates. The ejector stroke is generously dimensioned at 150 to 200 mm in order to be able to operate the molds with long



**Fig. 5.** The PX can be equipped or else retrofitted with hydraulic core-puller controls or cooling water circuits located close to the mold (© KraussMaffei)

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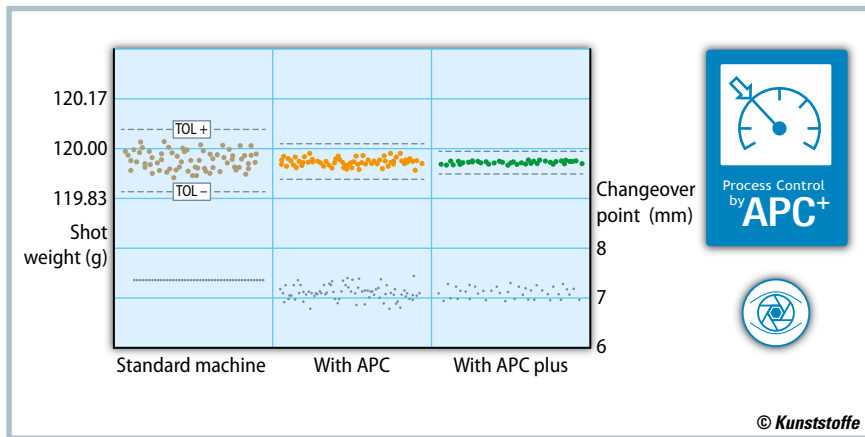
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**Fig. 6.** Even in the standard configuration, the PX maintains a narrow tolerance band for the shot weight. The newly developed APC plus provides maximum shot-weight constancy, and is also suitable for thin-wall applications and cascade injection molding (source: KraussMaffei)

demolding distances. It is optionally possible to increase the ejector force (by 50%) and velocity (by 100%). The former is ideal if parts are shrunk onto cores; the latter provides even shorter cycle times.

Where parts are to be precisely transferred to a removal robot, it is advisable to equip the machine with optionally available electric ejectors, which can also have different levels of performance. In the case of PX, hydraulic mold functions, such as core pullers or needle valves can be very easily retrofitted (Fig. 5), since the servo hydraulics necessary for supply is already integrated. Even in the standard version it achieves very high volume flow rates, which can be further augmented as required. All functions can be directly programmed via the MC6 machine control system.

### Clamping Unit: Geometry, Force and Speed

As regards the clamping unit, there are three important factors: geometry, force and speed. In all three areas, the PX offers options for matching the machine to individual needs. The platens can be enlarged by using the above-mentioned intermediate types, with the entire machine bed of the next larger machine always being used. Thanks to the linear roller guide, the tiebars only serve for force transmission and do not have any contact with the moving plate. Lubricants are not needed; the mold space remains clean.

The maximum mold height can be increased by 100 mm compared to the standard version; for example from 450 to

550 mm in the case of the PX120. The mold height adjustment itself takes place automatically – a property that is also offered by the optional automatic clamping force control system. If a deviation is registered, it controls the clamping force to  $\pm 2\%$  of the preset value by adjusting the mold height. This avoids any process disturbances.

A smooth-running, zero-backlash mechanism of the PX and the dynamic drive technology ensure high manufacturing precision. Ambient disturbances, such as batch fluctuations in the material or temperature changes, can be additionally compensated with the APC plus (adaptive process control, Fig. 6) machine function. It ensures parts with highly constant weight and is also suitable for cascade injection molding and thin-wall articles. The absolute volume of the cavity is

measured for the first time, and the user can select from 20 base materials in a drop-down menu, so that the respective specific properties are used for computing the changeover point.

### Ergonomy and Accessibility

Where a PX 50 and a PX 200 are seen side by side, it becomes noticeable that the center axis is always 130 cm. That allows every tool-setter to work ergonomically for installing the tools, the view of the nozzle or for cleaning work. The development team placed great importance on ease of accessibility from all sides, and therefore large guard doors and removable cladding elements were provided.

The PX is flexible, but is also a solid basis as a technology flagship. With other options, it can also be equipped for lightweight design processes, silicone processing or high-temperature applications – it is also possible to tailor it to particular industries, such as medical technology. In this case, the belt drives are encapsulated, the lubrication systems closed and the machine is operated with food-grade lubricants (class NSF H1).

### Summary

To meet market demands, KraussMaffei has completely redesigned the PX. With this series, all-electric injection molding machines can for the first time be used in a modular and flexible manner to a degree that has only been possible with hydraulic machines until now. ■