ADDING COMPONENTS TO ADD VALUE

ALWAYS IN GOOD HANDS WITH OUR MULTINJECT TECHNOLOGY

KraussMaffei

Pioneering Plastics

APPLICATION AREAS OF MULTINJECT TECHNOLOGY **AS DIVERSE AS YOUR APPLICATION AREAS**

Automotive

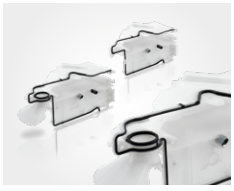
Infotainment cover (turntable technology)

Decorative strip (combination of IML and 2-component injection molding)

Headlight (turntable technology with 4-component machine)

A-pillar paneling (SpinForm technology with ColorForm for a scratch-resistant, high-gloss finish)

Electrical/electronics



Door lock housing with TPE seal (SpinForm technology)

Lens (multilayer technology, turntable or index plate technology)

Hammer drill handle (index plate technology)

Fan thumbwheel (index plate technology)

Consumer goods

Power drill (turntable technology with 3-component machine)

Thermomix cover (turntable technology with 3 stations and 3-component machine)

Sandwich application with recycled material (2-component machine with sandwich plate)

Designer seat with foam core (2-component machine with sandwich head)

Medical technology / Life Science

Disposable pacifier (transfer technology)

Interdental toothbrush made of LSR (2-component machine with transfer technology)

Logistics / Packaging

Trash containers with a sandwich construction and recycled material (2-component machines with sandwich head)

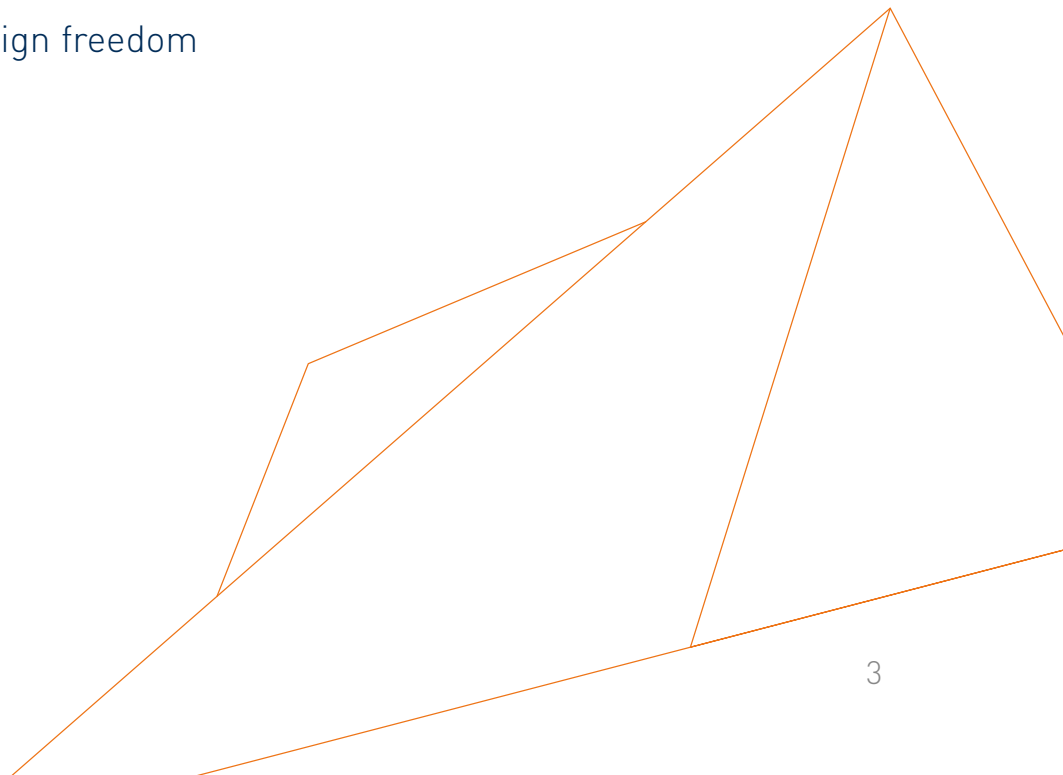
Reclosable can closure (SpinForm technology)

ALWAYS IN GOOD HANDS WITH MULTINJECT TECHNOLOGY **ADDING COMPONENTS TO ADD VALUE**

When it comes to selecting the right Multinject technology, a detailed analysis of the individual task at hand is just as important as the ability to choose the ideal components from a wide range of machines. With its many years of experience in mold and process technologies and its end-to-end machine portfolio, KraussMaffei is able to offer both of these from a single source. Any multicomponent technology is supported – the possibilities are endless. Whichever technology is ultimately best suited to the application, we will find the right solution in order to combine two or more plastics in a single step to create a multifunctional part.

The highlights of Multinject technology at a glance:

– Excellent integration of functions
– Combined material properties
– Integrated workflows
– Improved quality
– Considerable design freedom



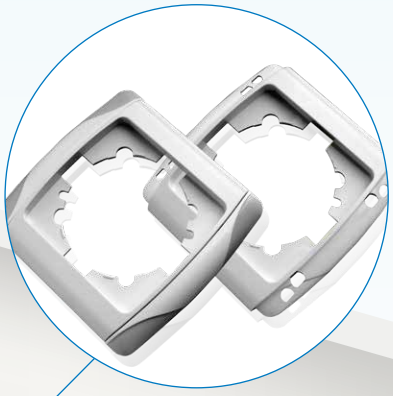
VERSATILITY IN SHAPE, COLOR, AND FUNCTION
MULTINJECT TECHNOLOGY

Cordless screwdriver
Hard/soft material combination for nonslip gripper

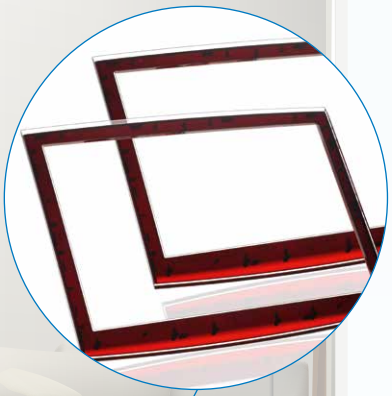
Toothbrush
Colorful soft-touch surface for pleasant haptics

Filter housing
Seals molded on for lasting functional integration

Coffee machine
Refined plastic surfaces thanks to the use of effect pigments



Electrical outlet
Color combinations
for a refined look



TV housing
Clear layer with
3D effect for special
surface effects

Comparison with common process variants

The mold technology is determined by the geometry of the product

With the Multinject or multicomponent technology, the same or different thermoplastics can be combined in a single pass. Various types of plastic can be combined (thermoplastics with elastomers or polyurethane systems), for example.

High bond strengths which are as resistant to external influences as the single-component equivalent can be achieved depending on the material combination and type of bonding. A typical multicomponent injection molding machine combines a clamping unit with several injection units working independently. As a result, the process variants are as wide and varied as the different materials and possible combinations.

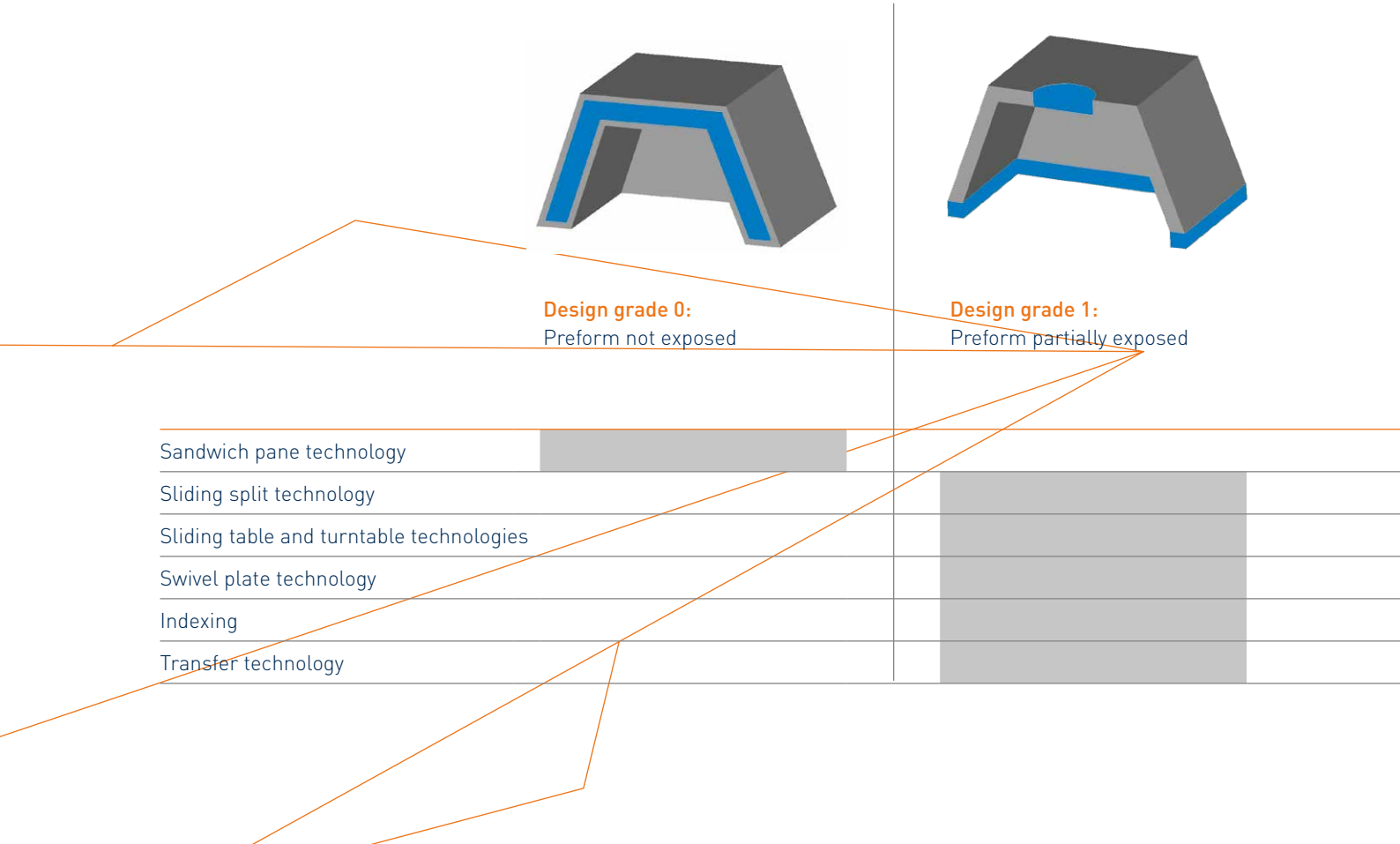
When it comes to selecting the right process, a detailed analysis of the individual task at hand is just as important as the ability to choose the ideal components from a wide range of machines. With its many years of experience in mold and process technologies and its end-to-end machine portfolio, KraussMaffei is able to offer both of these from a single source, serving all manner of industrial sectors.

Joining of components and cycling

Based on how components are joined, a distinction is made between additive molding and sequential molding. Additive molding allows materials to be injected alongside or on top of one another (overmolding). In sequential molding, components are injected one inside the other. With regard to cycling, a distinction is generally made between sequential processes, in which all components are injected into a cavity one after the other, and parallel processes, for which at

Design grade 0:
Preform not exposed

Design grade 1:
Preform partially exposed



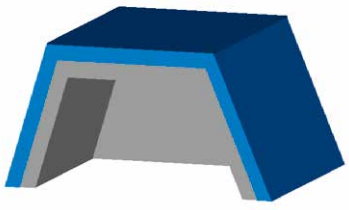
least two different cavities are required. The molds used for the latter are, therefore, larger.

Adhesion is crucial

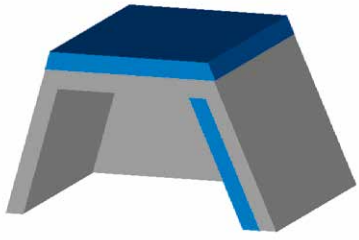
Depending on the type of adhesion, a distinction is made between composite injection molding (i.e., a fixed connection) and assembly injection molding (a moving connection). In composite injection molding, adhesion is dependent on the material pairing, the surfaces, and the injection parameters through cohesion (looping) and adhesion (surface adhesion). If adhesion is poor, the connection can be improved by using mechanical anchorings. If, as is the case in assembly injection molding, the individual components need to retain the ability to move once assembled, non-adhesive material combinations are deliberately selected. The connection is generated with mechanical undercuts.

Multicomponent technology and design grades

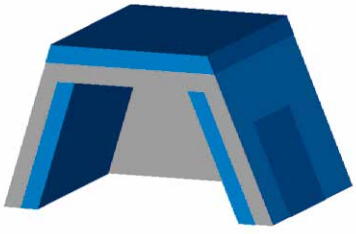
The primary factor determining which multicomponent technology is used is the part geometry, although customer-specific and financial considerations also play an important role. With regard to geometry, there are a number of different design grades. Design grade 0 corresponds to sequential sandwich molding. The higher design grades are all produced using additive molding technologies. Design grade 1 is the simplest geometry which can be produced with each additive molding technology. The higher the design grade, the fewer technologies can be used to produce it. A more detailed description of which design grade of a part can be produced with which technology appears below. This description is based on a consideration of the source side and geometry of the second component. The preform must be exposed accordingly.



Design grade 2:
Preform exposed on one side



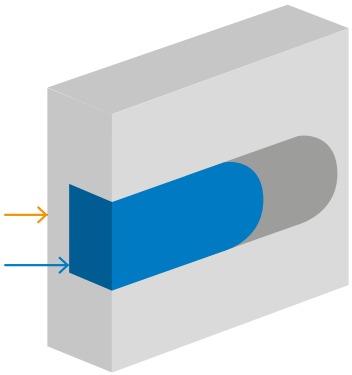
Design grade 3:
Preform exposed on one side, partially exposed on underside



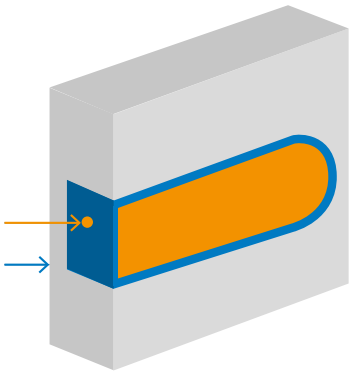
Design grade 4:
Preform exposed on both sides

Flexibility afforded by adapter plate or sandwich head
Sandwich pane technology

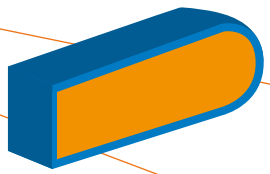
Sandwich technology is suitable for all two-component parts that consist of an outer and an inner component. In applications of this type, the parts are design grade 0 (see table), in which the preform does not need to be exposed.



Injection of the outer component = skin



Injection of the core material into the core of the first component



Finished product, shown in cross-sectional view

The outer component usually forms a premium quality skin. Either recyclate, a filled material, a foam core, or another cost-effective option can be selected as the inner component.

In the case of sandwich pane technology, the process starts with the mold being partially filled with material 1 for the outer skin. Following a brief simultaneous phase during which both materials are flowing, the core material (material 2) is injected into the core of the outer material.

Marbled effects can be achieved by injecting the same material alternately in different colors.

Adapter plate for small shot weights

The use of an adapter plate is recommended for small- to medium-sized machines. The plate is attached to the fixed platen. In this "sandwich plate", the melt flow is bundled under controlled conditions. The adapter plate can easily be removed, making the machine very flexible in application. Conventional cold runner technology is usually used for the molds.

Sandwich head for larger shot weights

The use of a sandwich head is more cost-effective in large machines. The sandwich head joins the primary and secondary plasticizations by means of piggybacking. This technique enables the shot weights from the primary and secondary plasticizations (some of which can vary significantly) to be used for single-component applications either separately or together alongside standard sandwich injection molding.

Sandwich head joins primary and secondary plasticizations

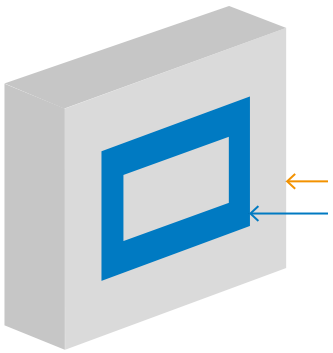
YOUR BENEFITS:

- Economical thanks to the use of cost-effective filler materials
- Can be used with cold runner technology with standard molds
- Sandwich plate for straight-forward retrofitting of existing two-component machines
- Sandwich head flexible for use in single-component applications
- Adapter plates can be used for all machine configurations (Z, L, and V)

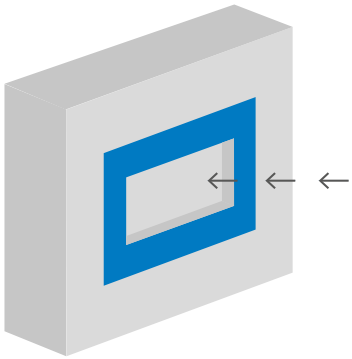
Example application for Y supply lines:
Resistant to media thanks to a combination of specific materials; produced synchronized with water injection technology

Compact and cost-effective solution **Sliding split technology**

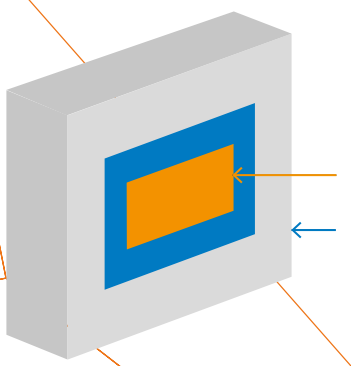
Sliding split technology is suitable for all design grade 1 parts in which the preform must be partially exposed. A standard multicomponent machine without swivel unit can be used for this purpose.



Injection of the first component



Pulling the sliding split



Sequential injection of the second component

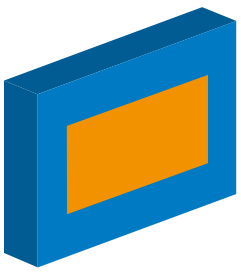
The major advantage is that the molds are very compact and cost-effective by design, as only one cavity is needed for a finished part. In terms of the process, once the main component has been injected into the mold and the preform has cooled down, the sliding split from which the technology gets its name (also called the blocking slide) is pulled to release the zone for the second component.

Next, the second component is injected sequentially. The mold remains closed throughout the process; only the clamping force is reduced before the core is pulled.

Freely programmable core-retractions

Thanks to the design of the mold and the way in which the second component is joined, in this process, there is no need to transfer the preform or rotate the mold. The freely programmable core-retractions with standardized interface mean that the splitters can be programmed flexibly and run according to the settings with an MC6 control system.

The touchscreen version of the MC6 control system provides a variable user interface on which only the functions that are necessary for the prevailing application are displayed. This prevents data entry errors during programming. The splitter function can easily be assigned to each core-retraction.



Finished part – full view

Compact production unit with unloading robot for the production of wind deflectors using sliding split technology

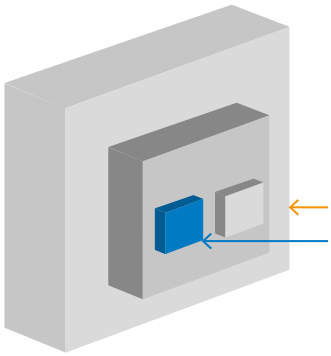
Example application, wind deflectors:
Integrated seal does away with the need for assembly work

YOUR BENEFITS:

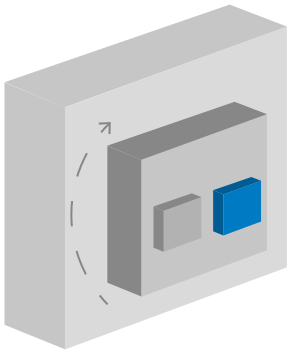
- Optimum sealing against second component as first component remains in the cavity
- The mold does not need to be transferred or rotated
- Compact and cost-effective mold design
- Flexible and straightforward programming of core-retraction functions with MC6 control system

Traditional turning with modern technology
Turntable technology

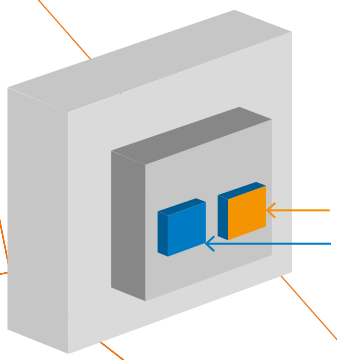
Turntable technology is by far the most common technology used to produce multicomponent parts. It is suitable for design grade 1 and 2 parts, i.e., parts with single-side or partial exposure.



Injection of the first component



Turning of the mold half on the moving side with a turntable



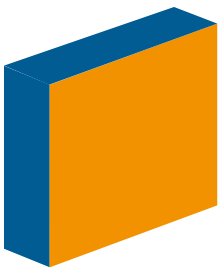
Injection of the second component with simultaneous injection of the first component

This technology is used if parts have to be overmolded from one side and higher production rates need to be achieved.

In the turntable technology process, once component 1 has been injected, the mold is opened and rotated by the turntable on the moving platen before being closed again. After this, the second component is injected at the same time as the first component is injected into the other cavity. Ejection takes place before or after turning. Depending on prevailing requirements, the process will involve two (0°-180°-0°), three (0°-120°-240°-360°), or four (0°-90°-180°-270°-360°) turning cycles.

Turntables with servomotor as standard

As standard, all KraussMaffei turntables are equipped with a servomotor to turn the mold. They are capable of high-precision movement at high levels of dynamism. As the machine hydraulics are independent, turning can take place in parallel with the opening motion of the mold. The turntables benefit from centralized lubrication and are mounted on bearings which have been dimensioned to support heavy molds. The clamping force determines whether built-on or built-in turntables are recommended. Built-on is the recommended option for small to medium clamping forces from 650 to 2000 kN, and built-in for clamping forces above 2000 kN.



Finished part – full view

KraussMaffei turntables are characterized by hard-wearing mechanics and generously dimensioned media circuits

YOUR BENEFITS:

- Optimum sealing against second component as first component remains in the cavity
- Parallel process for high production rates
- Low-maintenance thanks to hard-wearing mechanics and automatic centralized lubrication
- Short cycle times thanks to effective mold cooling and electric hand axis

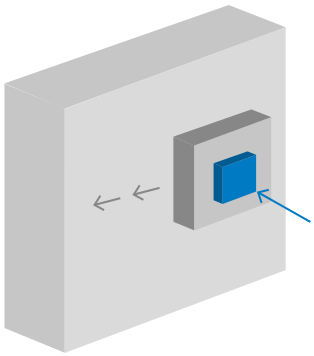
Generously dimensioned media flow

Built-on turntables are equipped with up to six inputs and six outputs for media flow. They can be configured for water and oil circuits. Built-in turntables have twelve media circuits: 8–10 for water and 2–4 for hydraulic oil. This provides sufficient capacity even for applications which use significant amounts of cooling water.

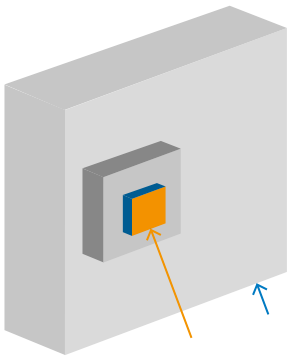
Sample application, grinder housing:
Hard/soft combination for improved haptics

Simple mold technology for low investment costs
Sliding table technology

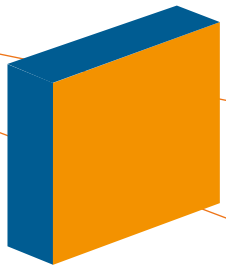
Like turntable technology, sliding table technology is also suitable for design grade 1 and 2 parts, i.e., parts with single-side or partial exposure.



Injection of the first component with subsequent movement of the core side to cavity 2



Injection of the second component



Finished part – full view

However, unlike the frequently encountered turntable technology, sliding table technology is more suitable for lower production rates, such as those found in prototype manufacturing or small batches, as the sequential nature of the individual stages of the process necessitates a longer cycle time. One advantage is the straightforward nature of the mold technology used for sliding table technology.

In sliding table technology, the mold consists of one core side and two cavity sides, with one component representing the contour of the second component. The sliding table technology process starts with the first component being injected into the mold. After this, the mold is opened and the core side is slid onto the second half of the cavity. The mold is closed and the second component is injected. Material 1 and material 2 are injected sequentially.

Flexible mold configuration

The sliding mechanism is an integral component of the mold. The sliding table moves in the same way as in sliding split technology, based on freely programmable core-retractions controlled by the proven MC6 control system. The machine can be equipped with components from the extensive CX, GX, and MX Series portfolio.

Production of seat belt buckle covers with SkinForm technology and sliding table technology

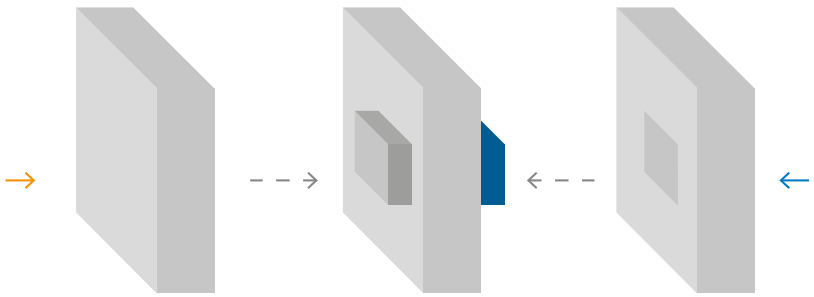
YOUR BENEFITS:

- Optimum sealing against second component as first component remains in the cavity
- Simple mold technology for low investment costs
- Unrestricted cooling of both halves of the mold is possible as rotation is not required
- Straightforward and precise process control thanks to the clear structure of the MC6 control system

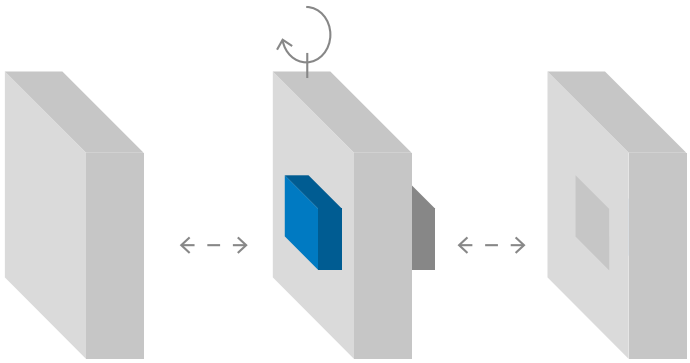
Sample application, seat belt buckle cover:
Change of color from shot to shot achieved by combining sliding table and SkinForm technologies

Double production rate with same size machine **SpinForm technology**

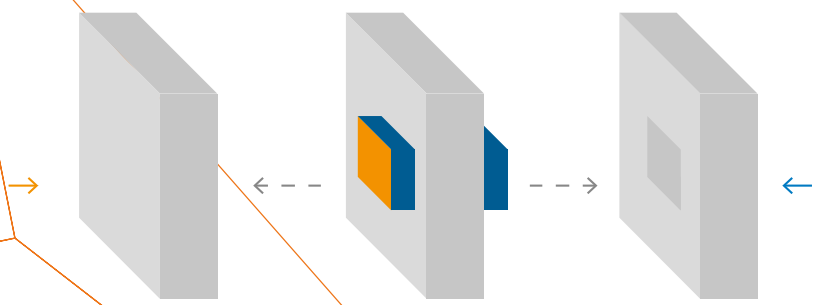
SpinForm technology is particularly suitable for large-format, contoured parts or applications with high numbers of cavities. Like the turntable and sliding table technologies, SpinForm is also suitable for design grade 1 or 2 parts.



Mold closing, injection of the first component



The mold is opened and the spin unit rotated.
Mold is closed.



Injection of the second component. The first component for the next part is injected at the same time. Finished part is ejected.

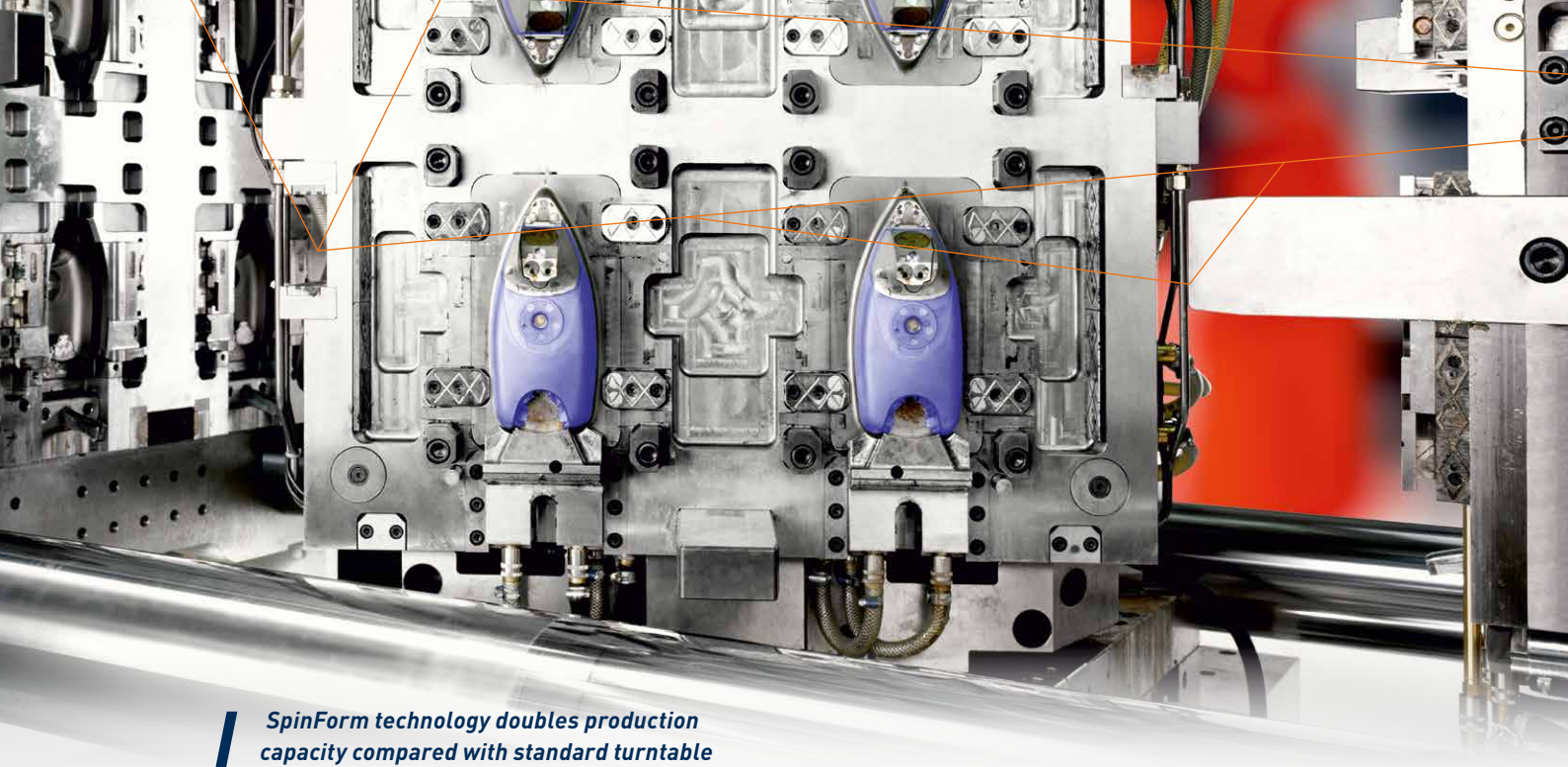
In SpinForm technology, the knitpath parting lines are located one behind the other and the injection units are opposite one another on the machine axis. A turntable, known as the spin unit, which rotates around the vertical machine axis, is located in the center.

The SpinForm technology starts with the first component being injected into the mold. The resulting preforms are fixed on the core of the spin unit when the mold is subsequently opened. Next, the spin unit turns through 90° for cube molds or 180° for mounting stack swivel-platen molds and the preforms are overmolded with the second component in the new cavity. The next preform is created in parallel with this process.

Suitable for heavy molds

With this mold technology, the spin units are mounted on a sliding table which sits on the machine bed. Heavy molds can thus be supported and the vertical distance between tiebars can be optimized as appropriate for the mold concept. Like the turntables, all spin units are driven by servomotors and benefit from centralized lubrica-

Finished part – full view



SpinForm technology doubles production capacity compared with standard turntable applications

tion. Media are supplied from below through the rotary distributor in the machine bed. This leaves space for generously dimensioned media circuits with a hose diameter of up to 2".

Open for cubes and peripherals

Optimized access from the side makes interfacing with automation and peripherals easy. Intermediate steps, such as the addition of inserts, pre-processing of the preform or demolding of parts from the side, can be introduced, for example. For this purpose, molds known as cube molds with four mold halves are used on the spin unit.

Zero stress in the part

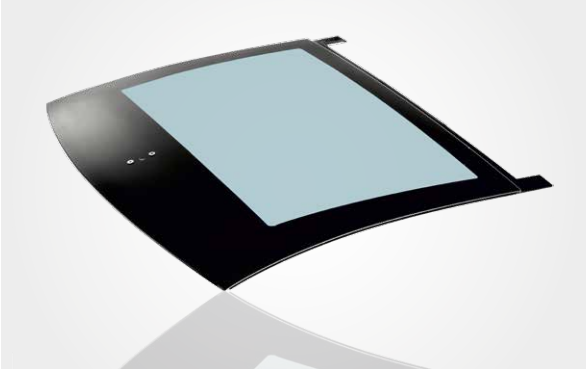
Large-format, contoured parts are often compression-molded to reduce stresses and achieve longer flow paths. Necessary processes such as expansion compression, SGI, and glazing can be integrated into any SpinForm solution. In this type of application, compression molding can take place sequentially in each half of the mold.

Suitability for cleanroom use included

SpinForm machines can be used in cleanrooms due to their two-platen technology. Special features of the motor design minimize air turbulence and temperature fluctuations. The housing concept used for the clamping unit facilitates easy definition of the cleanroom.

YOUR BENEFITS:

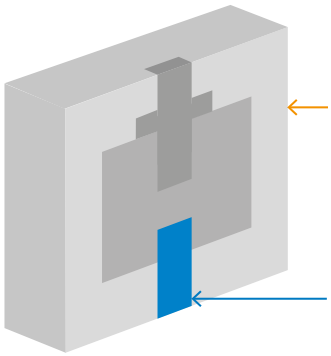
- Double production capacity with machine of the same size
- Improved cooling performance thanks to generously dimensioned media circuits
- No limitation on large-format, contoured parts
- Suitable for cleanroom use
- Compression molding processes can be integrated



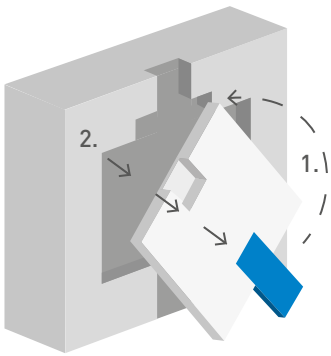
Sample application, sun roof:
Assembly parts are integrated in the part

Lifting to increase design freedom
Index plate technology

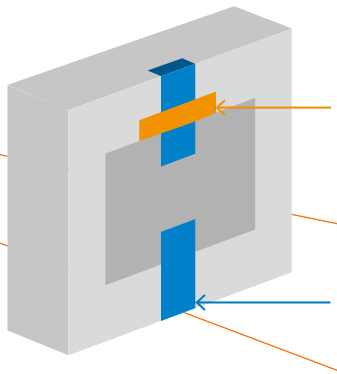
For design grade 3 parts, the preform has to be lifted during the production process. As this cannot be done with a turntable, index plate technology is recommended.



Injection of the first component



Lifting, turning, and pulling back of the index plate



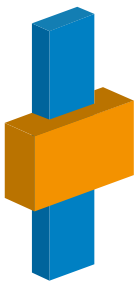
Injection of the second component. The next preform is injected in parallel.

This technology covers design grades 1 to 3. It has the advantage over transfer in that the preform remains partially in the cavity and can thus be more effectively sealed against the second component.

In index plate technology, the first component is injected into the cavity, which is part of the index plate. Next, the preform and index plate are pushed forward and out of the mold half by the machine and turned through 90°, 120°, or 180°. When the index plate moves back, the preform is set down on the core of the second component. It is then overmolded from both sides with the second component (the ejector side can only be partially insert-molded).

Intelligent machine technology reduces mold costs

In indexing applications, the index shaft and drive have traditionally been component parts of the mold, resulting in both high mold costs and large mold assemblies. The KraussMaffei solution uses production cells with the index drive unit and/or index shaft integrated on the machine side. The two-platen clamping concept provides sufficient space for the index drive motor, which is installed behind the ejector plate so that no installation height is lost. The drive unit is a servo motor and thus operates independently of the machine hydraulics. The index shaft has four water circuits and the hoses are connected via a separate energy chain.



Finished part – full view

Compact positioning of the index drive unit behind the ejector

YOUR BENEFITS:

- The drive technology is a unique part of the machine. Follow-up costs for molds are significantly reduced
- Improved access and rapid mold changing thanks to the simple interface
- Effective cooling of the part due to four cooling circuits
- Short cycle times achieved through optimized rotational speed of the index shaft in parallel with movement of the mold

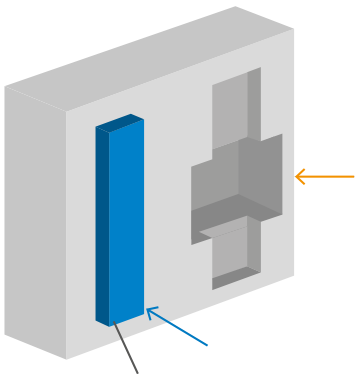
High availability thanks to fast set-up times

At the moving platen, a media and torque transfer point provides the interface to the mold. As the mold does not have to feature an index shaft, its design dimensions can be reduced accordingly. Work to maintain and change molds can thus be carried out quickly and easily. Mold investment costs are reduced, because the molds can share a common drive and shaft.

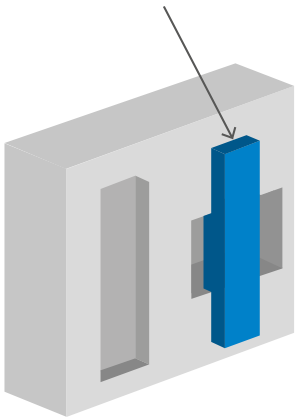
Sample application, ventilation flap:
Integrated seals render rework unnecessary

Two become one
Transfer technology

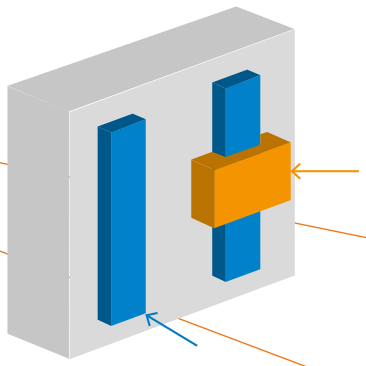
Design grade 4 parts can only be produced with transfer technology, as the second component is distributed on the first component in such a way that the preform cannot remain in the first cavity.



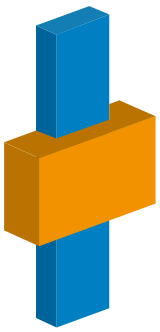
Injection of the first component



Transfer of the preform to a new cavity



Injection of the second component.
The next preform is injected in parallel.



Finished part – full view

This mold technology is the most flexible multicomponent technology which can cover all design grades. This process is also used, for example, in the production of thermoplastic/rubber compounds to achieve thermal separation of both components.

In the transfer technology process, the preform is taken out of the first component using a robot, and it is transferred to a new cavity or other injection molding machine, where the second component is injected. Meanwhile, the new preform is already taking shape in the first cavity.

Unit comprising machine and automation

KraussMaffei uses robots from its own IR and LRX Series for transfer tasks. These automation solutions have long been established on the market and are capable of precision repeatability at high speeds. At the core of each one are hard-wearing mechanics with high-performance servo drives. Rapid closing movements and accurate part insertion can thus be assured without the usual axle vibration, even when traveling at high speeds.

Faster thanks to BUS technology

High-resolution signal processing and thus extraordinary precision in transfer technology is assured by high-speed VARAN bus systems combined with the

Production of a preform on injection molding machine 1, demolding with automation, buffering and insertion with automation in injection molding machine 2 for overmolding of the second component

YOUR BENEFITS:

- Can be used for many multi-component parts with design grade 1 to 4
- Two single-component machines can be combined to create a multicomponent production cell
- Maximum precision thanks to VARAN bus technology
- No hot/cold separation in the mold required for thermoplastic/rubber compounds

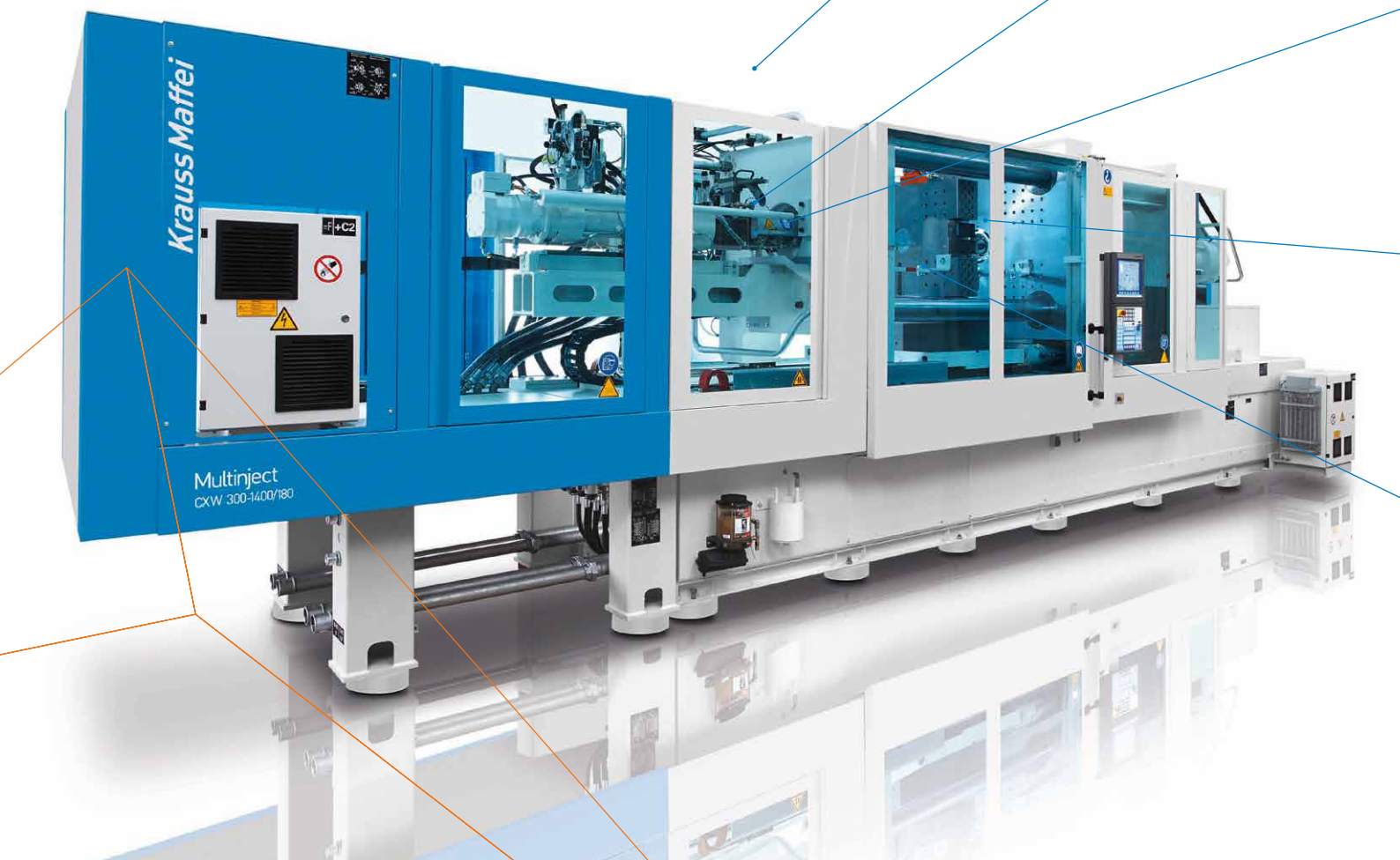
MC6 control system working in master/slave operation. Programming is quick and easy thanks to the intuitive learning operating concept. Maximum accuracy is assured by the absolute position measuring system of the robots, which is a standard feature. A common control system minimizes interfaces and operator errors. The systems conform to CE as standard and demonstrate the philosophy of "machine and automation as a single unit" in practice.

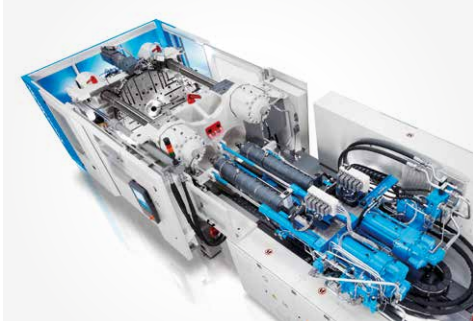
Sample application, perfume bottles:
Part geometry requires the use of transfer technology

The ideal machine configuration for each and every task
Flexible machine arrangement

Thanks to the flexible arrangement of the injection units, KraussMaffei injection molding machines are able to support numerous options for the production of multicomponent injection-molded parts.

As the machines are so easy to access, injection units for the second component can be freely configured as appropriate for the prevailing infrastructure and available mold technology. All machines are very compact by design.





H-position – Parallel arrangement
- Good accessibility to both injection units and the mold
- Lowest design
- Fewer deflections in the mold

V configuration – Vertical arrangement
- Primary injection unit is easy to access
- V injection unit can move fully out of the clamping zone
- Molds can be changed quickly

Z configuration – Piggyback arrangement
- Extremely compact design
- Does not require a specific ceiling height
- Ideal for applications where space is at a premium
- Ideal for cleanroom applications

L configuration – Lateral horizontal arrangement
- Both injection units are easy to access
- Low design so particularly suitable for low ceiling heights
- Easy to retrofit

W configuration – Horizontal arrangement
- For SpinForm technology with swivel plate or cube mold
- Alternative to turntable for high output
- For large parts

With ColorForm and SkinForm coating in closed mold
Integration of functions beyond process boundaries

ColorForm and SkinForm are production concepts which enable complex multicomponent parts with leather-look soft-touch or high-gloss surface finishes to be produced cost-effectively in a single step. They have been developed in the context of collaborative projects involving KraussMaffei and industrial partners. They can be combined with thermoplastic, duroplastic, and polyurethane substrates.

The process starts with the injection of the substrate. Next, the mold is turned and then closed again. The PUR system is injected in a second cavity which partially or fully covers the surface of the substrate. This is how high-gloss surface finishes are achieved with ColorForm.

The SkinForm process is all about leather-look surfaces which can be lent additional soft-touch property patterns covering part or all of their surface.

Furthermore, the ColorForm and SkinForm processes can be combined with multicomponent processes. Depending on the part, more plastic components are injected for even more extensive functional integration.

Hard-wearing two-component injection molding cell with SpinForm technology

ColorForm and SkinForm parts are usually produced with fully integrated production cells. The basis is usually provided by a swivel plate injection molding ma-

Sample application, tool box:
High-gloss surfaces can be produced cost-effectively with ColorForm

YOUR BENEFITS:

- High-gloss surfaces in one process cycle
- Cost-effective thanks to single-stage production with high degree of automation
- Uses less material than downstream paint finishes
- Highly resistant to scratches and adjustable surface hardness
- Flexible color management with impressive 3D effects

MXW 1600-8100/3000
injection molding machine

YOUR BENEFITS:

- Leather-look and soft-touch surfaces in a single step
- Cost-effective thanks to single-stage production with high degree of automation
- Simple logistics when compared with downstream paint finishing/ laminating
- High scratch and abrasion resistance
- Flexible color management
- High dimensional accuracy of the surface structure

chine with PUR metering machine which is additionally equipped with handling robots and other peripheral devices. Particular emphasis is placed on the mold technology, since the process will only succeed if the fit is exact and parallel. This is ensured by the optimized geometry of the two-platen clamping unit. The very low-viscose PUR system can thus be applied to the thermoplastic substrate with high precision, even in thin layers. The PUR systems harden while the mold is closed.

Metering machine and mixing head for precision and low volumes

The application of the PUR system involves a RimStar Nano metering machine with a new in-house pump design. This metering machine has been dimensioned specifically for low volumes. The self-cleaning mixing head, which is fixed to the mold, safeguards the precision pour from the PUR system while also providing excellent protection against abrasion and optimum mixing throughout lengthy production runs.

Sample application, parts for vehicle interiors:
Cost-effective production with SkinForm soft-touch surfaces

OUR WORLDWIDE EXPERTISE IS YOUR ADVANTAGE
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With your KraussMaffei machine, you have chosen a product that delivers the highest levels of productivity and reliability. In addition to our range of machinery, KraussMaffei focuses on comprehensive and future-oriented solutions, innovative business models and an innovative portfolio of digital products.

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KraussMaffei is the only supplier in the world with a product range comprising the most important machine technologies for plastic and rubber processing: injection molding machinery, automation, reaction process machinery and extrusion technology. KraussMaffei is represented worldwide with more than 30 subsidiaries and over 10 production plants as well as about 570 commercial and service partners. Working together with our customers and partners, we are thus in a position to offer vast and unique expertise in the industry.

You can find further information at:
www.kraussmaffei.com

KRAUSSMAFFEI – PIONEERING PLASTICS

Extensive expertise from a single supplier

KraussMaffei is one of the world's leading manufacturers of machinery and systems for producing and processing plastics and rubber. Our brand has been synonymous with cutting-edge technology for over 180 years. Our product range includes all technologies in injection molding, extrusion and reaction process machinery. KraussMaffei has a unique selling proposition in the industry as a result. By drawing on our proven innovative capacity, we can guarantee our customers sustained additional value over their entire value-adding chain through our standardized and individual product, process, digital and service solutions. The range of our products and services allows us to serve customers in many sectors including the automotive, packaging, medical and construction industries. We also supply manufacturers of electrical and electronic products and household appliances.

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ALWAYS IN GOOD HANDS WITH OUR MULTINJECT TECHNOLOGY

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