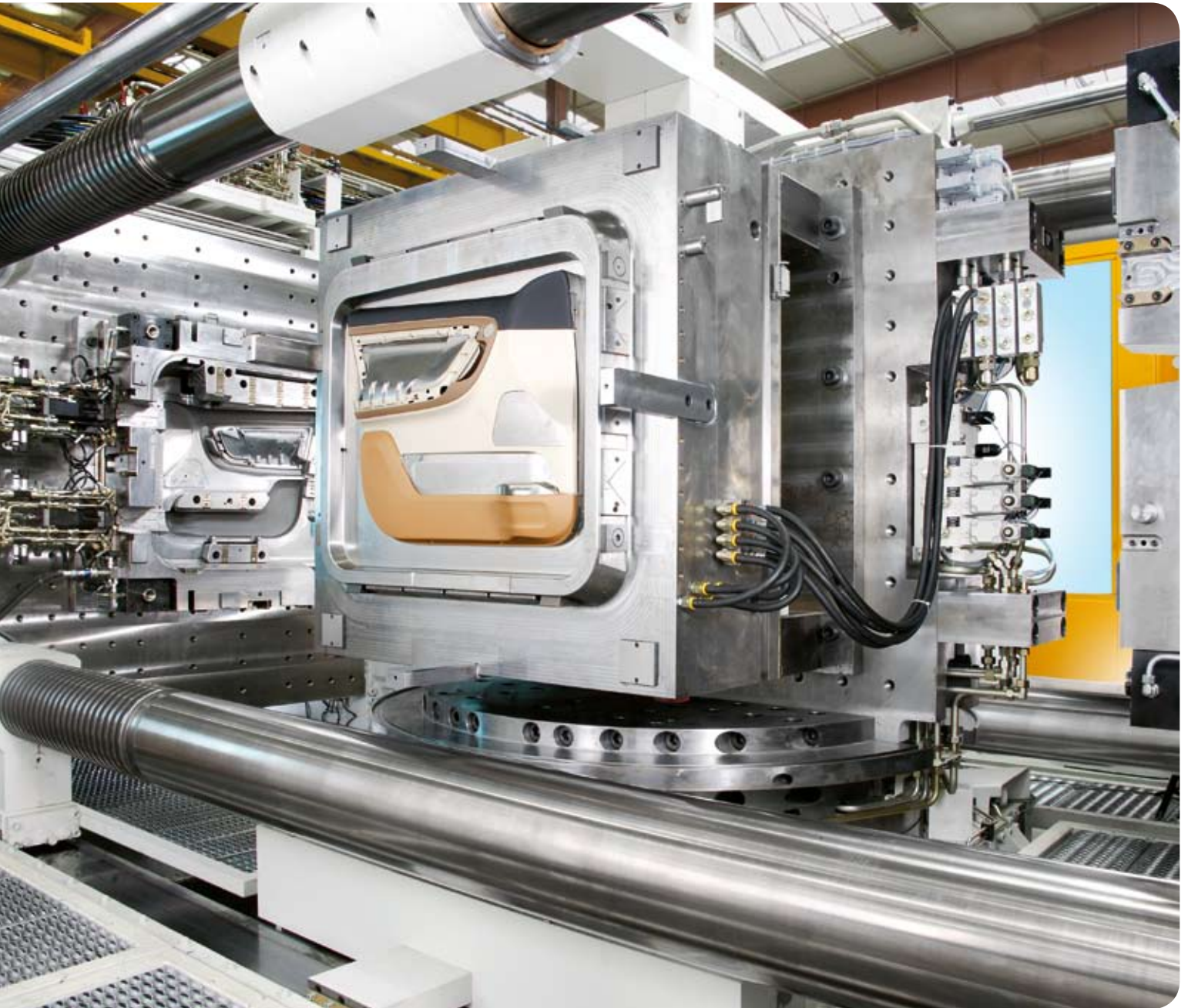


KraussMaffei

PEOPLE FOR PLASTICS



SKINFORM® TEAMS INJECTION MOULDING WITH REACTION PROCESSING

SkinForm®: Cost-Effective polyurethane coatings for thermoplastic parts in a one-shot process

IN PARTNERSHIP WITH INDUSTRY

KraussMaffei is a premium partner for the plastics and rubber processing industries worldwide



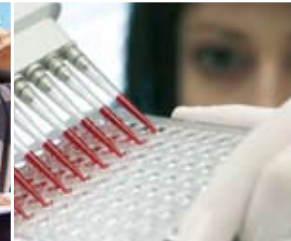
Automotive



White goods



Construction



Medical/pharmaceutical



Electrical/electronics

Whatever you aim to achieve in plastics or rubber processing, KraussMaffei is your partner. We are the only company with intensive expertise across the three main engineering fields. And we have a strong track record in integrating this expertise to develop new processes and systems.

Ready for any challenge

Our **Injection Moulding Technology Division** supplies machines and systems for standard and special applications, very large machines and fully automated solutions. Our main markets are in the automotive, packaging, electrical, electronics, medical technology and consumer goods industries. Our **Reaction Process Machinery Division** supplies machines and complete systems for processing polyurethanes and other reactive materials. Completing our product portfolio, **Tooling Technologies** supplies foam moulds, cutters and routers. Our customer base is wide, with a focus on the automotive, construction and white appliances industries.

Our **Extrusion Technology Division** supplies machinery and systems for compounding, for pipe, profile and sheet extrusion, physical foaming, and the production of technical rubbers and intermediates for tire production. Machinery from the company's range – from single extruders to

complete extrusion lines – is used in many industries, including chemicals, pharmaceuticals, automotive, construction, furniture and packaging.

People for Plastics

We are the “people for plastics”. We are your partners from the first exploratory discussion, through development to commissioning, servicing and operating your system, and final disposal. At all times, you are assured of outstanding competence in planning and engineering, as well as reliable and fast spare parts, service and support.

Adding value for customers

We put our expertise to work for your success. With machine ranges engineered for modularity, we can deliver application-specific solutions based on our wide range of standard modules and specially engineered solutions. This strategy offers customers technical and cost advantages.

Close to customers around the world

As an international company, KraussMaffei has a presence in all the major markets for the plastics and rubber processing industries and employs over 3,000 people worldwide. Our sales and service network keeps us close to all our customers around the world.

SkinForm® – an intelligent combination of injection moulding and reaction processing for a one-step process



Packaging

SkinForm® is a new process that combines the advantages of injection moulding and polyurethane processing. SkinForm® is a one-shot process for producing complex composite parts that combine a thermoplastic and a polyurethane.

In the automotive industry, SkinForm® can be used to add value in the form of attractive, highly scratch-resistant surfaces with the look and feel of leather. PUR opens up a huge range of applications – from high-value paint systems to foam systems for softtouch effects, acoustic or damping properties. Integrating different production stages in one machine and in a one-shot process, it is possible to produce parts with new functionality and to save on expensive post-processing. All these factors make SkinForm® a system worth looking at for your business.

DESIGN BASICS

SkinForm® – innovative production concept for multicomponent parts combining a thermoplastic with polyurethane

The intelligent combination of injection moulding and reaction processing results in convincing technical benefits.

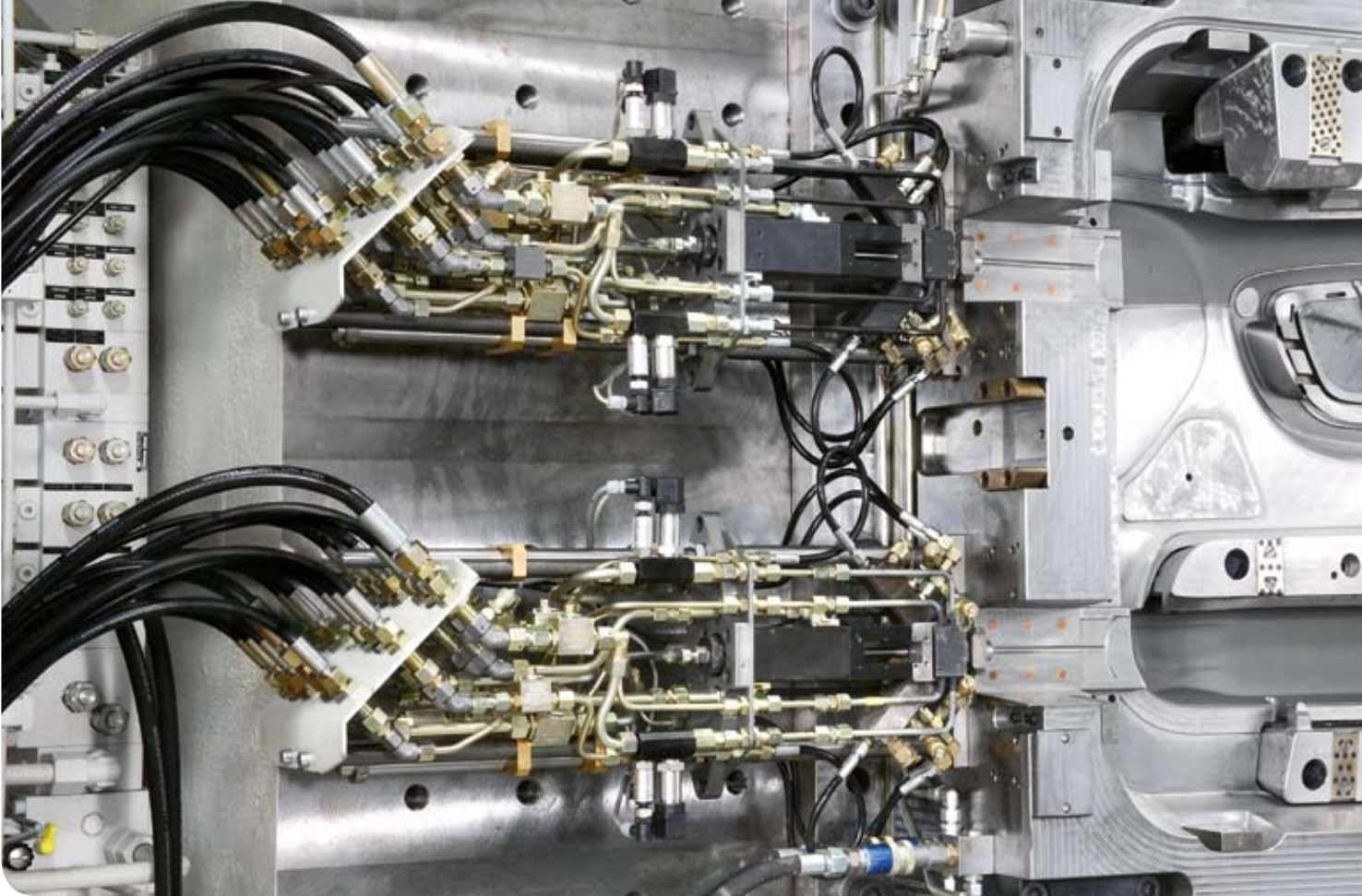
What is SkinForm®?

A technology is a technology developed by KraussMaffei for making multicomponent parts combining the benefits of the two processing techniques. The first step of the work cycle produces a thermoplastic substrate. In the second step, the substrate is partly or completely coated

with polyurethane in the mould. The technology was premiered at the K2004 in Düsseldorf with a system making a seatbelt buckle cover. Even with this early system, it was easy to demonstrate all the advantages of the thermoplastic/polyurethane material combination.



SkinForm® – seatbelt buckle cover with leather look, localized softtouch zones, with wall thickness changes of between 0.8 and 4 mm in the PUR zone, and very high resistance to scratching and abrasion.



Direct, flexible mixing head fixing on mould

Your benefits

Processing benefits of injection moulding and automation

- One-step process
- An easier way to make complex components
- Great design freedom
- High-precision clamps with high clamping forces available
- Proven multicomponent mould and transfer technologies (eg, spin-platen, turntable, indexing platen, sliding table)
- Flashfree polyurethane products
- Short cycle times
- Fully automated, incl. post-processing

Polyurethanes: materials with big benefits

- High-quality haptics, look&feel of leather
- High scratch and abrasion resistance
- Overall, or localized, softtouch zones
- Abrupt wall thickness changes with no substantial increase in cycle time
- Thin-walled coating – cost-effective enhancement for substrates

- High-quality, undistorted reproduction of mould surface textures (graining)
- Versatile colour variation with innovative pigment metering; colour changes from shot to shot
- Compensates for sink marks
- Composite parts with very low warpage risk

SkinForm® process

The starting point for SkinForm® technology is multicomponent injection moulding. Mould technology is basically similar. Proven multicomponent machine and mould technologies (eg, spin-platen, turntable, indexing platen, sliding table) can be used for SkinForm. Instead of a second thermoplastic injection unit, a SkinForm® machine has a PUR mixing head docked onto the mould cavity. The PUR is metered by a PUR metering machine. The actual mould design is determined by the part geometry and production volume.

COST SAVINGS

Cost savings through the one-shot SkinForm® process and efficient use of PUR materials

Cost benefits from efficient use of PUR

In principle, almost all thermoplastics and PUR systems are suitable for SkinForm. Polyurethanes have many advantages over other materials, especially for producing high-quality surfaces. Their low viscosity makes it possible to produce a very thin coating layer over a large substrate area. At the same time, PUR foam systems offer tremendous scope for integrating acoustic, damping and softtouch functions into the one-shot process. The fact that density can be varied within a wide range is another advantage.

Injection moulding, with the possibility of high clamp forces, and the high-precision of today's multicomponent moulds are two factors that make composite PUR/thermoplastic injection moulding with SkinForm® a successful process. And there is the bonus that manual post-processing, often necessary in conventional PUR processing, falls away completely.

SkinForm® as a substitute for soft painting: cost comparison for a cover

Cover as example	Material	Price factor
Injection moulding [1C]	ABS	1
Soft painting	ABS + soft paint	2–2.2
Insert moulding	ABS + film	2–3
Back injection/compression	ABS + decor/softtouch film	2.5–4
SkinForm®	PA + PUR	1.9–2.2

SkinForm® cost benefits

These are the factors that deliver SkinForm's important benefits:

- **Cost-efficient use of material:**
PUR can be coated thinly over large areas, it follows substrate contours exactly and is available in low densities.
- **Productivity with highly-integrated production systems:**
several production steps on different machines can be integrated into a single manufacturing cell using the one-shot SkinForm® process. For example, the conventional three-layer structure of a door trim section or an instrument panel (skin + semi-rigid foam + substrate) can be replaced by a two-layer structure (PUR softtouch layer + thermoplastic substrate). The number of production machines is reduced from three to just one.
- **Lower labour costs:**
high levels of process integration and automation eliminate labour-intensive post-processing.

- **Much lower logistics effort:**
the integrated one-shot process reduces or eliminates costs of handling, transporting and storing semi-finished parts before final processing in conventional production.
- **Lower overheads:**
space savings from having just one compact system help to reduce overhead costs.
- **Fewer rejects:**
the excellent dimensional stability of the thermoplastic substrate in the integrated SkinForm® process means fewer rejects than with direct PUR processing. This contributes to cost savings. Compared with other surface-enhancement processes, SkinForm® delivers not only a more stable and flexible process, but also attractive cost benefits.

SkinForm® production cell of the CX type.
Type KM 160-750 CX,
LR 100 and RIM-Star
MiniDos



Cost effective

TRANSPARENT TECHNOLOGY

Meet the machine: take a tour of a SkinForm® system solution

Injection unit

Produces the thermoplastic substrate with high repeatability and best material quality

Punching, laser cutting, routing

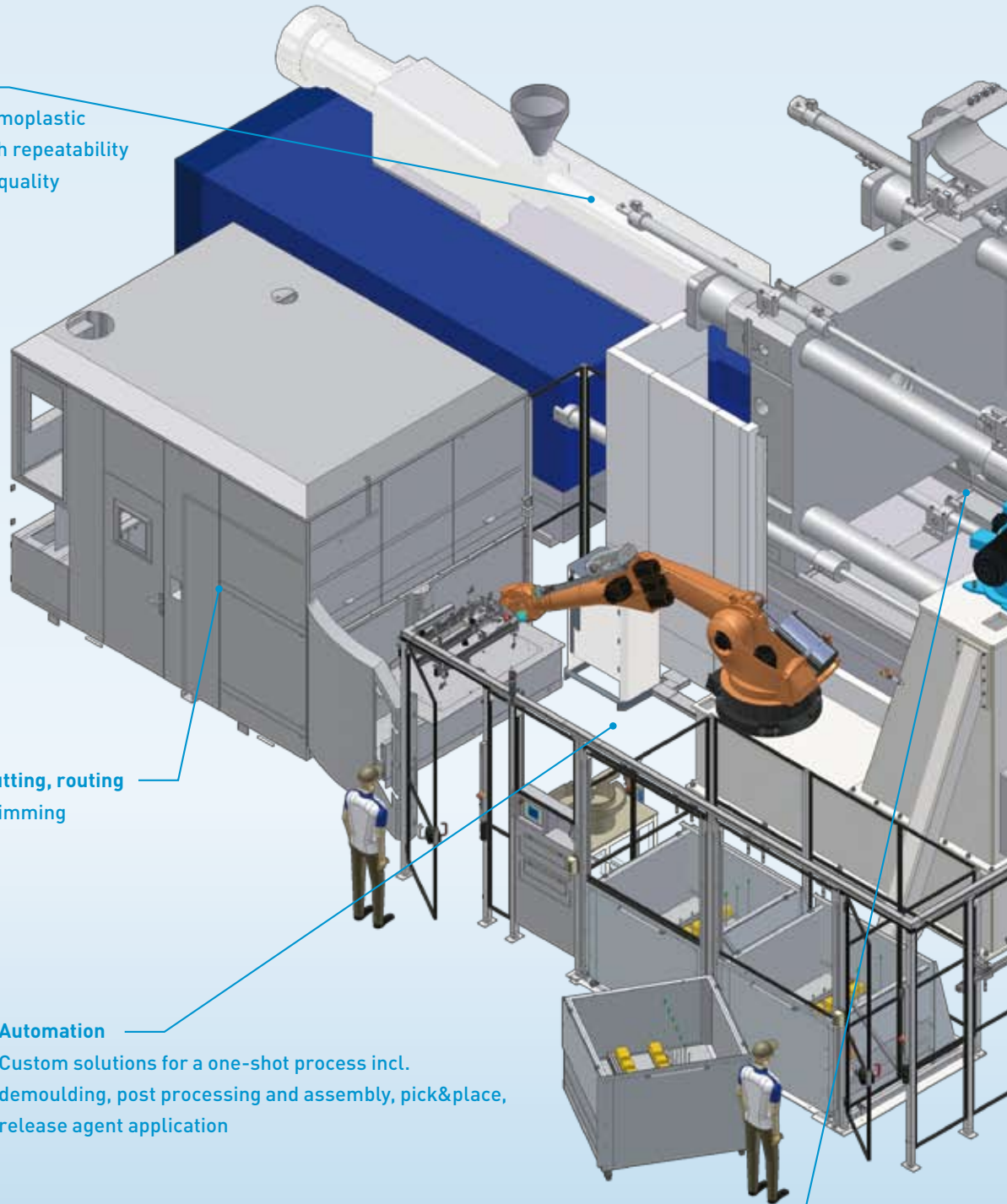
Fully integrated trimming

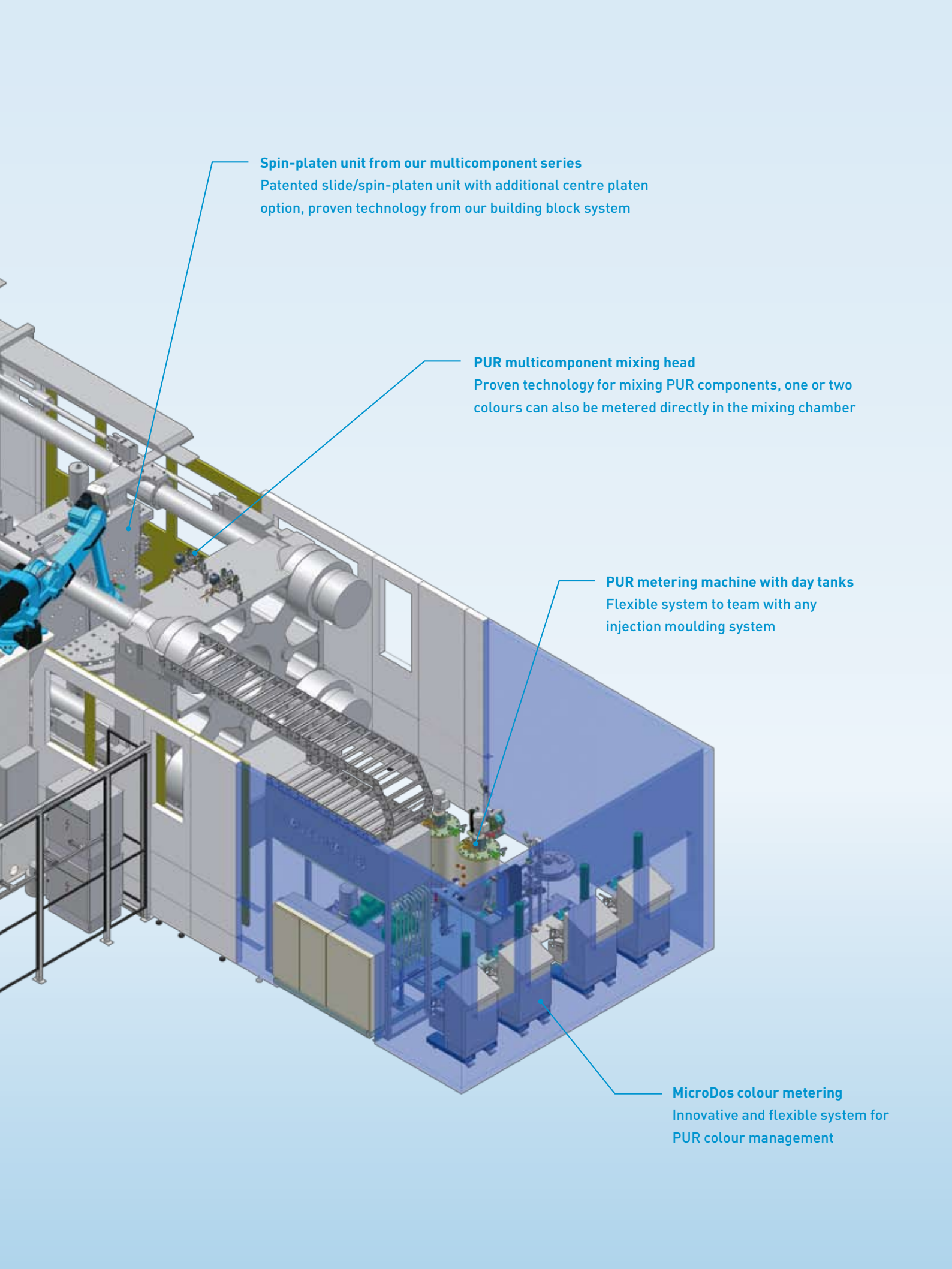
Automation

Custom solutions for a one-shot process incl. demoulding, post processing and assembly, pick&place, release agent application

Part, mould technology

Complete turnkey solutions, know-how support in implementing SkinForm® systems





Spin-platen unit from our multicomponent series
Patented slide/spin-platen unit with additional centre platen option, proven technology from our building block system

PUR multicomponent mixing head
Proven technology for mixing PUR components, one or two colours can also be metered directly in the mixing chamber

PUR metering machine with day tanks
Flexible system to team with any injection moulding system

MicroDos colour metering
Innovative and flexible system for PUR colour management

INJECTION MOULDING

Injection moulding systems from KraussMaffei – proven quality across the whole range, the starting point for new technologies

KraussMaffei is a system supplier for tried-and-tested injection moulding systems with clamp forces from 35 to 5400 t.

Market leader in injection moulding technology

Our hydraulic machines comprise of the CX series for small- and medium-tonnage machines up to 650 t, and the MX series of big machines above 800 t. We also offer an all-electric EX series. With this product portfolio, KraussMaffei is among the market leaders in injection moulding machines. From standard to highly complex injection moulding processes, our systems are designed to be deployed in a wide variety of customer-specific production solutions. Even in the standard versions, our machines offer a number of important features:

Two-platen technology:

KraussMaffei injection moulding machines are built to a two-platen design. Two-platen machines are compact and space-saving. The clamp unit is about 30% shorter than the clamp of a conventional 3-platen machine. KraussMaffei's patented two-platen clamp concept guarantees absolute platen parallelism.

Plasticizing as you like it

Depending on your requirements, we can offer you universal or application-specific high-performance systems for whatever materials you need to process. High repeatability, high output and very fast production cycles mean that you can rely on high productivity and a good return on your investment. Versatile combinations of clamp and injection units make it possible to

configure a machine that is an optimal match to your requirements. It is unique in the market.

Energy-saving drive concept

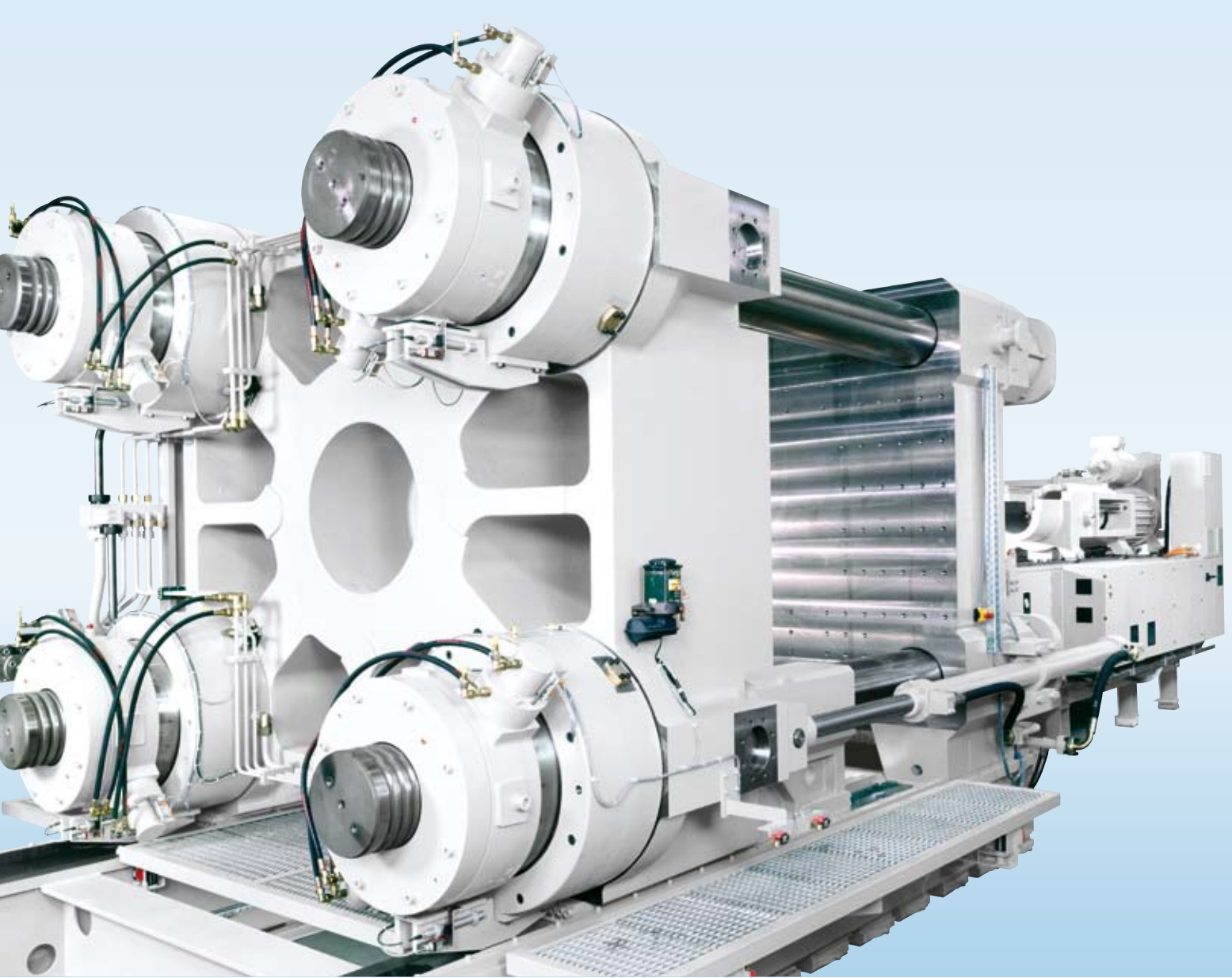
Our drive concept is also modular and engineered for high machine performance and low energy consumption. For every working point, the exact required volume of oil at the right pressure is made available – energy consumption is kept to a minimum.

Flexible microprocessor control system

All machines operate under the new MC5 control system as standard. One hallmark of the system is user-friendliness. The process visualization is clear and easy to understand, and concentrates on the essentials. Extensive functions for machine movements, process monitoring and data capture and evaluation ensure flexibility in production applications.



Different screw geometries



Compact, fast and low-maintenance: the two-platen clamp of an MX machines

Multinject for SkinForm®

KraussMaffei's multinject technology offers a complete suite of solutions for multicomponent moulding on large and small injection moulding machines. We can supply a complete package, including the multicomponent mould technology and extensive processing know-how. The product specifications are the starting point for planning a multicomponent application. They influence the choice of materials and the type of solution from a very wide range of options. It takes expertise and experience to arrive at the optimal combination of materials and mould technology and to go beyond these decisions to plan a complete system solution. KraussMaffei configures application-specific system solutions from our comprehensive range of

standard machines and machine modules. Many of the modules in a SkinForm® system are based on proven multinject concepts. Well-established multicomponent variants, such as sliders, turntables, indexing and spin platens, have been adapted for the polyurethanes used in the SkinForm® process. KraussMaffei is in the unique position of having outstanding injection moulding and polyurethane know-how in-house, together with the mature product portfolio of these two divisions. This convergence is driving innovation in many areas, of which SkinForm® is one.

Optimal metering and mixing makes all the difference in polyurethane processing

Polyurethane is produced by reacting two components, polyol and isocyanate, in the mould. The components must be stored, conditioned, metered and mixed and then poured into the mould in highly repeatable shots.

RIM-Star series: optimal solutions for any production requirement

KraussMaffei's RIM-Star series with three different versions (RIM-Star Modular, RIM-Star Compact and RIM-Star MiniDos) is a very versatile machine range ideal for all PUR applications. A high level of modularity means that the machines can be flexibly configured for the best possible match to customer- and application-specific requirements. The PUR components are mixed in the mixing head and poured into the

mould. KraussMaffei's transfer mixing head with recirculation grooves has been proving its strength in PUR processing for many years. KraussMaffei offers various mixing head versions to match output specifications and material grades. Like all our high-pressure mixing heads, SkinForm® mixing heads are self-cleaning and don't require separate cleaning. The different mixing head versions can be flexibly adapted to the injection moulds for the SkinForm® process. Multicolour mixing heads, for example, are ideal for the process. It makes sense to mix in the colours for multicoloured parts directly in the mixing chamber of the mixing head. Waste is reduced, because only a precise amount of PUR is coloured.



Colour change from shot-to-shot with the flexible MicroDos colour management system demonstrates the true performance of the mixing head in this SkinForm® application



RIM-Star Compact

**Colour changes without cleaning:
MicroDos colour metering system**

The MicroDos colour metering unit makes it possible to change colours within minutes, without cleaning effort. All elements in contact with the colour are integrated in a 'colour-change module'. For a colour change, this module is simply swapped in its entirety.

There is no risk of colour carryover and no need to clean the whole system between colours. MicroDos stands for cost-effective, time-saving colour management.



MK 5/8 ULKP-2KVV+2K multicolour mixing head with two extra colour nozzles



MicroDos with colour-change module for flexible and compact colour metering

Customer-specific solutions – complete technology from a single vendor

Prime criteria for successful production processes are high productivity, top product quality and smoothly integrated automation.

The optimal robot solution for every application

KraussMaffei is your single contact partner for complete automation systems for injection moulding applications – from consulting and project planning to commissioning and after-sales service. KraussMaffei Automation offers a product portfolio that comprises linear robots (LR) for many standard tasks, industrial robots (IR) for complex tasks and side entry robots (SR) for fast-cycling applications. The SkinForm® process generally uses linear and industrial robots.

Linear robots for standard tasks

Linear robots can move in three main axes and three linear axes. Major application areas are assembly, sorting and transport. There is a linear robot, pre-configured with the required axis lengths and wrist axes, for every injection moulding machine tonnage. Linear robots from our LR/LR-S and LRX/LRX-S series are available for injection moulding machines from 35 to 5400 metric tonnes clamp force. The huge range of axis variations, axis extensions and wrist axis combinations available for each machine size

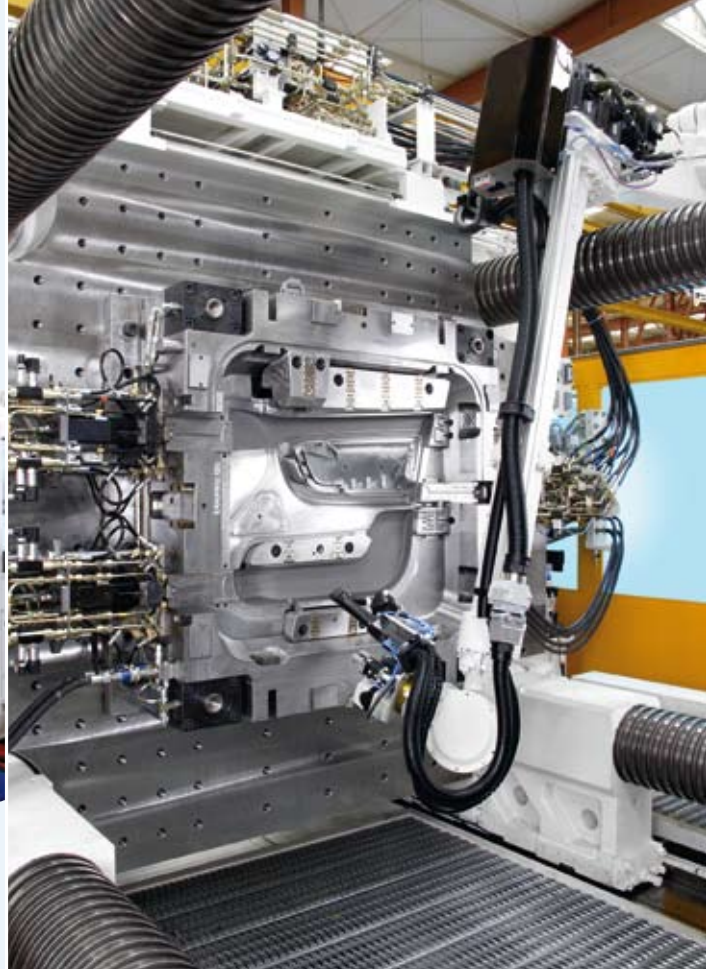
make these linear robots extremely agile and mobile. Almost 500 combinations are possible. The LR/LR-S and LRX/LRX-S series have CE conformity for three different drop zones: operator side, non-operator side, or lateral-mounted robot with a drop zone in the machine's longitudinal axis.

IR series industrial robots for complex tasks

Industrial (6-axis) robots are the answer for complex part removal and processing tasks. They offer maximum flexibility, thanks to freely programmable axes. Industrial robots are used mainly in sectors where speed and path accuracy are top priorities. Mounting options are shelf-, floor- or wall-mounted or mounted inside the machine housing. KraussMaffei realizes customer-specific manufacturing cells using standard components – from pick&place to turnkey solutions. One important automation task in SkinForm® processing is precise and repeatable application of release agent to the mould surfaces in contact with polyurethane. IR robots with their special kinematics, extreme flexibility and wide action radius are well-suited to this task, especially for complex mould geometries.



Integrated LR 300 linear robot in a manufacturing cell for a SkinForm® tray



This IR industrial robot uses a fully-automated spray gun for fast, accurate application of release agent on mould surfaces in contact with PUR

Other tasks in the SkinForm® process for which robots are deployed:

- Part demoulding using article-specific grippers
- Sprue removal by punching, routing or laser cutting

- Post-mould assembly, eg, attaching fasteners, singling components, picking, welding
- Dropping or stacking parts in customer-specific transport containers

KraussMaffei is a system supplier delivering individual, custom solutions for cost-competitive, one-shot SkinForm® processes.

FOAM MOULDS AND POST-PROCESSING SYSTEMS

The optimal tooling for perfect, price-conscious post-processing

KraussMaffei supplies foam moulds and punch dies and the complete, flexible cutting technology. The new addition completes the Reaction Process Machinery division's classic equipment portfolio.

Process, machinery and moulds perfectly matched

With shorter development cycles and tighter deadlines, the efficiency of planning and design processes for polyurethane plant and tooling is an important factor in overall efficiency. Excellent interoperability for the process, the plant and the tooling must be a priority at an early stage of a project. In developing the SkinForm® process, our experienced designers came up with solutions for fully-automated removal for the PUR sprue separation. Depending on part geometry and product

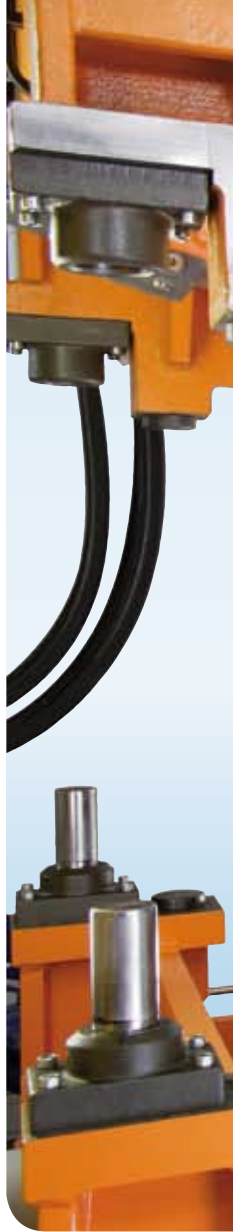
specifications, the solution may use punching, routing or laser cutting. Here too, KraussMaffei is a single contact system supplier.

Punching with fast cycle times and no post processing

The punching process is optimized for plastics and adapted to specific materials and part geometries. The high-precision cutting gap means no further post-processing required. The tools are equipped with hydraulic slides as knife drive for the non-0° cuts. Short cycle times mean high-capacity utilization for the system. The system combines outstanding cut quality with low operating costs.



KraussMaffei's Routing Star is an automated cutting cell for flexible production





Precision punch&die tools

Routing with short cycle times and high repeatability

The Routing Star is a robot cutting cell that can be equipped with one or two robots. Depending on the application, the system operates with or without a rotary table. Optimized cell design –compact and robust with smooth walls and floor – contributes

to highly repeatable cuts and fast work cycles. All functional components are fully integrated in the cell. Hallmarks of the Routing Star are highly stable processes, low cleaning effort, easier maintenance and excellent waste management. The systems are also extremely versatile.

SkinForm® – productive teamwork!

No other process offers as many interesting prospects as SkinForm® technology from KraussMaffei.

Use the benefits

Firstly, the SkinForm® process opens up all the possibilities of injection moulding with thermoplastics to produce complex, functional, three-dimensional parts. Secondly, SkinForm® opens up the almost limitless potential of polyurethane as a tremendously versatile material.

SkinForm® is an investment in the future

Combining injection moulding and reaction processing in a one-shot process open up a wide range of potential applications. These range from new design solutions for automotive interiors to many new non-automotive applications. SkinForm® products score top marks for an outstanding look&feel and mechanical properties. It also offers convincing cost benefits. Based on SkinForm, different processes and several process steps can be integrated in compact system solutions. The outcome is high-value, functional parts produced at very competitive unit costs. Talk to KraussMaffei about your application – our whole expertise as a system supplier is at your service.



SkinForm® switch surround



Perfect thin-walled surface-enhancement for large areas, like these trays



Pleasant, grippy haptics, scratch-resistance and good damping properties: SkinForm® door panels



Leather substitute for three-dimensional parts:
SkinForm® headrest



Pleasant, grippy haptics, scratch-resistance and good damping properties: SkinForm® grips for hammer drills





SERVICE WORLDWIDE

Service, support and spare parts – when you need them, where you need them

Rely on us for a fast and competent response to all your service needs anywhere in the world. Whatever you need – from troubleshooting or training to spares or repairs – we're on the job.

We're dedicated to supplying service quality on a par with the outstanding quality of our machines and systems. We offer far more than spare parts and hotlines. We'll work with you to choose the best and most cost-effective solution for your operation. We'll help you test new applications and we'll plan customized service packages.

All-round service

Our service offering is broad. We'll configure your system, install and commission it, train your staff, plan measures to minimize your downtime risk and maximize productivity, and carry out maintenance, repairs and upgrades. You'll find us fast, reliable and competent. Our hotlines are manned by highly-trained and experienced service technicians. If necessary, we'll get a technician to you quickly. Remote diagnosis, interfacing directly with your machine's control system, can be a practical alternative. Spares for all important wear parts are available at short notice. We're continuously expanding our service network to speed up spare parts shipment. Talk to us about the right service solution for your business.

Customer trials and prototyping in our test labs

The Injection Moulding and Reaction Process Machinery divisions have operated their own test labs for many years. We can run trials, produce prototype parts and fine-tune processes on your behalf. We can work with you to test and evaluate processes, machines and equipment in order to identify the best approach for a particular project. Our highly-qualified application engineers are there to help you.

Training with high hands-on content

Courses are held in our labs and training centres, or, optionally, on your premises. We offer clearly-structured basic and advanced training in the operation, process control and maintenance for KraussMaffei machines. On request, we'll plan and hold special courses on topics of your choice. All participants spend a high proportion of their training working hands-on with original KraussMaffei machines. A well-structured training program produces skilled operators and technicians, which will positively impact your up-time and productivity.

KraussMaffei service

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KraussMaffei is a premium partner for the plastics and rubber processing industries worldwide. KraussMaffei machines and systems are used wherever plastics and rubber are converted into products. As a knowledge-driven technology company, we build on many decades of experience and a strong commitment to research and development.

KraussMaffei's unique **SkinForm**[®] process teams injection and reaction moulding techniques, delivering many of the advantages of both. As a highly-integrated one-shot process, combining thermoplastic substrates and different polyurethanes, SkinForm[®] produces parts with new functionality and saves on cost-intensive post-processing. PUR materials offer a whole range of applications – from high-value paint systems to foam systems for softtouch effects, acoustic or damping properties. All these factors make SkinForm[®] a cost-competitive choice for your business.

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