

automotive

System solutions with drive.



ENGEL
be the first



ENGEL automotive – competence is standard

For a long time, ENGEL has been a **technological partner** and supplier to the automotive industry where the goal has been to create plastic components using injection moulding. Process development, mechanical engineering and automation seamlessly mesh at ENGEL. Close co-operation throughout the world with many noted enterprises and innumerable installations proves the reliability of ENGEL machine technology, the developmental competence of ENGEL process engineering and the flexibility of the ENGEL service department.



More comfort **and security.**

The automotive industry is one of the most important technological drivers for injection moulding technology. Many components in the outer layer of an automobile or truck, the interior, the safety and operation technology and the drive train - can be manufactured only using injection moulding. **New procedures and combinations of these are continually opening up new applications, fulfilling the constantly growing demands of automobile drivers.** ENGEL injection moulding technology makes automobiles and trucks more comfortable, safe, economic and environmentally friendly. This integration ensures the highest quality and optimal manufacturing costs.



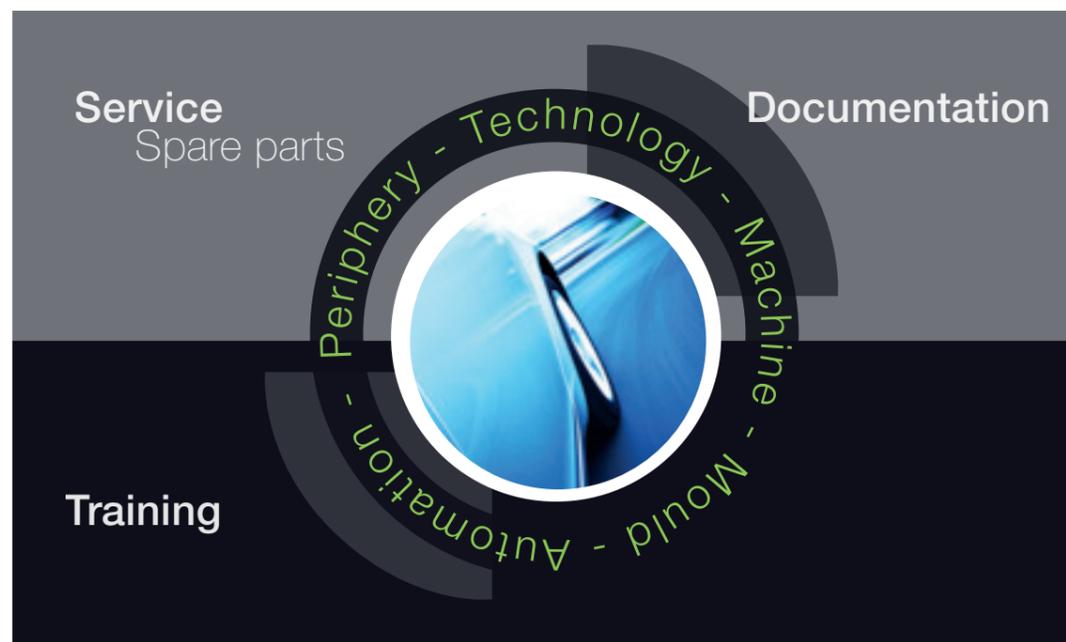
ENGEL automotive. Injection moulding technology for the mobility of the future.

- **Complete range** of injection moulding machines of every size
- **Turnkey systems consisting** of machine, process and automation for cost-optimised solutions, flexibly adapted to individual customer requirements
- Wide-ranging competence in all injection moulding technologies and **customer processes**
- Fundamental **application-related know-how**
- **Many years of experience** in the branch of automotive technology
- Close network with **competent system partners**
- Extensive customer service facilities and **fast spare parts supply** for minimum plant downtime
- Eight production plants on three continents and a global network of subsidiaries and sales representatives: **The worldwide presence helps us to achieve best lead times.**

Economic and reliable: Complete solutions and custom equipment

In addition to machines and technologies, ENGEL provides a wide range of additional equipment and services to the automobile industry and their suppliers to:

- design an **holistic concept** for production,
- **simplify and accelerate mould changing**,
- efficiently **configure moulded part** handling,
- **optimise cycle times**,
- **increase transparency** in production and **fulfil the strict documentation** requirements
- **optimally train employees**, and
- ensure **fast problem-solving** when servicing is required.



Complete solutions from a single source

ENGEL injection moulding machines, technologies and automation can be combined in order to economically manufacture plastic parts for automobiles. ENGEL also supports its customers when machine technology is to be combined with material supply and logistics. This service includes creating production layout and providing support when planning new "greenfield" factories.





ENGEL automation.

Efficiency that works.

Straight ahead. And efficient. As a linear robot from ENGEL. That's how we solve your automation tasks. Drawing on our extensive experience, ENGEL has been **highly successful on the market for over 30 years with its own automation systems**. Including a high degree of competency. ENGEL automation experts work for you in sales companies worldwide – and in its own competence centres. This is where our extensive know-how in the area of robots & more is effectively implemented.

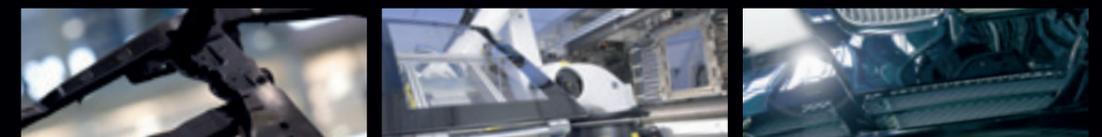
Expertise in complex technology.

The range of tasks assigned to ENGEL automation goes far beyond linear robotics. Do you need complex, highly integrated production cells, in which several injection moulding machines produce, linear robots interact perfectly with industrial robots, and numerous processing stages are included – such as quality control using state-of-the-art camera technology, marking and packaging tasks? No problem. The specialists at ENGEL automation system will **handle the overall concept and implementation of your demanding projects**. And they will ensure that all parts are precisely coordinated and mesh seamlessly into one another.

In the service of efficiency. For premium parts quality, stable processes and increased overall productivity.

Dis-cover the automotive future.

Special injection moulding procedures are especially indispensable in automobile production. Nowhere else is there a demand for so many technologies to make multi-colour or especially light parts, to decorate and coat surfaces, as well as to integrate a wide variety of functions in one component. **ENGEL provides the right technology for every application.**



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01. ENGEL combimelt

Multicolour and multi-component injection moulding of tail lights, control armatures and labelled buttons, as well as hard-soft connections for special haptics or sealing functions.

02. ENGEL clearmelt

Scratch-proof, high quality surfaces combined with 3D effects that visibly impress. Thanks to ENGEL's innovative clearmelt process, decor parts with these characteristics can now be produced in a time-saving, economic and highly productive manner. A thermoplastic carrier is flowcoated with transparent polyurethane – using familiar techniques from multiple component injection moulding.

03. Dolphin

Injection moulding of instrument panels, console parts, flaps and door panels with a soft-touch surface by overmoulding plastic beam parts with a foamed TPE on ENGEL duo combi M large-scale machines.

04. ENGEL fibermelt

Injection moulding of front-end modules, underbodies, door modules and other structural elements made of long-fibre-reinforced, thermoplastic plastics on the ENGEL duo large-scale machine series.

05.-07. ENGEL elast/LIM & BMC

Important applications for classic elastomers in automobiles are engine and body supports, seals for windows, media lines and electrical systems as well as bellows. Insulation and sealing components for electrical plugs as well as sealing rings and sealing membranes made of LSR provide especially high resistance against heat and cold, an excellent ageing behaviour and very good resistance against weather.

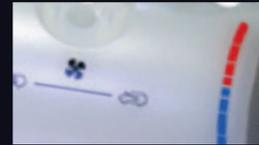
ENGEL provides a complete range of vertical and horizontal injection moulding machines to process cured elastomers. Plasticizing units to process ribbon-shaped prepared rubber compounds according to the first-in first-out principle are marketed as ENGEL elast. Screw or piston plasticizing machines, as well as plasticizing and conveying technologies for liquid silicon are specified as ENGEL LIM.

BMC: ENGEL has a high competency in BMC processing and offers special rotary conveyors for it.

08. ENGEL foammelt (MuCell®)

Structural foam moulding of housings and interior parts for the lowest possible weight and the best properties by foaming the plastic in the mould.

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09. ENGEL foilmelt

Individual surface design for parts in vehicle interiors using back injection of multi-layer films that bear effects such as metallic coatings, aluminium designs, chameleon effects and holograms.

10. ENGEL gasmelt

Gas injection technology for injection moulding grips and bars to improve quality and the surface by extending the post injection pressure, shortening the cycle time and saving material.

11. ENGEL glazemelt

Injection-compression moulding of large-scale transparent panes with low internal stress using integrated assembly elements and sealing functions on the ENGEL duo combi M dual-plate large-scale machine.

12. ENGEL insert

Overmoulding of metal and glass to form plugs, switches and sensors, elements of the fuel system, electrical and electronic components and glazing elements in vertical injection moulding machines and moulds with a horizontal parting line.

13. ENGEL joinmelt

The ENGEL joinmelt process supports hot gas welding directly in the mould – and offers thereby considerable potential savings.

14. ENGEL organomelt

Revolution in lightweight construction: This technology replaces steel and aluminium sheeting with thin, yet strong organic sheets, not only saving weight in automobile manufacturing but scoring extra points by avoiding corrosion and providing broader design options.

15. ENGEL tecomelt

Production of textile-decorated vehicle interior parts using injection moulding or injection on injection moulding machines with a horizontal or vertical clamping unit

16. ENGEL watermelt

Water injection technology for the injection moulding of large-scale ribbed components, media cables and moulded parts with large-volume cavities.

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Attractive and protective: Structural and exterior parts



The first impression is the crucial one – especially for automobiles. The design freedom of plastic is utilized more and more in order to individually design the outer layer of vehicles. Injection-moulded exterior parts meet very high demands in terms of the surface and the dimensional stability. ENGEL injection moulding machines and technologies ensure the best surface quality and maximum economy, even for large moulded parts and those with long flow paths.

Strong in light-weight construction

As an **alternative to metal structures**, light-weight fibrereinforced designs have increased in importance. Today, they can be essentially tailored to fit, and laid out according to the application and safely injection-moulded using ENGEL fibermelt.

A **revolution in lightweight construction offers ENGEL organomelt**. This technology replaces steel and aluminium sheeting with thin, yet strong organic sheets.

Large-scale exterior parts

High-performance screws ensure a high degree of plasticization during plasticizing. This is of high importance, e.g. in the bumper production. Hydraulic or electrical screw drives that can work synchronously with the mould movements reduce the cycle time, increasing output and economy. Special-purpose screws provide minimal wear and **a long lifetime** despite the strong wear and tear in high-performance plasticization.

Automatic postprocessing.

Customer- and application-specific automation of the injection moulding machine during the production of coatingfriendly bumpers and oth-

er exterior parts **increases the economy of the overall system**. Automation includes separation of the sprue, flaming to activate the surface, deburring, quality control and packaging of the component.

Injection-compression moulding for increased quality

In the case of injection moulding large exterior parts with long flow paths and large flow path to wall thickness ratios, injection-compression moulding is recommended to safely fill the moulded part, and to cleanly mould the surface and to avoid internal stress. Injection-compression moulding results in **highly precise parts with a high cost efficiency**.



The integrated mould change system ENGEL famox (fast mould exchange) reduces the set-up times, increases the flexibility of the machine and increases the utilisation.

01. Wheel-well liners

Wheel-well liners and cover strips at the engine compartment should have **noise-reducing properties**. These are attained by injection moulding specifically modified polymers or by overmoulding textile material. By combining the ENGEL combimelt multi-component technique and the ENGEL tecomelt back injection technique in a single injection moulding machine, noise-optimised products that can be totally adapted to customer requirements in terms of geometry, mounting elements and acoustic properties, are produced in a single operation.

02. A-, B- and C-columns

The ENGEL combimelt multi-component technique **integrates assembly, optical and sealing elements in a single operation**, eliminating sink marks and ensuring the best possible surface quality. Impact-absorbing column elements can be fully overmoulded with a second plastic in order to attain highly reflective surfaces. Furthermore, an additional TPE component seals the chassis and absorbs vibrations.

03. Front-end beam made of LGF plastics

Special-purpose screw units for gentle preparation Single-screw systems for long glass fibre-reinforced granulates (LGF) permit processing on standard injection machines. Using ENGEL fibermelt technology on the ENGEL duo large-scale machine, it is possible to produce **highly stressable structural elements** with a lower investment in production technology. Melt preparation with optimised screw unit geometries reduce the shear load of the material, providing optimum embedding and distribution of the long reinforcing fibres in the polymer.

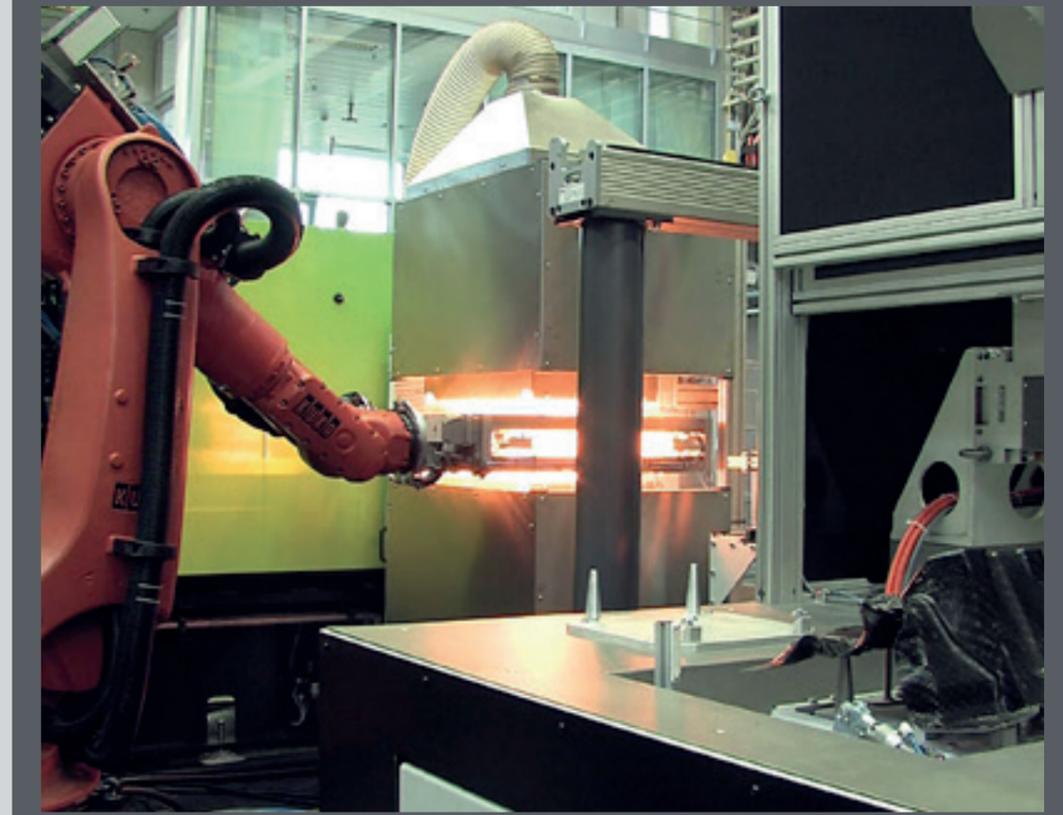
04. Structural elements with hybrid technique

In the hybrid technique, sheets are **inserted into the mould and overmoulded** with plastic to reinforce it. ENGEL provide their own automation solutions for inserting and removing the sheets. The highly precise, self-learning mould protection detects deviations on the inserted part, thus providing the highest level of safety from mould damage and ensuring operational safety and uptimes of the entire plant.



Steering column holder

ENGEL organomelt replaces steel and aluminium sheeting with **thin, yet strong organic sheets**. The result: Considerable weight savings compared to conventional solutions. The steering column holder is produced within a fully automatic production cell based on an ENGEL duo pico machine - in a very compact and energy efficient way. And: The solution is suitable for mass production. Moreover, ENGEL organomelt scores extra points by avoiding corrosion and providing broader design options.



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Transparent, coloured or luminous: glazing and light engineering

Panels of transparent plastics, mainly of polycarbonate, are not heavy and provide designers a great deal of freedom. Today, complete glazing systems of plastic integrate numerous functions and lower system costs.

LED future

Lighting engineering, which is now based more than ever on plastics, has the greatest potential. The classic multicolour technique is supplemented by the use of modern LED technology and the integration of sealing functions.

More and more, optical and glazed parts in automobiles are being made of transparent plastics instead of glass.

On the one hand, injection-moulded plastic parts – due to the fact that several colours can be combined without problems – provide increased design freedom; on the other hand, they are significantly lighter, thereby lowering the fuel consumption and CO₂ emission of vehicles.

Clean production

Increasing demands of glazing and lighting engineering also raise the demands in production technology and the production environment. Therefore, many glazed parts are injectionmoulded and processed further in a clean-room environment. Machine-related precautions, such as undirected tie-bars on ENGEL

injection moulding machines, provide for very low soiling tendencies.

No tie-bars. Free access.

The ENGEL victory machine saves valuable space in the clean-room – e.g. in the injection moulding of automobile diffusing lenses. This is due to the fact, that the clamping unit of this machine does not have any tie-bars. Therefore, robots can access the parts very fast. In addition, the mould changes can be done very fast as well.



Source: Bayer MaterialScience

Glazing using plastic

Specific equipment for injection moulding glazings is available on the dual-plate ENGEL duo large-scale machine. The compression packages BASIS, PROFI and EXPERT are **highly precise special compression programmes** with which large-scale moulded parts can be injection moulded with especially low stress. This ensures that the optical properties are constant over the entire surface of the moulded part.

Compact machines for large parts

Compared to standard two-component machines, the machine concept of an ENGEL duo combi M with rotary plate technology provides a **reduction in the clamping force requirement** and in the investments in machine technology. Furthermore, both the clamping force control and the process control are simplified because the injection moulding units, which lie opposite of one another in the centre of the machine axis, cause centric swelling forces. This results in the largest possible components in relation to the size of the clamping unit.

Gentle plasticization

In order to ensure that moulded parts of transparent plastics such as PMMA and PC always have the highest optical quality, ENGEL provide **screws with special geometries** and distinct check valves. These gently prepare the melt and prevent the formation of so-called black spots.

Integration of decor and function

ENGEL foilmelt in-mould decoration permits the **integration of functional elements**, such as antennæ or heating coils, in glazing elements. Furthermore, back injection of transparent films is an alternative to a scratchproof coating using varnishing.

Overmoulding windows

Mineral windows can be overmoulded with thermoplastics or elastomers in order to provide a sealing and assembly function. The single-step process in injection moulding machines with a horizontal or vertical clamping unit reduces the assembly effort and reduces costs. In its complete machine programme, ENGEL provide a **tailor-made, compact production** solution for every size of window, every overmoulding material and every process-related requirement. As ENGEL machines can be equipped with plasticizing units for both elastomers and thermoplastics, they provide the flexibility of changing the injection unit based entirely on customer requirements.

The use of the sensitive ENGEL mould protection system autoprotect **reduces glass breakage and rejects** while increasing the up-times and productivity of the overmoulding system.

Reflectors

Reflectors in lamps require a high surface quality so that they can have very specific properties after metallization. This requires **precise moulding**, if necessary using the ENGEL gasmelt gas injection technique to avoid sink marks.

To produce reflectors from thermoplastics that are resistant against high temperatures, special screw units provide a long operating life **due to low wear**. In order to injection mould reflectors made of thermosets, ENGEL BMC injection units are designed specifically for processing wet polyester.

Stable processes without interruption

The rotary feeding unit ENGEL roto feeder BMC 50 and HCR 50 **offers maximum process stability in feeding of material** to the plasticising unit. An uninterrupted constant flow of material is guaranteed, free of entrapped air and at constant pressure. Maximum operator convenience included.

Fibre optics and LEDs

The production of fibre optics and light-emitting diodes poses special requirements in terms of the lack of stress and on surface quality. Highly precise fully electric injection moulding machines, such as the ENGEL e-motion with its compression function, **meet these high demands**. Combined with variothermal mould tempering, even complex geometries and lens effects can be easily provided at optimum costs.

Maximum free space

The tie-bar-less design principle of the ENGEL victory and ENGEL e-motion small- and mid-scale machines provide **very easy access to the mould installation space** and high flexibility in the mould dimensions due to the great rigidity of the clamping unit. Last but not least, the tie-bar-less clamping unit simplifies the adaptation of the clean-room technique using the mould.

Diffusing lenses

Diffusing lenses for headlamps have the **highest requirements regarding optical quality**, lack of distortion and surface properties. Due to their limited size, they are produced using classical injection moulding and not using injection-compression moulding.

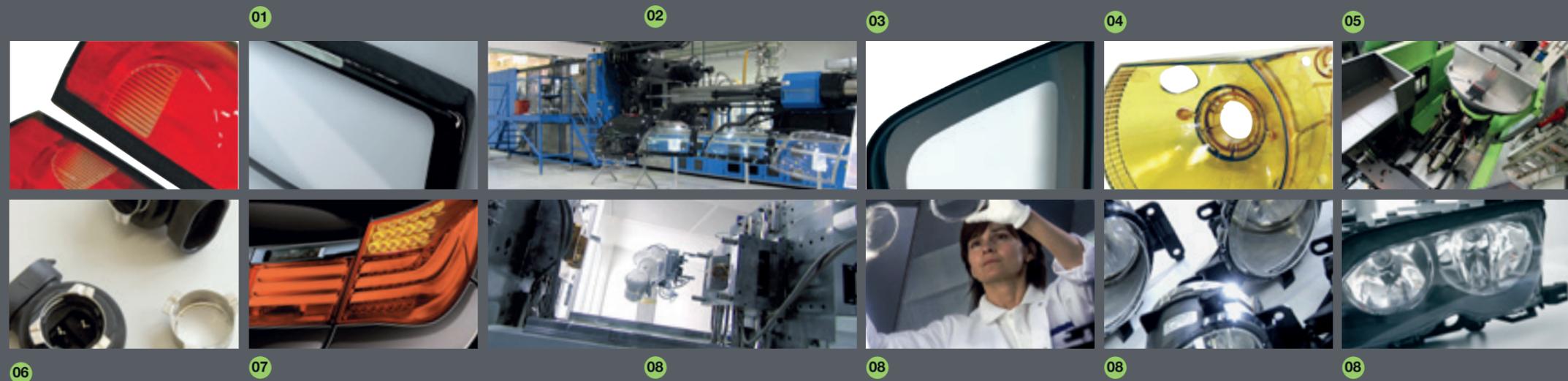
Highest melt quality

In this application, ENGEL screws, with their special geometries and distinct check valves, ensure **gentle material preparation** and avoid the formation of "black spots". After the diffusing lenses are injection moulded, fastening elements are often moulded on using ENGEL combimelt.

Rear lights

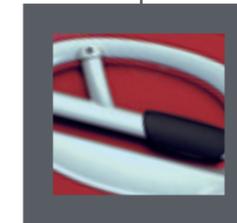
Multicolour automobile tail lights are produced using the multicolour ENGEL combimelt technique in multiple moulds on large-scale ENGEL duo machines with integrated rotary tables. **Any arrangement of up to four injection units** optimally adapts the machine to customer requirements.

01. Rear window of a Chevrolet Blazer, source: Sabic/Exatec **02.** Glazing production on a large ENGEL duo machine, Source: Sabic/Exatec **03.** Overmoulded stationary side window for a Mitsubishi automobile **04.** Reflector made of polyther imide (PEI) for an automobile dual headlamp that will subsequently be enhanced **05.** ENGEL roto feeder: The convenient rotary conveyor for BMC 50 and HCR 50 combines highest process stability and continuous feeding of the solid silicone to the plasticising unit. **06.** H8 bulb holder, source: Simon **07.** Rear light, source: Automotive Lighting - A Magneti Marelli Company **08.** Tie-bar-less ENGEL injection moulding machine with clean-room module for the injection moulding of automobile diffusing lenses at ZKW Slovakia.





Decorative and of high quality:
Panels and interior parts



Perfectly **cased**

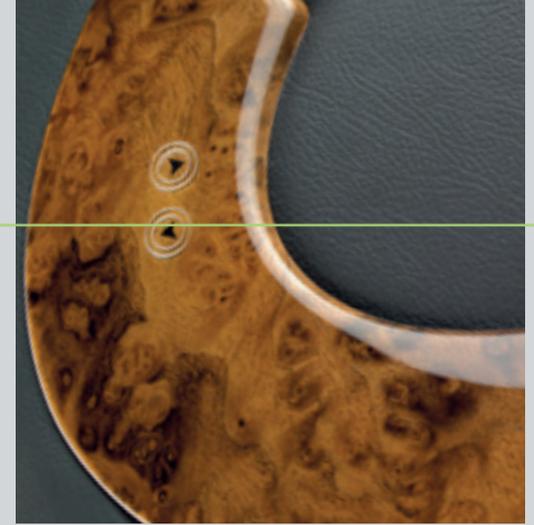
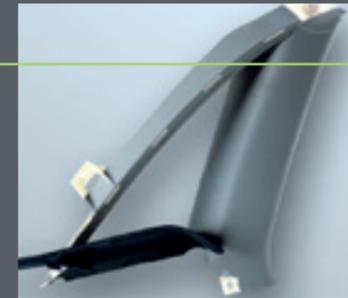
A large variety of plastic components can be found in a vehicle interior. Dashboards and consoles hold countless functional elements and have a pleasant look and feel. This also applies to door and pillar panels that hold airbag systems for protection against head-on or side impact, requiring precisely defined characteristics.

Optics meets haptics.

Door panels cover power window systems, seals, speakers and cables, and their surfaces have a high-quality look and feel. Technologies such as ENGEL tecomelt and Dolphin provide comfort and safety in automobiles.

High productivity.

Whether you need the compact injection moulding of panels or interior parts, back injection using soft foam films, the transfer of injection moulded structures in a polyurethane shaped foam plant or the injection moulding of highly stressed structural parts and load-bearing elements from long glass fibre-reinforced plastics using the inline compounder: ENGEL provide all single-stage processes on a multitude of injection moulding machines in economic production cells with a high degree of automation.



Dashboards

While dashboards of economy cars are usually made using standard injection moulding, a **multitude of ENGEL specialpurpose procedures** is used for soft or decorative surfaces in vehicles with higher requirements.

Fit for just-in-sequence

In the case of the injection for soft foam film backings in the ENGEL tecomelt procedure, it is possible to switch the colour or surface structure from cycle to cycle, as is required in just-in-sequence production. ENGEL automation solutions for a corresponding injection moulding machine make such a production job **rational and inexpensive**.

Dashboard supports

A dashboard support made using ENGEL fiber-melt has the required combination of **strength, rigidity, and the required resistance** against impacts. Weight optimisation can be attained using a combination of ENGEL foammelt structural foam moulding and the ENGEL coinmelt compression technology.

Soft-touch surface with Dolphin

Dolphin – its name was inspired by the elegance of the dolphin and the elasticity of its skin. Thanks to this innovative two-component injection moulding method, parts can be moulded and coated with premium quality soft-touch surfaces **in a single-step process**. There is a wide range of potential applications. Dolphin has already impressively demonstrated its benefits for vehicle interiors, for example dashboards and door panels.

The carrier structure of the parts is fully coated with a microcellular foamed polyester layer. The process uses a combination of foam injection moulding and „negative“ compression technology (precision opening). The process runs on **ENGEL duo large-scale machines** with two counter-positioned injection units and a rotary mould carrier.

Single stage instead of multiple stages

Dolphin moulded parts combine **structural rigidity with a premium haptic experience** – in a single step. Dolphin moulded parts are an extremely economical alternative compared with parts moulded in legacy multiple-phase processes, for example by lamination with PU foils, or by in place foaming with polyurethane foam. As a single-stage process Dolphin offers obvious advantages with respect to space requirements while at the same time reducing the logistics overhead.

Column panels

Today, textile-decorated column panels are produced by back injecting textile structures in the injection mould – usually on mid-sized injection moulding machines. During the fully automatic insertion and securing of the textile cuts, the tie-barless clamping units of the ENGEL victory machine series provides the **unique advantage of access** to the mould without any obstacles at all. Robots and grippers can use the entire available space and are not inhibited by tie-bars; moulds can be changed quickly and easily. This ensures shorter cycle times and improved economy.

Use of entire mould fixing plates

As back injection occurs at relatively low pressures in the first place, the **entire surface of the mould fixing plate** can be used for bulky moulds on tie-bar-less machines. Compared to normal machines with tie-bars, tie-bar-less injection moulding machines take full advantage of their higher production efficiency during back injection.



Decor parts

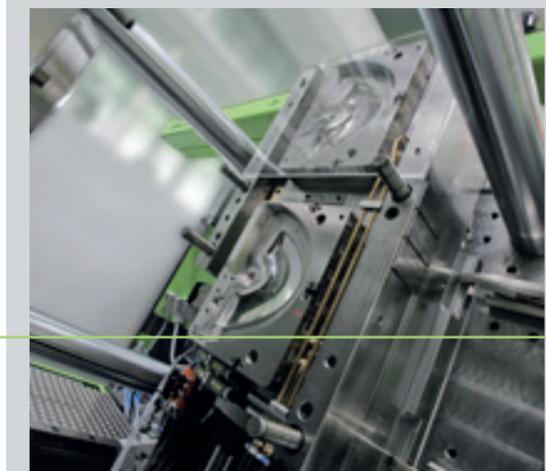
Scratch-proof, high quality surfaces combined with 3D effects that visibly impress. Thanks to ENGEL's innovative clearmelt process, decor parts with these characteristics can now be produced in a time-saving, economic and highly productive manner. A thermoplastic carrier is flowcoated with transparent polyurethane - using familiar techniques from multiple component injection moulding.

A flood of benefits

Compared to legacy fully thermoplastic methods, the **required level of scratch resilience and 3D effect** is achieved with thin coatings using the ENGEL clearmelt approach. Legacy coating systems can only achieve similar quality in time-consuming and expensive multiple coating processes which are also prone to high reject levels due to the multiple stage process. In contrast to this, ENGEL clearmelt achieves visually impressive effects on decor parts using back-injected foils as a carrier. This makes panels in vehicle interiors real eye catchers.

Outlook into the future

This technology might shed new light on the world of switches in the future. The reason for this is that ENGEL clearmelt also supports overlaid carriers **with integrated circuits** which are comprehensively protected by a layer of PUR sufficiently thin to support easy actuation.



High-quality soft touch surfaces thanks to advanced Dolphin technology.





01. Door panels

The ENGEL duo series is used for large door panels. The significance of compression increases with larger moulded part surfaces and longer flow paths. The ENGEL injection compression programme **protects the material during injection**, permitting very low clamping forces. Platen parallelism control ensures a uniform wall thickness distribution over the entire surface of the moulded part, as well as minimal mould wear.

Very large parts with textile decoration that are produced in low numbers can be made on injection moulding machines with a vertical clamping unit in the ENGEL tecomelt procedure. Here, the melt is inserted into the open mould using injection units that can be moved in three dimensions and is gently pressed onto the textiles at a very low internal pressure. In this technique, significantly **simpler and less expensive moulds** can be used without a hot runner, providing an economic advantage for low and mid-sized batch sizes.

Map pockets on the insides of doors

Map pockets on the insides of doors also usually have a thick-walled area that can be shaped **using ENGEL gasmelt**.

02. Speaker covers

Low-viscosity, easily flowing plastics are usually used to precisely shape grid-shaped speaker covers with many delicate holes. Fully electrical machines such as the ENGEL e-motion provide sensible process control: they precisely maintain the tight processing window, provide the best surface shape and prevent overmoulding and burr formation. If a moulded part gets stuck during removal from the cavity, the reactive mould protection of the ENGEL machines, **with its numerous sensitive pins** protects the mould from damage, which could be expensive.

03. Door handles

Thick-walled moulded parts such as door handles are often made with the ENGEL gasmelt gas injection technique. This technology maintains the post-injection **pressure longer** than in conventional injection moulding, thus ensuring well-shaped surfaces and moulded parts with low mould shrinkage and high dimensional stability. This is a requirement for subsequent metallization or electroplating, which would make surface defects very apparent.

04. Arm rests

The option of the Dolphin procedure for making panels entirely with thermoplastics instead of with the film back injection method will become more popular, not least because tight radii can be executed better than with the back injection method. Likewise, **the significant logistics and post-processing costs** that are usual in the most common soft foam films **are not necessary**.

05. Support structure for backrests

A support structure that has been invisibly integrated into the seat and that has been made using the ENGEL insert vertical machine represents one of the most important transitions from the driver to the vehicle. The movable structure of plastic-overmoulded metal rods is manufactured in an injection moulding cell. The ENGEL combimelt technology is used **to combine the desired rigidity with excellent antifriction properties**.

06. Vent grilles

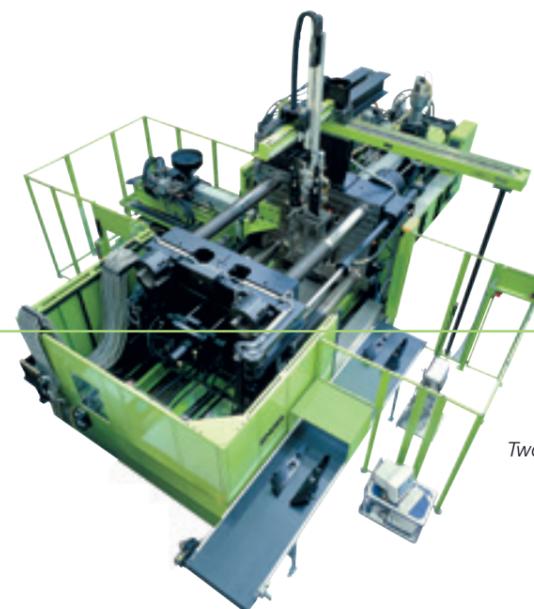
Air vents have gone down in the history of injection moulding as the "classic" movable part in multi-component moulding. Today they are usually produced in multiple moulds. Depending on the dimensions of the moulded part and the number of bars, various injection moulding machines serve as the basis for multi-component injection moulding: ENGEL victory, ENGEL e-motion. **Both can produce the vents in a single operation**. Climate control vents for the VW Golf and Audi A3 are produced in a 4+4 mould by combining ENGEL foammelt structural foam moulding with the ENGEL combimelt multicomponent technology to form a sealing lip.

07. Airbag covers

Airbags covers must have specific break-open properties during a crash, but must also be perfectly adapted to the look of the vehicle interior. ENGEL machine, procedural and automation technologies **ensure the process stability required for this**.

Safety for the passengers

Various options in the ENGEL CC 200 machine control unit and the modular ENGEL e-factory software solution analyse and **document all relevant process parameters**.



Two-component machine with integral barcode printing



Reliable and safe:
safety, clamping and operation technologies

Not only active and passive safety equipment, such as **ABS, ESP, seat belts, headrests, seat belt tensioners and airbags**, consist mainly of injection moulded components today. Driver assistance systems, steer-by-wire and break-by-wire systems also require plastics. Particularly in the case of these safety-relevant parts, with their sensors, switches and plugs, the automobile manufacturer requires documentation of the production data for reproducible product quality.

Both mechanical as well as electrical and mechatronic components of safety equipment are produced by **overmoulding insert parts** in the ENGEL insert vertical machine.

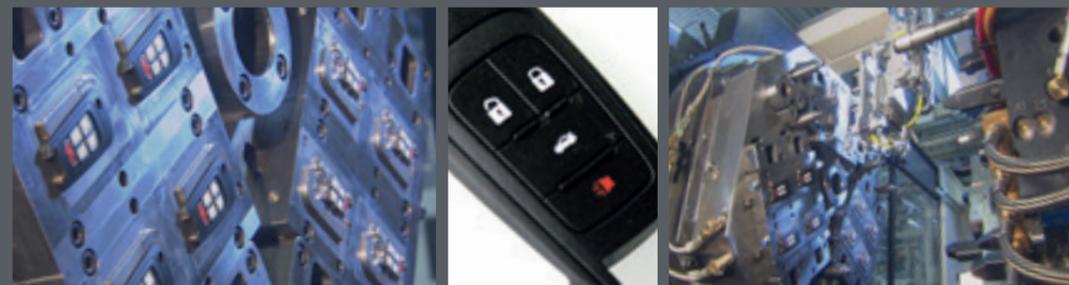
The self-learning and highly sensitive ENGEL autoprotect mould protection programme provides the lowest possible mould wear. **This reduces maintenance costs to a minimum.**

Seat belts, belt buckles, belt tensioners and belt deflectors

Safety elements from overmoulded metal parts are usually produced on small horizontal or vertical injection moulding machines. Modular automation systems for entire families of parts ensure **the fastest possible adaptation** capability with replaceable mould cavities: moulds do not have to be removed. Machine and automation technology that are adapted to one another ensure quality control and preheating of the insert parts, keeping insertion and removal times to a minimum.

Lock housings

Lock housings are complex, highly precise functional parts whose production can combine a number of ENGEL technologies. In the ENGEL insert vertical machine, metallic parts are inserted into the mould and integrated into the injection moulded part as function elements. The required seal is economically implemented either as a thermoplastic or elastomer component using ENGEL combimelt multi-component technology combined with the ENGEL elast rubber machine within an overall system. Furthermore, ENGEL foammelt structural foam moulding makes low-distortion, weight-optimised thermoplastic structures possible.



Lock housing with dual-component technology



Complete ENGEL system for punching and overmoulding lock housing components



01. Circuits and connectors

Electric and electronic safety elements from thin, overmoulded metal parts are usually produced on small horizontal or vertical injection moulding machines as well. As is the case with mechanical safety parts modular automation systems for entire families of parts ensure the fastest possible adaptation capability: With replaceable mould cavities **moulds do not have to be removed**. A large rotary table diameter permits the use of several work-stations that can also be equipped with different moulds.

In command of insert parts: The electrical vertical machine ENGEL e-insert in combination with the powerful robot ENGEL viper.



02. Skids and guide rails

ENGEL combimelt unites the optimum sliding properties of polyoxymethylene (POM) with the high rigidity of polyamide (PA) to form a precise component with defined friction properties **for the highest possible operating comfort**.

In the case of window guide rails, the TPE component provides optimum positive damping between the window pane and the POM guide element.

03. Switches and buttons

Switches and buttons with functions and a label or icon are produced **using the ENGEL combimelt multi-component technique**. For example, a 130-tonne ENGEL victory machine with an ENGEL ERC 63 parts removal robot can produce switches of polyamide and two POM types in a 4+4+4 mould. The functionality of flexible plastic parts is provided by costoptimised assembly injection moulding.

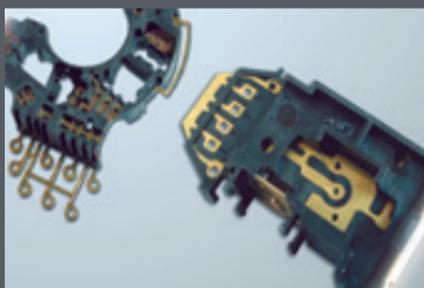
04. Airbag igniters

The injection moulding procedure is also used to manufacture pyrotechnic components to protect passengers and pedestrians. To do this, the pyrotechnic material is overmoulded directly on a fully electrical tie-bar-less precision ENGEL e-motion machine. The machine **increases production by reducing the cycle time** due to optimum conditions for automation. It provides the injection precision and mould protection required for working with highly explosive material.

05. Parking brake levers

ENGEL combimelt combines a comfortable look and feel with high-quality mechanical properties. **Large moulds with low clamping force** requirements – the tie-bar-less ENGEL victory machine is predestined for such injection work.

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Valeo air flap with sealing function using two-component technology.



The fully automatic mould changing system ENGEL famox (fast mould exchange) provides optimal equipping times for mid-sized batch sizes.



Electric engine supports

Drive elements should neither produce noise nor transfer oscillations or vibrations to other structures. Therefore, they are **acoustically insulated** and mechanically decoupled. In a holder for a blower motor, the mounting point – over-moulded with TPE using ENGEL combimelt – dampens vibrations and thus also the emitted noise.

Housing parts, air baffles and fan impellers

As the market leader for the MuCell® physical foaming procedure, ENGEL have successfully produced a number of components. In the case of housing parts for the rear climate control system in the Mercedes-Benz S-class, developed and produced by Behr, ENGEL foammelt structural foam moulding results in an **improved moulded part quality at a reduced cycle time.**



Comfortably tempered:
ventilation and air-conditioning technology

The pleasant interior atmosphere of the vehicle is a major convenience factor. Actuators and controls, compressors, and heat exchangers, along with air baffles, air baffle controls and vents rely on a large number of plastic parts that all need to be as light and compact as possible. Therefore, many components are weight-optimised and foamed using ENGEL foammelt technology.



Compact, light and functional: plastic engine components

There is an increasing trend towards manufacturing engine components and engine-related subassemblies from plastics. Today, custom-built injection mouldable plastics are designed to withstand high operating temperatures and for contact with fuel, oil, coolant and brake fluid.

As a result, new components with very high performance and low weight are continuously being developed for very tight spaces in the engine compartment. The range of applications extends from decorative cylinder head hoods to suction pipes and suction modules, plugs for the electrical system and parts of the fuel system to flaps and valves for heat management and climate control.

More and more, new production solutions with ENGEL machines and technologies are replacing metal parts with injection moulded ones of plastic.

Engine covers

Although they are purely design parts, engine covers are subject to high temperature stresses. Therefore, they are **injection moulded from glass fibre-reinforced plastics**. Design or sealing elements often require the use of the ENGEL combimelt multi-component technology. The high process capability of ENGEL injection moulding machines permits the production of high-quality surfaces that permit refining not only using hot compression or varnishing, but also with electroplating.

Valve lids

This valve lid of **glass fibre-reinforced polyamide** is used for Audi engines. It is manufactured on an ENGEL duo with a clamping force of 700 tonnes.

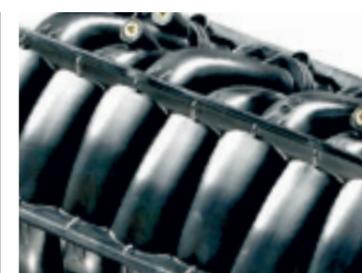
Air intake manifolds

In compact injection moulding on a 1500 tonne ENGEL duo large-scale machine, the parts of an air intake manifold are made of PA66-GF; these parts are then welded together. **Variable mould tempering** achieves an optimum mould wall temperature, which ensures the tight tolerance range for the component geometry, as is necessary to weld half bearings. The use of group moulds ensures uniform manufacturing conditions for the two individual parts that are to be subsequently welded together.

Hot gas welding directly in the mould: The innovative solution ENGEL joinmelt, for which a patent is pending, promises considerable potential savings, especially in the engine compartment. The technology **removes the need for additional welding equipment**. Part take-off and re-insertion are no longer needed, as the finished product can simply be taken off directly out of the mould.

To allow this to happen, both halves of the component are injected simultaneously into a single mould. After the cooling phase, the mould is opened; one half of the part stays in the left half and the other in the right half of the mould. The movable left half of the mould is now positioned so that both parts are opposite each other in welding position. The heating element is positioned between the cavities and the edges of the component halves are heated. When the mould closes, the two parts are bonded so that the finished part can be taken off when the mould re-opens.

This new technology is suitable for all thermoplastics. **The process developers see huge potential in processing of glass fibre reinforced polyamides** as media-bearing parts for deployment in engine compartments.



Air intake flaps

In the production of air intake flaps, ENGEL demonstrate that the combination of the two-component technique and multicomponent moulding attains **the highest possible technical level**: two connected injection moulding machines produce a set of air intake flaps with ready-to-mount flap systems for V6 and V8 engines using multi-component moulding, complete assembly and a 100% test.

Pick & Place and overmoulding

In the first 300-tonne ENGEL victory combi injection moulding machine, the body is first made of PA46-GF15 in a 2+2 mould; after Pick & Place using a linear robot, this is overmoulded with PPS in the second mould position. The robot of the second ENGEL victory 130 combi injection moulding machine picks up these sets of two and positions them in the first injection station of the mould, where a lever of the same PA is moulded. **After Pick & Place, a rubber seal is vulcanised onto the flaps.**

Easy access of the mould

Advantage of ENGEL victory: the design of the tie-bar-less clamp unit provides increased space in the mould mounting area for complex two-component injection moulds and the overhanging end of arm tooling of the robot.



Two coupled injection moulding machines produce tumble flaps using the two-component technique at Schneegans

Support for air intake controls in a turbocharger

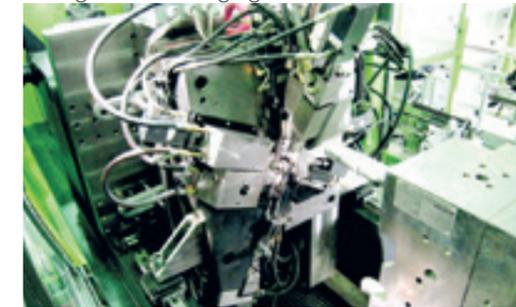
Temperature stresses, media effects and a low idling drag require vulcanising rubber to be used as a sealing element. In order to manufacture this support, ENGEL combined the dual-component processing of rubber and thermoplastic in a single mould that has both a hot area and a cold area using thermal separation. **The two components are connected without any bonding agent.**

Suction pipe of NBR/HNBR

The combination of an ENGEL elast rubber injection moulding machine with the most up-to-date robot technology resulted in **a one-of-a-kind suction pipe production cell** for the automobile industry at AR-TEX Spa in Italy. The two machines can be connected or they can produce fully automatically, independently of one another. The heart of the system is the high-demand moulded part removal system. Only the optimum interplay of a gripping function, sufficient compressed air and the part removal system, which is based on the movement of a human hand, permits parts to be pulled off the core without damage.

Inlet water headers

Highly complex functional parts for the engine compartment require injection moulds that are just as complex. A number of solenoids and media connections increase the space requirements in the injection moulding machine, although little clamping force is required. **Injection moulding machines with a tie-bar-less clamping unit provide the advantage of high accessibility for the mould mounting surface.** This helps in "downsizing" the machine equipment as well as during mould changing.



Switching levers

In order for the operating forces and the operating feel to be the same in all the gears in an automobile series, switching levers must have especially steady, uniform quality. By overmoulding two metal parts with glass fibre-reinforced plastic, an opening for attaching a cable (among other things) can be integrated in metal pipes. For this purpose, the pipes and the cable attachments are inserted by the robot and the finished parts are removed automatically.

Oil dipsticks, media pipes

Spatially bent oil dipstick guide pipes made of PA66-GF are manufactured using the ENGEL watermelt water injection technique. Even media lines with branchings and several layers can be **produced economically, fully automatically and quickly in a single operation** with a combination of ENGEL combimelt and ENGEL watermelt. Although glass fibre-reinforced plastics are used, the pipes have a smooth interior surface. Lines for coolants also have a media-resistant inner layer.

Increased precision

ENGEL are the first provider to integrate a **water injection unit with piston injection in the injection moulding machine**, thus saving space. Thanks to reduced pressure losses, this mechanical and control-related integration provides more precise controllability and better reproducibility over conventional systems.

Oil pans

The first truck oil pan made of plastic, for the Daimler Actros truck with a V6 engine, was manufactured on a vertical machine ENGEL insert using fibre-reinforced polyamide PA66-GF35. **Compared to the classic tin variant, the plastic oil pan has significant weight savings.**

01. Switching flaps manufactured by Schneegans 02. Tumble flaps manufactured by Schneegans 03. The thermal separation of thermoplastic and elastomer in the same mould permits the production of air controls at KBS 04. Suction pipes, produced by AR-TEX 05. All-plastic oil dipstick, produced by Schneegans 06. Oil pan using fibre-reinforced polyamide PA66-GF35

07. Complex inlet water header for an automobile engine, manufactured by Plastic-Concept 08. Metal/plastic composite component for an automobile gearshift



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Clutch pedals

The pedal itself consists of PA66-GF30 and is manufactured using the **ENGEL watermelt technology**. The bearing block is produced on an ENGEL insert vertical machine by overmoulding the metal block. The pedal pad is rubber that is injection moulded on an ENGEL elast vertical machine.

Pedal bearing blocks

So-called pedal bearing blocks support the brake and clutch pedals in automobiles and trucks. They are currently manufactured with a hybrid method from plastic and galvanised sheet metal. In **completely automatic manufacturing cells** surrounding an ENGEL injection moulding machine, the threedimensionally shaped and contoured sheet is inserted into the injection mould and overmoulded with plastic.

Hybrid technology integrates fastenings for attachments

The attached plastic ribs stiffen the construction and prevent the galvanised sheet from collapsing if it is overloaded. The high E-module of the metal permits a delicate overall construction, and the ductile behaviour of the sheet prevents the component from breaking or falling apart during a crash. Furthermore, because of the plastic overmoulding, fastenings for attachments such as **switches and sensors** can be integrated.

ENGEL services

Always there where you need us



01. Clutch pedal of plastic with overmoulded bearing 02. Pedal bearing block with hybrid technology for a Mercedes model 03. Spark plug boot 04. Reduced-weight shock absorbers by Barre Thomas, MuCell®-foamed from TPE on an ENGEL insert machine

Damping elements and spark plugs boots

The ENGEL elast and ENGEL insert machines are combined to manufacture shock absorbers for an automobile axle. Modified PPE-GF20 replaces the metal that was formerly used. It is overmoulded with an elastomer and **fulfils the same functions as a heavy moulded part of metal and rubber.**

Economic mass production

Air hoses, spark plugs boots and sealing elements such as O-rings on moving parts and single-conductor seals in automobile electrical systems are produced from classical cured elastomers using ENGEL elast and ENGEL LIM machines or from cured liquid silicon (LSR) on ENGEL vertical and horizontal injection moulding machines.

560 of the best equipped service technicians

55 support hotline technicians

9 production plants

29 sales subsidiaries

60 representatives

