25 years of ENGEL tie-bar-less technology

Already 25 years ago ENGEL was the first injection moulding machine manufacturer worldwide to present a tie-bar-less machine. It was marvelled at, frowned upon by some and there were plenty of arguments against it. However, the innovation equalled a revolution. After all, we altered the so far unalterable principle that the clamping side of an injection moulding machine has to have tie bars. The huge success of the tie-bar-less technology, large mould fixing surfaces, and free accessibility of the mould proved us right long ago. Worldwide 60,000 tie-bar-less ENGEL machines are currently in use by more than 10,000 customers.

A success story that does not happen too often in the industry. The tie bars have been and still are a bothersome element and this was exactly the challenge for our technicians: to find a solution that creates added value for our customers. To develop a machine which offers larger mould fixing surfaces and better accessibility in order to make our customers even more competitive. The courage to think differently and to throw traditions overboard has led to this outstanding technical solution, the ENGEL tie-bar-less injection moulding machine.

Also the courage to implement this technology over the entire clamping force range up to 500 tonnes was eventually a convincing argument for many customers. Plastics manufacturers who are using tie-bar-less machines do not want to miss the freedom of machines without tie bars. They offer increased efficiency and economy in production. The tie-bar-less technology enables all of this at once and even after 25 years allows for new variations. Right on time for the anniversary we have introduced a new tie-bar-less machine onto the market. The all-electric ENGEL e-motion 30 TL is targeting the market segment of small, high-precision plastics components. The clear focus of this machine lies on the high precision of the clamping unit and the absolute platen parallelism during the entire clamping and injection processes. This machine managed to achieve precisions in the production of camera lenses, which had previously not been feasible.

Even after 25 years the tie-bar-less technology is very young and dynamic and we are sure that this technology will continue to be a part of ENGEL’s success for many more years to come. We will not stop to think outside the box.
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Fairs, events, projects

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The ENGEL tie-bar-less technology celebrates its anniversary

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ENGEL restructures service offerings
As the pressure to reduce costs continues to rise, innovation, efficiency and automation increasingly become the focus for injection moulding producers in Asia. ENGEL was demonstrating how to successfully meet such current challenges at Chinaplas in April 2014 in Shanghai. All four highly integrated manufacturing cells on display at ENGEL’s trade fair stand combined top performance with maximum energy and material efficiency while making clear that intelligent automation is also beneficial in terms of process technology.

An ENGEL duo 900 injection moulding machine with integrated ENGEL viper 20 linear robot was the focus of the automotive exhibition. Under the ENGEL foammelt banner, ENGEL offers turnkey solutions from a single source for MuCell structural foam moulding by ENGEL partner Trexel. For the MuCell process, the plastic melt is loaded with nitrogen or carbon dioxide and then injected into the mould, during which time the gas expands in the mould cavity. The use of raw materials and the component weight are thereby reduced, while at the same time the rheological properties of the melt improved. This results in dimensionally stable injection moulded parts that are free from sink marks. Thanks to the complete integration of the control unit, the injection moulding machine and the robot access the same database and can precisely coordinate their move sequences.

“Automation is increasingly becoming an integrative process that enables extremely economical production processes and guarantees a constant high level of product quality,” states Gero Willmeroth, Sales and Service Manager of ENGEL Machinery Shanghai.

Robert Bodingbauer, the managing director of ENGEL Machinery Korea, has been awarded with the Presidential Citation Order of Merit of the Republic of Korea for contributing to Korea’s industrial development and supporting foreign investments over the course of many years. The order is presented by the Korean president, Park Geun-Hye, to honour people who have made an outstanding contribution to the country. The Presidential Citation Award is the highest civilian accolade bestowed by the Republic of Korea and is comparable to the Decoration of Honour for Services to the Republic of Austria and the Order of Merit of the Federal Republic of Germany.

Robert Bodingbauer was the only foreigner to receive an order of merit from the Korean government this year.
Others who were honoured along with him included high-ranking managers from corporations such as Hyundai Motors, Samsung SHI and Posco. Mr Bodingbauer has worked in Asia for ENGEL since 1986. After a good number of years in Hong Kong, he moved to Korea in 2003 to take charge of the ENGEL production plant in Pyeongtaek City.

Promote young scientists
25 years ENGEL Benelux

In April 2014, ENGEL Benelux commemorated its 25th anniversary with 160 guests. The sales and service centre based in Houten, Netherlands, thanked its loyal customers and partners for their trust and the open and at times challenging collaboration by throwing a huge party. “Over the years, we have grown together with our customers,” stresses Kurt Callewaert, managing director of ENGEL Benelux. “We have a close partnership or even friendship with many of our customers.” Therefore, it was a matter of honour for him and his team to delight their guests on the occasion of the anniversary – culinary treats, live music and comedy. Instead of presents the subsidiary asked for support of a very special project, the ENGEL Benelux Award, a prize which as of now will be awarded annually to honour the best thesis in the plastics field. The anniversary party opened the competition. Students studying plastics technology in the Netherlands, Belgium, and Luxembourg, can apply as of now. In September, the jury will convene and award the first prizes. The award winners receive a sum of money, as well as a trip to visit ENGEL in Austria. “ENGEL has always been very active in promoting youth. We as a subsidiary would like to make a contribution,” states Kurt Callewaert. “In Benelux we have excellent training and research facilities in the field of plastics manufacturing. With this award, we will make our region’s level of performance better known.”

Innovative technologies reduce unit costs

Plastics in Automotive Engineering

At the international congress “Plastics in Automotive Engineering”, at the beginning of April 2014 in Mannheim, Germany, ENGEL AUSTRIA was presenting...
innovative products and technologies for greater efficiency and competitiveness in automobile production. Lightweight design was one of the focuses. ENGEL is a leading partner to the international automotive industry in this market sector. At its own technology centre for lightweight composites, ENGEL co-operates closely with customers and partner enterprises, as well as with universities and research institutes, on developing economic processes for the mass production of innovative composite components. Special attention is given to the processing of semi-finished thermoplastic products (organic sheets and tapes) and to reactive technologies that use thermosetting and thermoplastic systems, such as HP-RTM and in-situ polymerisation. ENGEL was demonstrating its new efficiencies in composite processing in Mannheim.

First and foremost, additional service technicians are to be hired this year. A sale of spare parts in Wurmberg is another project for the future. “The rapid growth proves that we have struck the right path with the foundation of ENGEL Deutschland Technologieforum Stuttgart”, Claus Wilde stresses. “Now we have to bring our staff, our processes, and our offer in line with the demands of the market on a continuous basis.”

“The share of technologically demanding system solutions with automation increases and requires a constantly intensified collaboration. With the new site we have created perfect conditions to achieve this.”

Claus Wilde, ENGEL Deutschland Technologieforum Stuttgart

Established communication hub
ENGEL Deutschland Technologieforum Stuttgart

A year after its foundation, ENGEL Deutschland Technologieforum Stuttgart is taking stock, and the results are quite positive. The number of employees has been increased sooner than planned to 25. Thanks to its closer proximity to the market ENGEL was able to acquire a lot of new customers over the course of the past year. With its particularly large technical centre and conference area the ENGEL Deutschland Technologieforum Stuttgart endeavoured to become an information and communication hub for the injection moulding industry in the southwest of Germany. “We have achieved this goal”, branch manager Claus Wilde states. “Our events are very well attended throughout”. The team welcomed so far more than 1,100 guests to its forum events, workshops and seminars. ENGEL Deutschland Technologieforum Stuttgart works closely with partner companies and institutions, and is actively involved in professional associations and networks. Furthermore, ENGEL is supporting training centres in the region. As a result, the network of partners is constantly expanding.

Maximum efficiency in lightweight construction
Another contract from BMW

ENGEL AUSTRIA has won another contract to supply system solutions to BMW’s Leipzig factory, where ENGEL duo injection moulding machines are used to manufacture car body shell components for the BMW i3 electric vehicle. The latest order includes two large-scale ENGEL duo machines with 40,000 kN clamping force integrated as a double system. In master/slave mode, both machines can be synchronised to injection mould and complete two components at the same time. This manufacturing principle makes sure that both components undergo exactly the same material aging process and that the high quality requirements are met.

As the general contractor for the manufacturing cells, ENGEL has taken responsibility for incorporating automation into the entire system. Both machines are fitted with a multi-axis robot. ENGEL delivered the first manufacturing cells of this type to Leipzig back in March 2013.
**Delivery of 5,000th injection moulding machine**

ENGEL Machinery Korea

5,000 injection moulding machines have been built by ENGEL AUSTRIA’s production facility in South Korea since being established in 2001. The “milestone” machine – an ENGEL victory with ecodrive – was delivered at the beginning of 2014 to Flextronics. ENGEL pursued a global presence from early on and established its own production plants in regions with strong growth potential. Today, ENGEL is the only European injection moulding machine manufacturer with two production plants in Asia. The plant for injection moulding machines in the small and medium clamping force segment is located in Pyeongtaek City (Korea), while ENGEL builds large-scale machines for the Asian markets in Shanghai (China). “Our project running times are constantly getting shorter”, says Gerhard Zebe, President of Global Operations Mechanicals at Flextronics, based in Zhuhai, South China. “ENGEL adheres to the delivery times we demand and fulfils individual equipment requests in Asia. As a company with global production, we value partners that also have a global presence and provide the same quality and service worldwide. And this is precisely what we appreciate about ENGEL.”

Flextronics is a leading end to end supply chain solutions company that employs a staff of 200,000 in more than 30 countries. ENGEL is a preferred supplier in its injection moulding sector. All told, ENGEL has thus far delivered nearly 400 injection moulding machines and integrated manufacturing cells with automation and process technology to the group. The new ENGEL victory machine is destined for the site in Malaysia. The delivery of the 5,000th machine from Korean production was actually celebrated twice. First with the staff in Korea, and shortly afterwards together with the customer at ENGEL’s head offices in Schwertberg, Austria. Dr Peter Neumann, CEO of ENGEL Holding, thus had the opportunity to thank Flextronics for their trust and long-standing partnership. “Vigorous innovation, combined with sustainable operations, is what characterises the global activities of both Flextronics and ENGEL”, emphasises Peter Neumann. “Building on these shared values, our close cooperation continually provides new impetus contributing to the on-going development of both companies.”

**Control complex processes reliably**

PLASTPOL 2014 in Kielce

Exhibition debut in Poland: The new ENGEL CC300

Smart management of integrated processes: The new CC300 control unit generation was ENGEL’s main attraction at PLASTPOL 2014 at the end of May. With four production cells at two stands plus another machine at a partner’s stand, this year, ENGEL’s presentation in Kielce was bigger than ever. Process integration and automation are crucial to increasing efficiency in injection moulding production. At the same time, however, they make the manufacturing processes more and more complex. Making the operation of highly-integrated and automated production processes easier, more comfortable and safer was therefore the declared goal of ENGEL in the development
of its new CC300 control unit generation, which was presented in Poland for the first time at PLASTPOL 2014. “With the CC300 we are setting a new trend,” says managing director of ENGEL Polska Piotr Nachilo in Warsaw. “The first users’ feedback has been extremely positive.” One main reason has been that the operators are able to figure out the new control unit immediately. The basic principles that operators appreciated in the previous model have been retained. In addition, user technologies that have since become standard were transferred to the demands of the injection moulding processes – for example, the intuitive gesture controls found in smartphones. All four machines on display at the two ENGEL stands featured the CC300 machine control unit.

“In these areas of application, the potential for increasing efficiency is particularly great. ENGEL gasmelt reduces the amount of raw material used and shortens cycle times by producing outstanding component stability and surface quality. We will therefore continue to develop the technology with our partners and to make this a priority.”

From left to right: Klaus Mittmannsgruber, Sales at ENGEL AUSTRIA, Mario Haidlmair, Managing Director at Haidlmair, Raffael Kurz, Managing Director at Bauer Compresseurs in Aix-les-Bains, France, and Christian Wolfsberger, Technology Manager at ENGEL AUSTRIA, with the new compressor.

**Development partners strengthen cooperation**

**New ENGEL gasmelt module for Haidlmair**

ENGEL AUSTRIA and Bauer Kompressoren have delivered a gas injection technology cell to Haidlmair, a mould maker located in Nussbach, Austria, to increase the company’s mould proving capacity. In addition, the three partner companies expect the new cell to strengthen their joint development work. Bauer Kompressoren is ENGEL AUSTRIA’s exclusive partner in the field of gas injection technology (GIT). Under the name ENGEL gasmelt, the injection moulding machine manufacturer offers complete integrated solutions for injection moulding with gas injection technology. The project with Haidlmair also demonstrates that older systems can be easily upgraded. The new GIT module was integrated into a large existing ENGEL machine.

The ENGEL gasmelt process and the individual gas feeds can be controlled and monitored via the injection moulding machine’s display. During mould trials, Haidlmair particularly benefits from the leakage monitoring system integrated as a standard in the ENGEL gasmelt cell. A specialist in moulds for drink crates, large containers, pallets and high-quality automobile components, Haidlmair already has plenty of experience with gas injection technology. Christian Wolfsberger, Technology Manager at ENGEL AUSTRIA in Schwertberg, Austria, states: “In these areas of application, the potential for increasing efficiency is particularly great. ENGEL gasmelt reduces the amount of raw material used and shortens cycle times by producing outstanding component stability and surface quality. We will therefore continue to develop the technology with our partners and to make this a priority.”

**Preview 2014**

- **ENGEL med.con**, Stuttgart/Germany, 2nd June
- **ENGEL med.con**, Lyon/France, 18th June
- **FIP**, Lyon/France, 17th-20th June
- **ENGEL Automotive Days**, Bangkok/Thailand, 24th-25th June
- **ENGEL connections**, Stuttgart/Germany, 3rd July
- **Interplast**, Joinville/Brazil, 18th-22nd August
- **ENGEL med.con**, Hannover/Germany, 4th September
- **Indoplas**, Jakarta/Indonesia, 3rd-6th September
- **ENGEL med.con**, Mirandola/Italy, 17th-18th September
- **ENGEL Lightweight Days**, St. Valentin, Schwertberg/Austria, 17th-18th September
- **Expo Plast**, Bucharest/Romania, 24th-27th September
- **Plastex**, Brno/Czech Republic, 29th September – 3rd October
- **Colombiaplast**, Bogota/Colombia, 29th September – 3rd October
- **Interplas**, Birmingham/Great Britain, 30th September – 2nd October
- **Equiplast**, Barcelona/Spain, 30th September – 3rd October
- **Composite Europe**, Düsseldorf/Germany, 7th-9th October
- **Fakuma**, Friedrichshafen/Germany, 14th-18th October
ENGEL now presents its new digital look. Boasting a modern design and an extremely clear navigation structure, the new website guides its visitors intuitively to the information they want. Gerd Liebig, Group Marketing Director at ENGEL, says: “When the site was being developed, the aim was to get users where they want to be even more quickly. Our website is being used more and more, and our customers should be able to expect top-quality service from ENGEL online too.”

Solutions for specific requirements
Besides providing a detailed overview of ENGEL’s product range, the new website reflects the company’s strong focus on applications. Under the menu item “Business Lines”, injection moulding facilities can now find possible solutions for their specific requirements. Examples include solutions for high-quality car interior design, cost-optimised thin-wall containers and electronic display screens with multifunctional surfaces. Numerous hyperlinks allow users to learn more about a topic and read press articles, while videos and animation spots make even complex machine functions and manufacturing processes easy to understand.

ENGEL has a separate area called “ENGEL plus” for its service products. For the first time ENGEL’s complete range of after-sales services is presented here. The content is divided up according to various objectives, which means that even those who are not familiar with the ENGEL service products can learn a great deal about them and possibly tap into new ways of optimising potential.

Straight to the right contact
One highlight of the new website is the new global request and contact network. With just one click, visitors can contact the person responsible for a particular topic in their country. Gerd Liebig says, “This decentralised contact management system allows us to respond to online requests even more quickly and, above all, accurately.” Customer proximity is, of course, important to ENGEL online as well, and for this reason the website is available in 26 country-specific versions. This enables ENGEL to keep their customers up to date on local topics, events and job opportunities at their respective sites.

The same responsive site design has been used for every country. This ensures that the content and functions are displayed perfectly even on mobile end devices like tablet PCs and smartphones.

www.engelglobal.com
“The clamping unit of an injection moulding machine has four tie bars.” – Since the development of the first injection moulding machine with one screw in 1956 this design principle was considered unalterable. When ENGEL was the first company worldwide to present a tie-bar-less machine at the international trade fair for plastics K 1989 in Düsseldorf, this was a revolution. However, only shortly afterwards the tie-bar-less clamping unit was the predominant construction principle in the Schwertberg factory. The ENGEL engineers themselves had not expected such a huge and especially quick success, as they disclosed in the interview with Injection. Dr Alfred Lampl, former technical managing director of ENGEL AUSTRIA and now retired, Werner Kappelmüller, mechanics development manager for small and medium-sized machines and member of the development team already in 1989, and Franz Pressl met for a very intimate look back. The product manager for the tie-bar-less ENGEL victory machines started to work at ENGEL in 1988 as a young engineer and was excited by the concept of tie-bar-less technology from the very start.

Injection: ‘A clamping unit has four tie bars.’ – Why did you break with this tradition?
Werner Kappelmüller: It was a customer who came up with this idea. He said to us how easy mould changing would be, if it weren’t for the tie bars. And that is how the idea originated and of course we were enticed to try out, whether it was even possible. We started doing calculations, which was quite difficult without the nowadays commonly used finite element method. The experiments were much more important. We had a cast iron frame manufactured and combined it with an injection unit. It soon became clear: a tie-bar-less injection moulding machine is feasible. But it also became evident that a number of constructive particularities would be required, such as a joint between the moving platen and the closing piston, which compensates for frame deformation under clamping force. At first it was only a block with a lever bolt – the precursor of today’s Flexlink.

Injection: How did you convince the owners to see this idea through until it was market ready?
Alfred Lampl: This was easy, because Mr Schwarz has always placed a lot of trust in his technicians. We were able to work freely in product development. Also everything happened really fast. We presented the first tie-bar-less injection moulding machine in 1989 at the K show and soon afterwards we launched an entire series on the market. Within no time the tie-bar-less machine became our main product. Not even we had expected this kind of success.

Werner Kappelmüller: Initially our main focus was the simple mounting and dismounting of moulds. The market then recognised that thanks to the barrier-free clamping unit all of a sudden very large moulds could be mounted on relatively small machines and that this could further reduce manufacturing costs. Our customers back then were very open to try out new things and we have taken up all ideas and tested what was technically feasible and reasonable. It was an exciting time. At the time the development team was small and there were many evenings when we would sit together in the local pub to continue our discussions. As for teamwork the tie-bar-less technology is exemplary. The cooperation between construction, measuring, and other departments worked perfectly. It is nice that many of the colleagues from that time are still around. One important mastermind, the head of construction and later technical managing director, Heinz Leonhartsberger, sadly passed away since then. He was a strong advocate of the tie-bar-less technology and defended it successfully against sceptics, who of course also existed back then.

Alfred Lampl: It was important to convince our sales department of the tie-bar-less technology quickly. After all, we had tried out something completely new that many couldn’t even imagine yet. The tie-bar-less technology was a huge development. And its victorious triumph led to the name for the tie-bar-less hydraulic machine series, ENGEL victory.

Injection: With the tie-bar-less technology ENGEL has a unique selling proposition. Why has no competitor product so far been able to become established?

Werner Kappelmüller: The scope of the patent protection is very wide. All further developments have consistently been patented too. Meanwhile we can look back on more than 25 years of experience with the tie-bar-less technology and thus have an enormous head start.

Franz Pressl: And we have made the experience all over the world. The tie-bar-less injection moulding machine is a global product which we are manufacturing also in Korea for the Asian markets. Important for the success in this region is that it is not a “me too” product, but a real value added which we are offering our customers.

Injection: What links you personally to the tie-bar-less technology?

Werner Kappelmüller: It tends to amaze me how the simplest solutions are often the best ones. Take the flexlink for example – we really racked our brains while the solution was staring us in the face, but we didn’t see it for a long time. Suddenly we were able to master several technical challenges at once and make constructions even more cost efficient. As a design engineer you are closely connected to the product. Your own well-being very much depends on how the product is doing.

Alfred Lampl: What I’ll always remember is the collaboration with a customer in Germany who helped to advance the tie-bar-less technology. The customer was always honest with us. And this is exactly what is so important, that you have customers who are open and provide you with feedback.

Franz Pressl: This exciting time was when I started working for ENGEL. It was very interesting to observe

“If we consider that the tie-bar-less injection moulding machine is characterised by an elaborate, low-friction concept consisting of high-quality materials, which make it so robust, then the significance of tie-bar-less technology will continue to grow also in future.”

Werner Kappelmüller, mechanics development manager for small and medium-sized machines
how quickly this tie-bar-less injection moulding machines gained a foothold. When I became product manager for the ENGEL victory in 2007, I visited many customers right at the beginning and was impressed by how the tie-bar-less technology led to higher efficiency and to some extent to entirely new processes. And even today I still see an important task in showing users how they can make full use of the potential. Many are impressed by how tie-bar-less machines achieve a better platen parallelism and clamping force distribution thanks to their construction than machines with tie bars.

Injection: How do you see the development going further?

Franz Pressl: The tie-bar-less injection moulding machines are one of the biggest innovations in injection moulding machine engineering ever. And in my point of view still a young technology for which we have great plans. Especially in multi-cavity applications which require a relatively low clamping force compared to the mould size, the tie-bar-less technology will become even more predominant. Many moulds are already specifically constructed to use the entire surface of mould fixing platens or even extend beyond them. It is important that the cavities are located within the platen face. The big advantages of tie-bar-less injection moulding machines are lower investment costs and a smaller footprint.

Alfred Lampl: I agree that the tie-bar-less injection moulding machines are far from reaching their full market potential. The topic of energy efficiency will continue to play an important role and tie-bar-less injection moulding machines offer advantages also in this field. Save energy and at the same time remain stable – this will be a big challenge also in future.

Werner Kappelmüller: With the servo-hydraulic system ecodrive we have set an important milestone. With ecodrive the energy consumption of hydraulic injection moulding machine has almost reached the level of all-electric ones. Especially in technical injection moulding we already achieve the highest efficiencies. However, we will continue to work on the subject of energy efficiency. If we consider that the tie-bar-less injection moulding machine is characterised by an elaborate, low-friction concept consisting of high-quality materials, which make it so robust, then the significance of tie-bar-less technology will continue to grow also in future.
**Space**

for large moulds

The clamping unit of the tie-bar-less ENGEL victory

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**Support mould weights optimally**

A particular feature of tie-bar-less ENGEL injection moulding machines is their massive frame. The clamping unit is ideally supported and does not deflect even with very heavy moulds. Thanks to additionally available bearings for the moving mould half, the mould weight can be increased almost indefinitely.

“The mould with a mounting height of 1.5 metres on a 600-tonne tie-bar-less machine has really impressed me. It protrudes beyond the upper and the lower edges of the mould mounting platens. Thanks to the linear bearings the mould cycled with a smoothness and calmness no user had ever achieved before.”

*Gerhard Wimbauer*

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**Adjust platen parallelism perfectly**

The parallelism of mould mounting platens can be adjusted very easily and furthermore with extreme precision. ENGEL’s parallelism tolerances are significantly lower than those of the EUROMAP norm. Thanks to preloading of the patented force dividers, the platen parallelism remains constant even when the mould is mounted.

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**Highest platen parallelism even in motion**

No turning, no tilting: Thanks to three-point guidance – two precision guide rails and the central guide of the clamping piston – the moving platen retains its orientation even during opening and closing of the mould.

In contrast to other machine designs, the stationary mould mounting platen is not connected with the frame at the bottom end, but on the backside. This way it absorbs the machine’s vibrations in a symmetric manner and remains parallel to the moving platen even during acceleration and deacceleration.
Back in the 1990s, when Gerhard Wimbauer was head of ENGEL measuring technology, he was taking care of the first tie-bar-less customers. Today, he is the expert for mechanical measuring at the ENGEL production facility as well as the customer site. He knows the behaviour of the tie-bar-less clamping units down to the smallest detail.

**Maximum mould protection**

Under clamping force, an expansion of the clamping frame and a minimal deflection of the clamping cylinder and the stationary mould fixing platen occur in any injection moulding machine. In tie-bar-less injection moulding machines, however, the central elastic element Flexlink allows the moving platen to exactly follow the mould. This way the tie-bar-less injection moulding machine flexibly adapts to the parallelism of both mould halves and therefore ensures optimum mould protection.

“A customer told us that - thanks to his tie-bar-less injection moulding machine - for the very first time he had been able to cycle a mould with very long and thin cores over an extended period of time. The mould had previously been used on a different machine, but the cores kept breaking.”

**Distribute clamping force evenly**

No matter whether the cavities are centred or located on the edge of the mould mounting platen, they all are subject to exactly the same level of clamping force. The patented force dividers make sure that the clamping force is distributed evenly over the entire mould fixing platen. This guarantees a consistently high part quality even in multi-cavity moulds.

**Last but not least: It’s down to correct mounting**

The following is true for both, machines with tie bars and without: The best clamping unit is not worth a penny if the mould is not correctly mounted. The point is to pay attention to the alignment of both mould halves which can still change after mounting – for example due to increasing mould temperature. If the disalignment goes unnoticed, it can lead to parting line offset or increased mould wear.

“Initially it happened time and again that users thought the tie-bar-less clamping unit was the cause of parting line offset or mould wear. But the problem lay elsewhere: It was an incorrect mould mounting procedure. After thorough examinations we have written a guideline on the correct mounting of moulds on injection moulding machines. Mistakes can therefore be avoided. The guideline applies to machines of all types, because mounting mistakes have the same critical consequences on machines with tie bars as well.”

Gerhard Wimbauer
Energy efficiency has been a main concern for ENGEL long before the past years’ rise of energy prices and the favouring of sustainable solutions. As early as 1989 – meaning in parallel with the development of the tie-bar-less technology – the machine manufacturer from Schwertberg developed an energy-saving concept for hydraulic injection moulding machines, which was based on avoiding energy losses. However, back then this concept attracted the attention of only a few customers. At the time energy efficiency was hardly worth talking about.

Avoiding energy loss
Only in 2008 the servo hydraulics concept, which ENGEL is now marketing under the name ecodrive, had its big breakthrough. ecodrive represents the state of the art of energy-optimised servo-hydraulic drive technology, but its basic principle is not too different from the solution developed 25 years ago: The drive speed results from the currently required speed of the injection moulding machine axles. When a machine is idle, during a cooling phase for example, the drive is not running either and therefore does not consume energy. Thus, the energy consumption of drives is reduced by 30 to 70 %, depending on machine type and application. Energy losses are reduced to such a high extent that the hydraulic oil is heated only minimally. In many cases cooling the hydraulic oil is no longer necessary. The oil temperature or the required cooling performance is therefore an indicator of the injection moulding machine’s energy efficiency.

The energy efficiency of the tie-bar-less machines is also supported by their design. The clamp pressure lock-in ensures that no energy is required to maintain the clamping force and the electric variable displacement pumps further reduce the drive energy consumption by approximately 20 %. The first variable capacity pumps were introduced in 1994 and the goal was first and foremost to achieve a better control accuracy of injection moulding processes. The lower energy consumption is a positive side-effect.

All in all, hydraulic ENGEL victory injection moulding machines equipped with ecodrive nowadays achieve energy consumption values that measure up to all-electric machines. If moulds with hydraulically powered core-pulls are used, the overall energy balance of a hydraulic machine with ecodrive can be even better than compared to an all-electric machine with hydraulic auxiliary unit. The hydraulic units are available in several variants for parallel movements of ejectors, core-pulls and plasticising, in order to ensure optimum energy supply also for complex moulds. Therefore, the tie-bar-less ENGEL victory machines with integrated servo hydraulics are often the perfect solution for the broad application area of technical injection moulding. Nowadays, more than two thirds of all hydraulic injection moulding machines delivered by ENGEL worldwide are equipped with ecodrive.

Hybrid concept for special purposes
Thanks to the combination of tie-bar-less technology and servo electronics ecodrive, ENGEL succeeded in making also hydraulic injection moulding machines fit for future requirements. They are superior to traditional hydraulic machines not just in terms of energy efficiency. Moreover, they achieve a particularly high level of precision thanks to a very powerful injection moulding process controller and the hydraulically mounted injection pistons.

In order to meet even higher precision requirements and to achieve a particularly quick and at the same time energy-efficient injection behaviour, ENGEL introduced
the ENGEL e-victory series with hydraulic clamping unit and electric injection unit onto the market. The hybrid machine with hydraulic clamping unit and electric injection unit is used for manufacturing particularly complex technical parts, micro parts, and optical parts. Furthermore, the very high injection performances offer benefits if thin-walled injection moulded parts require an increased injection speed. In these areas of application ENGEL e-victory machines replace hydraulic machines with additional accumulators more and more frequently. When it comes to energy efficiency, there is no place for accumulators in an injection moulding machine. In order to make use of the entire energy efficiency potential, the ENGEL e-victory hybrid machine is equipped with ecodrive as standard. Because replacing individual hydraulic axles with servo-electric axles does not automatically improve the overall efficiency. Often energy savings derived from the servodrive account for less than the additional losses due to idle times of the simultaneously running hydraulics drive. Integrating individual servo-electric drive technology into an injection moulding machine is only beneficial if a traditional hydraulic pump is completely left out.

**Energy efficient for the future**

The importance of energy efficiency will continue to grow rapidly worldwide. For this reason, traditional hydraulic drives are more and more being replaced with energy-efficient electric or servo-hydraulic drives or a combination of both components. Another trend is to analyse the requirements of the product and manufacturing process prior to choosing the drive concept in ever greater details. What counts is overall efficiency. For ENGEL the future of energy-efficient drive technology has started a while ago. The energy efficiency will continue to constitute a main focus of development.
If the injection point is in plain view, it does not necessarily mean that the component is poorly devised. It could also be a particularly clever design. Last time the Injection editorial team visited Koziol, we were unable to find the injection point on the cutting board that had just been produced – while in fact, we were staring right at it. Because the knothole in the kitchen utensil’s wood-resembling design had struck us as very original right from the start. “Here at Koziol, an experienced injection moulder needs to start rethinking”, Michael Kredel, head of application technology, tells us. Creativity and innovative strength are two of the main ingredients in the Erbach based plastics manufacturer’s recipe for success. Founded in 1927 as an ivory carving shop, Koziol switched to using the new polymeric materials as early as 1932 and in the 1950s became known for its plastic snow globes. Today, design is the driving force and the product range is diverse. The know-how required for the entire spectrum spanning conception, design development, construction, injection mould production, manufacturing, assembly, and worldwide distribution is concentrated at a single location, the company’s head office in Erbach in the Odenwald region. Koziol is very committed to the region and the people who live there, which impacts even its injection moulding.

Tie-bar-less design facilitates automation
In 2013, Koziol put two new ENGEL victory injection moulding machines into operation. The two 400-tonne machines were delivered by ENGEL as a system solution complete with an electronic temperature control water distributor, conveyor belt, and linear robot. Cutting boards in various designs and many other products are being produced by these machines with minimum waste and maximum energy efficiency. Investing in the new production cells has cut the energy needed for producing these products by an average of 40 % thanks to the ENGEL ecodrive servo hydraulics. Another decisive factor in favour of the ENGEL victory series was its tie-bar-less technology. “Our production hall ceiling is rather low,” Kredel explains. While robots of other machines in the traditional tie-bar design require a telescopic arm, ENGEL victory machines use standard handling. This makes the new production cells very future-oriented, because “automation will become increasingly more important,” stresses Daniel Koziol, junior managing director. “Automation opens up opportunities to achieve even higher and reproducible product quality. This becomes ever more important, the more process steps we integrate.” The first process step to be integrated is labelling. Also cutting boards receive a label right after injection moulding. The ENGEL viper robot transports the boards to the labelling station after they are removed from the mould. “Only automation can ensure that the labels are placed on exactly the same spot,” says Kredel. “This is very important to us at the point of sale.” The adhesive labels are en vogue. They replace outer packaging for more and more products.

Shorter set-up times even for bulky moulds
Every spring and autumn Koziol presents 15 to 20 novelties at the world’s main trade fairs for consumer goods. “Currently our product range includes a total of 1970 products,” says Daniel Koziol. Production is carried out on demand, which means small batch sizes and frequent mould changes. “Some of our moulds are very large,” says Michael Kredel. “However, here the tie-bar-less design helps us to be efficient during set-up.” The magnetic clamping technology further speeds up the set-up process and improves safety together with the new integration in the ENGEL machine control unit. “The holding force of the magnetic holding plate communicates with the machine control unit of the injection moulding machine,” explains Falk Boost, sales engineer at ENGEL Deutschland Technologieforum Stuttgart. “Thus, the opening and ejecting force of the injection moulding
The use of ENGEL flomo is also supposed to ensure a higher level of process reliability. The electronic temperature control water distributor constantly monitors all temperature and cooling control circuits. “We know that once with an older machine this system would have saved us an entire batch,” Kredel reveals. “Therefore, we want to equip any new machines by default with flomo.” Efficiency has many faces. With the two new injection moulding system solutions Koziol has pulled out all the stops. “In order to use efficiency potentials to the fullest, you need the right partners,” stresses Michael Kredel. “Our contact partners at ENGEL have a particularly thorough understanding of the process. ‘That’s impossible’ – words we have never heard from ENGEL.”
PA replaces aluminium – the overall efficiency is compelling

The replacement of aluminium and other metals with plastics is progressing swiftly and this development also concerns components under the bonnet. But it is not just about lightweight construction, as the example of an oil filter module for four-cylinder diesel engines shows.

Hengst SE & Co. KG excels in both fields. As leading provider of fluid management modules, crankcase ventilation systems as well as filter technology for oil, fuel, air and cabin filtration the medium-sized enterprise based in Münster, Germany, is proficient in the use of different materials. At the Hengst plant in Nordwalde, aluminium and thermoplastic materials are processed using die casting and injection moulding, respectively. For every new product Hengst assesses which material brings the most benefits. “If forces and pressures allow the use of plastics, it is the preferred solution,” says Christian Oldenburg, head of industrial engineering in Nordwalde. Ever lighter, smaller, and cleaner – those are the demands from automobile producers for modern engines. Integrated plastics solutions play a vital role in meeting these requirements despite the further increasing cost pressure.

The roughly 35 cm long, 30 cm wide and 30 cm deep oil filter module for longitudinal installation in four-cylinder diesel engines will be used in various Audi and Volkswagen models. It is among the most complex three-dimensional components Hengst is injection moulding. In December 2013, the production of the previous series started on a new ENGEL victory 500 injection moulding machine with integrated ENGEL viper 40 robot and also the component design had already been devised by Hengst. “Our customers indicate performance data and mounting dimensions. On this basis we develop the optimum solution,” says Michael Oertker from the industrial engineering team. The biggest challenge with this component was to develop a very compact design despite the many cavities, junctions, and bore holes. Moreover, the component should ideally be manufactured in a single work step. “This high level of manufacturing
efficiency would be unimaginable with an aluminium die cast construction," stresses Oertker. “We would have needed several work steps and would have had to use cutting on some of the surfaces.” The construction from glass fibre reinforced polyamide renders this unnecessary. All junctions are formed during injection moulding and threads are cut out with a core-pull.

**Tie-bar-less technology keeps manufacturing cell compact**

All in all the 1-cavity mould comprises eight core-pulls, which account for its considerable size. Since the mould fixing platens of the tie-bar-less ENGEL victory machines can be fully used up to the edge, the oil filter modules can be manufactured by a single 500-tonne machine. “Alternatives using tie bars start at 800 tonnes,” says Michael Oertker. The tie-bar-less design has advantages for automation as well. The robot arm can reach from one side directly into the mould cavity and thus reduces the working height. Hengst assumes that automation will become even more important in the future. “The parts we manufacture in-house are getting more and more complex. Automation is increasingly becoming an integrating part of the process,” says Oertker. Because this requires a very intensive collaboration between plastics processor and system supplier, ENGEL also employs automation experts at its sales subsidiaries. “When removing the oil filter module, the gripper head in the mould needs to rotate,” explains Christoph Hoelscher, sales engineer at the ENGEL Germany Hannover subsidiary. “On location at the subsidiary we can implement even special solutions like this in no time at all.”

After the successful pre-series the production figures are increasing steeply. Planned are 300,000 filter modules a year. The cycle time is already being optimised, but there is not much room for improvement. The cycle time directly affects dimensional accuracy and surface quality and these factors are strictly limited for this component. The demands for the injection moulding machine are just as high. “When it comes to precision, tie-bar-less injection moulding machines are our first choice,” says Christian Oldenburg. “In fact at first it is astonishing how this can even work with such a huge mould. We have looked into this very carefully and know that with tie-bar-less machines we can achieve the best possible platen parallelism even under full load. Now, we only produce rejects during start-up.”

**New machine design ensures clear arrangement and organisation**

The Hengst machine park in Nordwalde comprises a large number of ENGEL injection moulding machines, including many machines of the ENGEL victory series. The ENGEL victory 500 is the first machine featuring the new design, which ENGEL introduced in late 2011 for the 500-tonne version of this machine type. The goal for this development was to make working even more ergonomic and comfortable. “Thanks to the two-part safety gate, access to the mould for carrying out smaller interventions is a lot quicker,” says Daniel Zimmermann, operating technician at Hengst. “And this doesn’t even require strength.” His fellow operating technician, Roman Gerber, also gives a positive account of the new design features, “We use the storage space and the clipboard a lot. Due to the many cooling circuits, examining the oil filter module mould resulted in a vast amount of information, which we were able to access directly via the machine control unit.”
A family owned business founded in 1940 as a producer of stamped metal gears, Winzeler Gear is now internationally known as one of the premier designers and manufacturers of high-precision high-tolerance moulded plastic gears for the automotive, lawn and garden, and office automation industries.

Winzeler Gear has adopted the principles of Scientific Moulding as a foundation in their business model. These principals are used to develop and control 100% of all moulding processes, ensuring minimum variability in gear dimensions and material integrity. With full corporate investment, all their process engineers are trained and certified by RJG Inc. – international leader in injection moulding training, technology and resources – to assure they understand the science of moulding and the scientific approach to process development and control. This specialized training in scientific and de-coupled moulding allows Winzeler to develop and maintain a precision production process for all gears manufactured in their facility.

To develop the process, cavity pressure sensors are used at the prototype moulding phase of each program. If gears moulded with the prototype process meet dimensional and durability requirements, Winzeler can ensure a smooth transition from prototype to production by matching the pressure fill curve template. When in production, the RJG computer must accept the process every cycle before the gears are allowed to flow into a “good” part container. The approval signal is stored on a production server, providing a record of 100% process validation by cycle with a date stamp.

Tie-bar-less design for the ultimate flexibility
All gear production is performed on horizontal ENGEL machines, with over 50% of the 39 machines in the facility being tie-bar-less. “The ENGEL tie-bar-less design provides us with the ultimate flexibility when designing our automation, and is the only machine we purchase,” says John Winzeler, President of Winzeler Gear. “The moulding plant dynamics would be changed completely if we had to rely on conventional machine designs.”

The company uses a combination of linear and six-axis robots when automating their systems, along with automated box loading with bar coding traceability. The highly automated moulding plant facilitates producing consistent quality for the 120 million gears shipped annually today.

The hybrid ENGEL e-victory is the new machine of choice for Winzeler. With the high-precision servoelectric injection unit and tie-bar-less hydraulic clamp, the machine keeps all the benefits of the tie-bar-less design – large mould space, efficient mould changing and easy integration of automation – with the flexibility for peripheral power, and energy-savings similar to an all-electric machine. The best of both worlds for their business. In addition to this, “the ENGEL machines are durable and reliable, which serves us both well,” says John Winzeler. “Re-qualifying machinery for the automotive business is difficult, and the long life of the ENGEL machine means that we seldom have to go through the procedure.”

Strategic partnerships are core to the company’s business model and their partners have contributed significantly to the success and growth of Winzeler Gear. ENGEL is one of their key partners and has been working together with Winzeler Gear for over 30 years.

Art on the machine
From the moment you step into the Winzeler Gear facility in Chicago, Illinois, their unique and creative brand is evident. From the gallery of Fashion Gear Art to the walls of their high-class facility, everything speaks to creative thinking, quality, precision and high performance. The injection moulding machines are no exception in this point. ENGEL North America recently installed five ENGEL e-victory injection moulding machines – meanwhile each one is some kind of artwork itself.

“The moulding plant dynamics would be changed completely if we had to rely on conventional machine designs.”
Injection moulding machines and manufacturing cells continually need to boost their output, efficiency, and flexibility. This also results in changing requirements for the machine manufacturer’s service organisation. ENGEL AUSTRIA has squared up to this challenge and reorganised its service products and services under the ENGEL plus banner. The objective is to create added value for their customers and, thus, to improve their competitive advantage.

Training and service are firm features of ENGEL’s system philosophy. ENGEL plus makes its service portfolio even more transparent, thus opening up optimisation potential for existing machines, robots and plants. “We accompany our customers through the entire production plant service life”, emphasises Wolfgang Degwerth, Head of ENGEL AUSTRIA’s Customer Service Division.

Boosting the productivity even of older systems
ENGEL plus ranges from global on-site support with spare parts logistics, remote services and a 24x7 hotline, maintenance and repair contracts at fixed prices to retrofitting options and optimisation tools, application engineering consultancy, and professional training and eLearning offerings. All service products and services are divided up according to various objectives: know how, availability, optimization, upgrade, efficiency and support. This means that even those who are not familiar with the ENGEL service products can possibly tap into new ways of optimising potential.

“Above all, the topic of retrofitting is becoming increasingly important against a background of increasing efficiency pressure,” says Mr Degwerth. Even older injection moulding machines and control unit generations can be improved in terms of energy-efficiency, shot weight constancy and maintenance overhead minimisation. At the same time, ENGEL plus allows for retroactive integration of additional process steps, technologies, and automation. To fulfil the customer’s specific requirements, ENGEL develops individual software solutions.

Close to the customers – anywhere in the world
More than 550 staff are employed in customer service and training at ENGEL’s global plants and subsidiaries. To ensure top quality standards for our services worldwide, all ENGEL service engineers and trainers are regularly required to take part in training and testing. ENGEL also uses its online learning platform to achieve this. After all, the ENGEL service network covers the entire globe. “Short paths to our customers are very important to us,” says Wolfgang Degwerth. “We are continually expanding our global service network.”

“With ENGEL plus, we ensure optimal asset health and planning security for our customers and, on request, help them keep their machinery up to date at all times.”
Wolfgang Degwerth, Head of ENGEL AUSTRIA’s Customer Service Division

Update on energy efficiency
Rising energy prices and the demand for more sustainability often make manufacturing systems that have been used for many years seem even older. ENGEL’s new retrofit solution ecodriveR reduces the energy required by existing hydraulic injection moulding machines by up to 50 %. ecodriveR means hydraulic injection moulding machines with an asynchronous motor and electric-hydraulic variable capacity pumps (EHVs) can now be controlled according to demand as well. This is achieved through the installation of a frequency converter that adjusts the speed of the pump drive to the amount of energy required. ecodriveR is set using a simple interface of the machine control unit. Since a machine’s hydraulic system remains the same when it is retrofitted, ecodriveR allows to adapt older injection moulding machines to the requirements of modern production companies quite quickly and at a relatively low cost.