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>> **injection Asia**  
>> **injection North America**

## Going North Engel machines at the Arctic Circle

>> Sometimes a story develops a dynamic all its own as soon as one begins to write it – and this story is no exception. We had planned a report on the history of an injection moulding firm in Akureyri, the town in the north of Iceland known to most of us as a popular cruise destination. And as far as we knew, it was also where the "northernmost" Engel machine was in operation. Indeed, given the latitude 65° 41' N – close to the Arctic Circle – this also seemed very likely, at least at first glance. But in order to be sure, we did some research through Engel's subsidiary network and came up with quite a surprising result: Engel machines on the Arctic Circle are no rarity (see list).

Whilst it is Iceland that one associates more readily with the frozen north, there are places in Scandinavia and Finland that are not only situated further north than Iceland but are also the locations of plastics processors using Engel machines: Rovaniemi, rumoured as the Lapland home of Santa Claus, is situated directly on the Arctic Circle. It is there that the Freudenberg subsidiary Rovamatto Oy, a manufacturer of special-purpose mats, and the knife manufacturer Marttiini Oy have Engel injection moulding machines in service. And the Norwegian firm of Vev-Al-Plast AS and the Swedish contract injection moulder Nordpolymer AB are located in even colder regions – between 70 and 100 km north of the Arctic Circle.

But let us return to the starting point of our report – Iceland.

### >> It all began at K 2004

In 2004, Hrafn Stefansson, a young engineer from Akureyri, visited the Düsseldorf plastics fair without knowing anything about injection moulding, but with a firm order in his pocket from a local dairy processor for the permanent supply of tubs for yoghurt and other milk

products. The customer wanted to have the same in-mould labelled 200 and 500 ml tubs that at that time were available only in far-off Reykjavik. On-the-spot production would make him more independent and flexible. Stefansson's initial discussions with the sales engineers on Engel's exhibition stand went so well that he immediately decided in favour of an Engel machine. What also helped to clinch the deal was the fact that Engel machines were already in operation in Stefansson's neighbourhood at home, and what could be a better reference than that?

It was to be an "all-inclusive package" – from product definition, injection moulds for the two sizes of tub and the automated label-placing and parts-removal system through to the injection moulding machine itself – a tiebarless ENGEL VICTORY 330/110 Power – and of course the necessary operator training course. The machine components were chosen with due regard for the need for maximum operating reliability and flexibility. The preferred solution was a combination of Engel injection moulding technology with moulds and automation systems from the Dutch firm of Van den Brink B.V.

Meanwhile, a great deal of work still had to be done back home in Iceland. A company had to be established – "Plasteyri", a hybrid of "Plastics" and "Akureyri" – and a production and warehouse building had to be built. Everything was ready only 18 months after K2004 and the machine was delivered and put into operation by July 2006.

This new machine now augments the number of Engel machines in operation near the Arctic Circle, but the prize for the northernmost Engel machine goes – by just a few degrees of latitude – to Sweden, unless there are some more Engel machines even further north, in the northernmost regions of Alaska or Russia, for example. Should this be the case, we shall of course investigate and report back. <<

### Engel machines on the Arctic Circle

- >> **65°41':**  
Akureyri/Iceland – Plasteyri hf.
- >> **66°29':**  
Rovaniemi/Finland – Rovamatto Oy ([www.rovamatto.fi](http://www.rovamatto.fi)) and Marttiini Oy ([www.marttiini.fi](http://www.marttiini.fi))
- >> **66°33': Polarkreis**  
The Arctic Circle is defined as an arbitrary boundary marking the southernmost extremity of the northernmost area of the Earth, where in summer the sun does not set even at midnight and permanent darkness prevails in winter. This boundary line is the parallel of latitude 66° 33' N.
- >> **67°05':**  
Rognan near Bodø/Norway – Vev-Al-Plast AS ([www.vev-al-plast.no](http://www.vev-al-plast.no))
- >> **67°10':**  
Gällivare/Sweden – Nordpolymer AB ([www.nordpolymer.se](http://www.nordpolymer.se))



The Icelandic flag



Plasteyri hf. at Akureyri/Iceland



Products from Plasteyri's production



Delivery of Engel machine



Acceptance test by Hrafn Stefansson



The ENGEL VICTORY 330/110 Power



The production cell at Plasteyri



Tub production at Plasteyri

Dear Customers,

Any machine manufacturer seeking a more innovative production concept must have a clear notion of those advantages that not only enable him to stand out against his competitors but also afford his customers definite benefits. This notion is nowadays influenced largely by the branch of industry for which the manufacturer's machines are intended. The solutions developed by Engel over the years stem from the experiences gained in the plastics processing industry and are clearly focused on the respective needs of its individual branches.

And not without good reason. It is our observation, as a company operating in many markets worldwide, that the requirements of the plastics processing industry – and this is the case in all economic regions – are becoming increasingly branch-related and that specific applications are becoming more and more dominant.

Engel is, by tradition, a highly competent systems supplier to the automotive industry, offering the whole range from injection moulding machines through automation peripherals to process technology, including training and after-sales service. And our leading role in other branches of industry, too, will continue to be augmented by innovative developments for increased customer benefit.

In the packaging industry, for example, we have meanwhile realized a comprehensive project for the development of high-speed injection moulding machines. Compared with competitors' packaging machines currently available on the market, the "Engel Speed" series achieves the fastest dry cycle times – without being pushed anywhere near the limits of its performance capacity.

But the machine alone is not adequate proof of branch competence. For such fast-cycling applications, all-embracing solutions are generally called for, such as in-mould labelling systems with integrated testing, stacking and packing stations. This competence is supported by Engel's own special experts who are wholly immersed in this branch of industry, speak its language and are able to provide customers with clever, economical solutions to their specific problems ranging from individual automated machines through to complete, tailor-made, turnkey production lines. This guarantees our customers not only the fastest possible delivery and installation but also the direct translation of our engineering competence into the fast, flawless and, last but not least, profitable production of their parts.

One of my new duties at Engel Holding will be to ensure that we shall at all times be able to offer you efficient solutions to your production problems, solutions that best meet your specific requirements, both technical and economic.



Yours faithfully,  
Christian Pum  
President, Engel Holding



## The new ENGEL E-MOTION Combi Multi-component injection moulding – now "all electric"

Engel has now extended the scope of its all-electric drive concept to include multi-component injection moulding (Engel "Combimelt" technology), thus enabling user of this technology to achieve an even higher standard of product quality. The new ENGEL E-MOTION Combi series comprises four basic machine sizes with clamping forces of 1,000, 1,500, 1,800 and 2,800 kN. They can each be equipped with up to three injection units.

>> The "correct" choice of injection moulding machine and/or drive technology for a particular application is of decisive importance for the desired quality of product. The advantages of servo-electric drives when it comes to the injection moulding of precision parts are meanwhile undisputed. Compared with hydraulic machines, the main advantages are:

- >> a clear saving of energy through much higher efficiency of the drive system and, more importantly,
- >> extremely high reproducibility of all machine movements and negligible temperature dependence through direct and rigid power transmission.

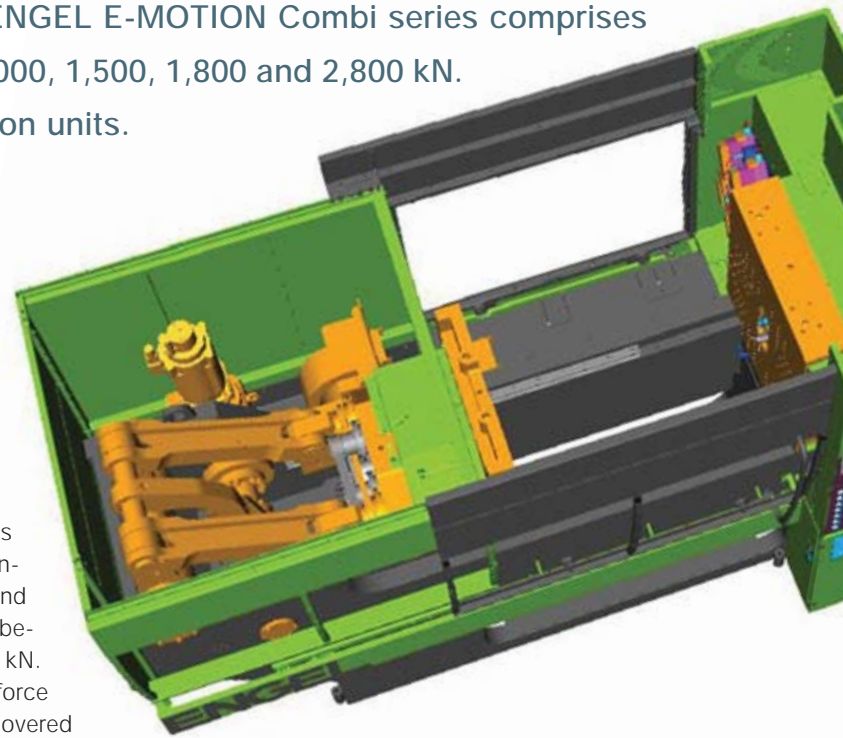
A practical comparison with a hydraulic ENGEL VICTORY, for example, has clearly proved the ENGEL E-MOTION's superiority as regards reproducibility: the servo-electric drive of the ENGEL E-MOTION achieves a metering accuracy of +/- 0.02 mm and a holding pressure accuracy of +/- 0.5 bar.

In order to make these advantages available for a much wider range of applications and, by the same token, a much larger circle of users, Engel has now extended its range of all-electric injection moulding machines to include multi-component technology. Since the

middle of this year, the new ENGEL E-MOTION Combi, equipped with a 1,000 kN tiebarless clamping unit, has been available as standard. All its main and secondary movements are servo driven.

The E-MOTION series meanwhile covers the entire range of small and medium-sized machines between 550 and 2,800 kN. The lower clamping force range up to 1,500 kN is covered by three tiebarless machines. These machines afford plenty of useful, unrestricted space for complex automation equipment – and the same goes for the new E-MOTION Combi machines with clamping forces of 1,000 and 1,500 kN.

The E-MOTION machines in the higher clamping force range (1,800 to 2,800 kN) are equipped with a newly designed tiebar toggle clamping unit. A 3,800 kN machine will be added to this range in the spring of 2007.



### ENGEL E-MOTION Combi: high speed, high precision, high flexibility

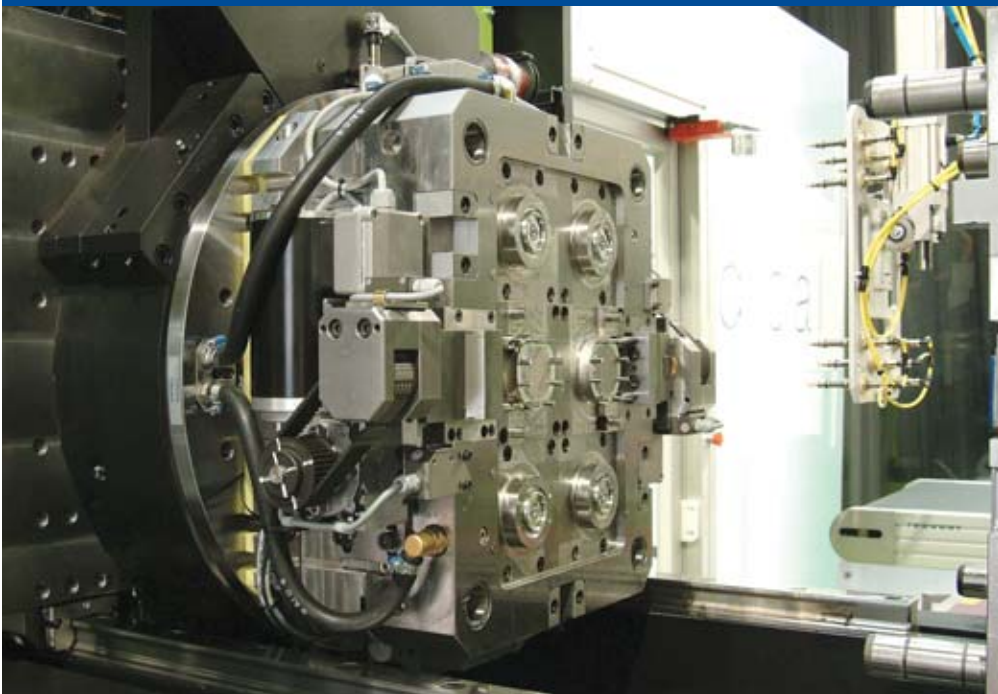
The new E-MOTION Combi is available with injection units in the following standard configurations:

- >> "L" arrangement (second unit arranged horizontally and at an angle of less than 90° to the standard unit),
  - >> "V" arrangement (second unit arranged vertically above the standard unit and mounted on a moving carriage),
  - >> "W" arrangement (second unit arranged in "piggyback" fashion above the standard unit).
- Thus the processor can choose the most suitable configuration from three standard options. If required, each of these basic configurations may also be combined with a third injection unit.

Particularly worthy of attention is the saving of space now possible on an all-electric machine through the piggyback (W) arrangement of the second injection unit. One of the advantages of this arrangement is the possibility of automation using standard com-



Parts mass-produced on an ENGEL E-MOTION Combi: Car ventilation system components with flexible seals (left) and an in-mould assembled rigid/flexible composite part (adapter) for medical apparatus (right).



Two-component mould for a rigid/flexible composite part (adapter for medical apparatus, see photo, bottom of page 2): all movements, including secondary movements, such as those for the ejectors and core pullers, and even for the needle shut-off mechanism, are servo driven. This feature renders the machine particularly suitable for clean room applications.



... mobile, interactive, live ...

>> A turntable of 600 mm diameter requires only 0.5 seconds for rotation through 180 degrees.

This rotary table (available in diameters from 600 to 830 mm) indexes accurately to any defined position (moulding station).

### Highest metering accuracy for highest precision

There are a great many multi-component applications requiring absolute reproducibility, especially in cases involving the smallest conceivable shot weights. Typical examples are seals on two-component parts as used in the automotive industry. Such applications are no problem for the injection units of the E-Motion series. Added to this is the fact that the all-electric Engel system permits a combination of thermoplastic and LSR injection units on the same machine.

A further advantage of the Engel all-electric injection units is their constantly high injection capacity across a wide range of injection pressures:

>> the injection rate (screw advance speed) is fully effective up to an injection pressure of approx. 2,000 bar (see graph).

E-Motion injection units are available in three performance options: Standard (220 mm/sec screw advance speed), High Speed (330 mm/sec) and Premium (450 mm/sec) – further details for these so-called in-line injection units see page 7.

And if a processor wishes to continue using his existing “hydraulic” two-component moulds but with the precision benefits of the E-Motion Combi, this is also possible – with the Engel hydraulic conversion module.

>> The ENGEL E-MOTION Combi will in the near future cover the entire range of clamping forces relevant to multi-component applications – from 1,000 to 3,000 kN. <<

>> Deepen or refresh your Engel know-how in absolute comfort – through the Internet, either in the office or at home. Engel’s “e-Trainer live”, a web-based interactive learning platform now makes this possible.

Following the unqualified success of the “Engel e-Trainer” – a CD training course that simulates an injection moulding machine equipped with the new CC 200 control system – “e-Trainer live” is a logical further development of training methods based on the effective and economical concept of individual learning. Introduced at this year’s Engel Symposium in St. Valentin, this new interactive learning platform is now available – “virtually” as standard – for use by all Engel customers in any part of the world.

### >> How can “e-Trainer live” be used best?

First of all, it must be said that “e-Trainer live” does not, and should not, replace practical training on the machine or personal attendance at a training seminar. Its most sensible purpose is to discuss with the trainer and the other participants of a live Internet training session the kind of questions, for example, that occur after a seminar or between two teaching modules, the particular advantage being that these questions and their answers are also visualized. And, quite apart from the content of the actual training session, it is also an ideal means of discussing individual problems arising from actual practice.

### >> How does “e-Trainer live” work?

The participants of “e-Trainer live” sessions book a time and day with Engel’s trainer beforehand. The trainer, as the coordinator and leader of the Internet training session, confirms the bookings by sending an e-mail to all participants with a corresponding link. At the appointed time, the participants activate the link on their PCs in order to gain access to the virtual classroom, where the trainer already awaits them.

The following is needed in order to participate:

>> PC with broadband Internet connection and headset (earphones and microphone), as participants communicate with each other not only visually and interactively on the computer screen but also verbally.

For the sake of efficiency, Engel limits the number of participants in any one Internet session to eight, even though the system can cope – theoretically – with well over 100 participants. And so as not to overtax the participants’ powers of concentration, the “classroom periods” in this virtual classroom are limited to a double period of two hours.

So that each participant knows who is also taking part in his Internet session, the names of all participants are shown on the screen. Available tools include the means of writing or drawing on the “whiteboard”, a large blank interactive space that also serves for solving the problems posed by Engel’s trainer – on the “virtual machine”, for example.

Every participant can record the training session on his hard disk for subsequent revision, or he may download the session as stored by Engel (around 10 MB).



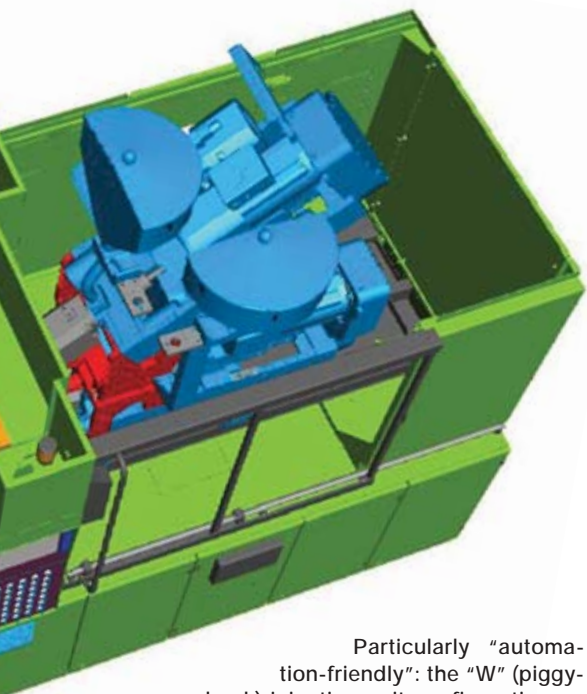
“Engel e-Trainer live” – the web-based teaching platform accessible from anywhere in the world. Top: Engel’s trainer has set up the “virtual machine” for the interactive training of all the participants during the two-hour session.

Engel currently offers “e-Trainer live” in German and English – other languages may be available subject to increasing demand.

### >> Three “e-Trainer live” modules already bookable

Three two-hour introductory “e-Trainer live” modules are already bookable for the beginning of 2007 (January and March): “Reliable setting of freely programmable sequences” – “Optimum quality assurance” – “Optimum mould protection and efficient adaptation of the screen pages”.

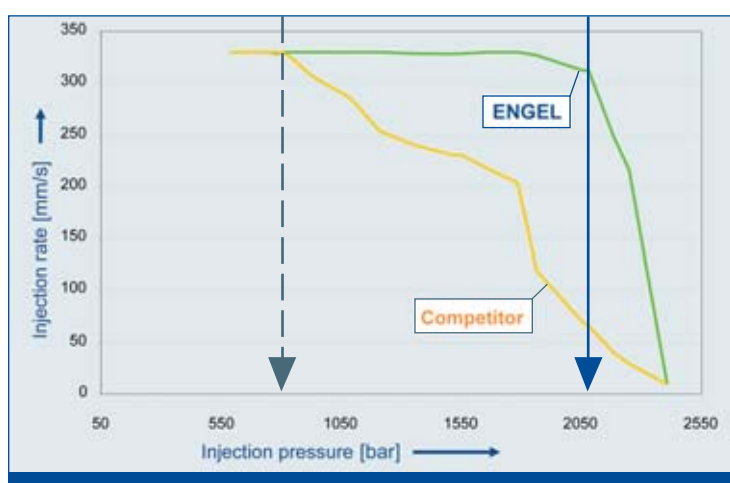
For details (also on individual, freely choosable themes) and enrolment, please visit: [www.engel.info](http://www.engel.info) (click on TRAINING). <<



Particularly “automation-friendly”: the “W” (piggyback) injection unit configuration on the ENGEL E-MOTION Combi affords virtually as much unrestricted space for automation components as a conventional machine – and also saves expensive floor space.

ponents: as in the case of any conventional (single-component) injection moulding machine, a standard robot can now be readily mounted on the stationary platen. A wide range of equipment options considerably broadens the scope of application. It is even possible, for example, to combine a thermoplastic injection unit with an LSR injection unit.

A further highlight of the new E-Motion Combi series is the servo-driven ultrafast rotary table. Its performance is astonishing:



The servo-electric injection units of the E-Motion series are also available as a “Premium” version with a screw advance speed of 450 mm/sec. Special feature: the high injection rates are fully effective up to an injection pressure of approx. 2,000 bar.



Coloplast – Photo on left: Coloplast at Esbjerg with central injection moulding production facility. – Photo on right: Freddie Nielsen (Coloplast's Injection Moulding Project Manager, right) showing Engelberg Glaser (General Manager of Engel Denmark) the company's medical products.



With a total area of 16,627 square miles and a population of 5.4 million, Denmark ranks 130<sup>th</sup> and 106<sup>th</sup> respectively among the world's 200 or so countries. For all its smallness, however, Denmark is an economic giant, for it can boast a great many firms that are up with the leaders in their respective markets.

## 1 Coloplast/Esbjerg The Lifestyle Company

>> Admittedly, our visit to Engel's customer Coloplast A/S ([www.coloplast.com](http://www.coloplast.com)) was difficult to cope with emotionally. Our briefing for our interview with Freddie Nielsen, project manager of Coloplast's injection moulding department at Esbjerg on the Øresund coast, was a cross between a hospital visit and a university lecture on diseases of the intestinal and urinary tracts, the key words being "stoma" and "incontinence". The former is the medical term for an artificial opening to or from the intestine, the latter the medical term for the inability to control defecation and/or urination. Both of them represent health problems that are treated discreetly and out of the public eye.

We were all the more surprised, therefore, to find that these health problems are considerably more diverse and widespread than one might generally assume. But then how else could a firm established no earlier than 1957 achieve a turnover of around DKK 6.8 billion (approx. EUR 914 million) and count among

today's big players on the medical technology field?

The history of Coloplast A/S, which has been registered as a joint stock company on the Copenhagen Stock Exchange since 1983, actually goes back a few years further than 1957, namely to an idea that the then 32-year-old Danish nurse Elise Sørensen had in 1954. She conceived the first adhesive "disposable ostomy bag", made of polyethylene and readily attachable to the stoma. The motivation behind this idea was the need to do something about the wretchedly isolated life that her younger sister was having to lead following a colostomy. This invention would mean a dramatic improvement in the quality of life for all suffering from bowel diseases for which such surgery was the only remedy.

However, it was no easy matter to find a manufacturer who would have enough faith in the idea and the product. One of the many fruitless contacts with potential manufacturers was her conversation with Aage Louis-Hansen, the proprietor of a packaging manufacturing firm, Dansk Plastic Emballage, on the outskirts of Copenhagen. He, too, saw no potential in the product, but then he mentioned it to his wife, who was also a nurse, and triggered a discussion that by the end of 1955 had materialized into the manual production of an initially very simple, square bag.

Mass production began in 1957, the year Coloplast was founded, and it was not long before a good fifty percent of production was being exported. As Coloplast made constant improvements to the bag, with particular reference to the skin compatibility of its adhesive adapter and to its ease of handling, the product enjoyed ever growing acceptance. In order to enable sufferers from incontinence as a result of paraplegia to live as freely and independently as possible, production was extended in 1979 to include the necessary auxiliaries: a large assortment of catheters and urine bags meanwhile completes the product range.

Coloplast currently operates with three business divisions and a total work force of 7,500 employees:

- >> Ostomy Care
- >> Urology and Continence Care
- >> Wound & Skin Care.

Central to the work of this last-named division, which is concerned with the care and healing of chronic wounds, is the special know-how acquired by Coloplast in the development of sticking plaster for long-term application. Coloplast is also the world's largest supplier of external breast forms – under the "Amoena" brand – for breast cancer survivors after cancer surgery.

Coloplast leads the European market, which takes 83 percent of its production. Committed to life quality improvement, Coloplast is growing at an almost two-digit rate and has set itself a target turnover of DKK 9 billion (about EUR 1.2 billion) for 2008.

Coloplast's success would not have been conceivable without the use of plastics. Whilst films for the production of a diversity of bags marked the beginning, injection moulded parts are now playing an increasingly important role, e.g. coupling flanges for the stoma bags, tube valves, urine jars and connectors for catheters. The tolerances achievable with injection moulded parts are decisive both for the functional improvement of the product and for user safety. Moreover, the design of the product can be rendered more appealing – a user aspect that is now becoming more and more important.

At present, around one third of all products contain injection moulded parts – and the trend is upward. Of the 54 injection moulding machines at Coloplast Denmark, ten are from Engel, all of them in the 300 to 1,100 kN clamping force range and five of them equipped for two-component applications (moulding of a welding-friendly adherent layer onto a urine bag valve).

In reply to our question as to why Engel tiebarless machines are used for this particular application, the project manager shows us

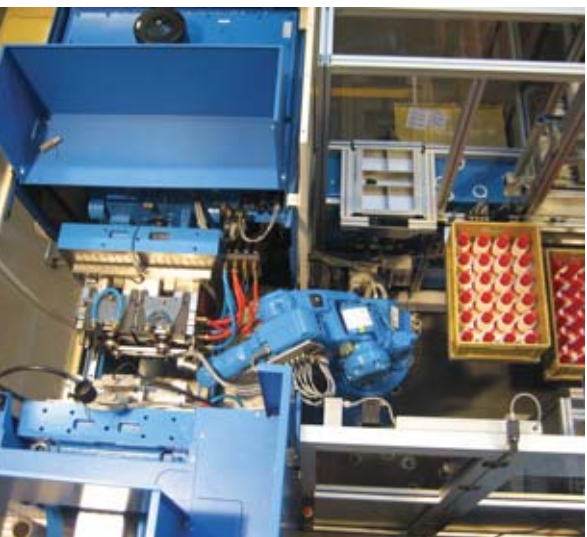


Coloplast – Typical injection moulded parts from Coloplast's production.



a comparative sketch and says: "A tiebar clamping unit would have meant having to install a 200 tonne machine in order to accommodate the same rotary table diameter of 700 mm – and the Engel machine is only a 90 tonne machine." Freddie Nielsen gives a satisfied nod and adds: "Even we have to keep a careful watch on our operating costs, not least for the benefit of the users."

On our way back through the impressive, spick-and-span, high-tech production bays, we are reminded of the preparations prior to our visit: Coloplast helps to improve the lifestyle of many people in spite of their illnesses – indeed, Coloplast is a "lifestyle company" in the best sense of the word. <<



Coloplast – Production cell with an ENGEL VICTORY 200/80 for the production of coupling flanges for stoma bags.



Coloplast – 54 machines engaged in the mass production of small precision plastic parts.



Coloplast – Stoma bags (left), Coloplast's most important product group, and urine bag systems (right), essential aids for improving the quality of life of paraplegics, for example.



Who isn't familiar with building bricks from LEGO? With shoes from ECCO? With Danish beds? With Carlsberg Lager? Who can say he has never seen wind turbines from VESTAS? Or cargo ships from MAERSK? Who hasn't heard of Grundfos pumps? Or of Danfoss thermostats? Or of hi-fi equipment and television sets from Bang & Olufsen? And without the healthcare products from Coloplast and Novo Nordisk, there would be no enjoyable quality of life for many. Conveyor chains and transport systems from Uni-Chains are in widespread use, and so are food packagings from Superfos. And let us not forget Danish butter, that worldwide synonym for good, wholesome food.

Engel has long since been doing business with leading Danish firms – at least since 1972, for it was in that year that Engel Denmark was established as Engel's first foreign branch. Read here about some of the Danish firms of world renown that count among Engel's customers.



uni-chains – The new central production building housing the injection moulding department (left). Right: Opening celebration on 24<sup>th</sup> August – the mayoress of Vejle, Karen Delfs, cuts the red ribbon.



promised in his speech was in fact already a reality, as we soon discovered once the red ribbon had been cut by the charming mayor-ess of Vejle: seventy-five injection moulding machines with clamping forces ranging from 250 to 6,000 kN, seventy of which were Engel machines, standing side by side in two production bays, all connected to a centralized infrastructure of raw material supply, cooling water supply and vapour extraction systems. An impressive sight indeed. But what is the actual business concept behind it?

As the company's name suggests, everything revolves around chain and belt systems for the transport of goods from A to B. What might at first glance seem to be quite un- spectacular turns out to be a vast range of special-purpose conveying systems designed for the widest conceivable diversity of products, from vegetables and beverage bottles to automotive components.

The history of the company goes back to 1968, when P.E. Damkjaer, an innovative engineer, began manufacturing conveyor belts. Always on the lookout for new solutions to conveying and transport problems, Damkjaer soon added flat chain conveyor systems to his product range. These comprised rows of adjacent individual metal elements – and also plastic elements from 1978 onwards. Such conveying systems are considerably more flexible than belt systems, especially when it comes to "negotiating" sharp bends, transporting relatively heavy loads or designing very narrow systems. The principle of the segmental chain conveyor was later applied to the design of segmental conveyor belts. Suitable segment design and choice of material made segmental conveyor belts more readily adaptable to specific applications than conventional conveyor belts, the latter then being discontinued as early as 1979. Since then, uni-chains has focused its activities entirely on the production of individual modular elements of every conceivable size and design. These elements are then joined together to form complete conveyor systems. Around 50 percent of all chain



and belt elements currently produced at uni-chains are made of plastic.

Like the building bricks from LEGO, likewise a Danish manufacturer, the individual elements must feature extremely high precision and stability in order to ensure the proper and reliable functioning of the conveyor system. As many as 6,000 different standard components are currently produced. Unlike the LEGO building bricks, however, these components are produced in different plastic materials, depending on the load rating, but often with the same injection mould. The most frequently used material, on account of its excellent anti-friction and wear-resisting properties, is POM. Other materials processed are PE-HD, PP, PA 6 and PA 6.6, PA 66, polyester resin and PVDF.

A characteristic feature of these moulded parts is their diversity of section thicknesses, these being very large in structurally critical areas. Consequently, the average cycle time is around 60 seconds, even when processing fast crystallizing POM. Enormous application- know-how is necessary in order to ensure the dimensional stability of the chain segments, the control of the mould cooling system being a particularly critical process in this regard. A good 30 years' experience with thick-sectioned parts cannot possibly be overlooked.

And so what at first glance seemed to be standard injection mouldings are in fact genuine high-tech. This is also our impression when taking a second look at the machines. Because of the long cycle times there is no need for any high-performance plasticizing system. Smaller plasticizing units than those normally installed on a standard machine are perfectly adequate, and the saving in energy is an additional bonus.

A further impressive feature is the logistics for the material and mould changing operations – a veritable challenge for a manufacturer producing 6,000 different standard components on 75 machines, and especially when just-in-time delivery with a minimum of intermediate warehousing is required. Not least the ergonomic advantages of the tiebarless Engel machines and the competence of the employees who operate them form the basis of uni-chains' high production efficiency.

As we leave uni-chains, a few impressive facts and figures given by its managing director in his welcoming address are still ringing in our ears: placed end to end, all the chain and belt conveyors from a single year's production would reach from Denmark to the south of Europe – an achievement that really deserves our admiration! <<

## Big Country

### uni-chains/Vejle The Material Flow Company

>> The 24<sup>th</sup> August was a beautifully bright and warm late summer's day – the perfect day for a garden party – and it was for a kind of garden party that the firm of uni-chains had invited us to Vejle:

>> uni-chains was celebrating a new milestone in its history, namely the official opening of its new 11,000 m<sup>2</sup> central production facility that has now replaced three separate, smaller factories located at different sites in the town.

Utilizing synergies, simplifying processes, saving costs and, in so doing, increasing competitiveness – these were the key points of the welcoming address delivered by managing director Lars Bugge. And what Lars Bugge



uni-chains – Most of the necessary "system components" for the conveyor belts today comprise injection moulded parts of a whole diversity of shapes and sizes (left). Middle: The new injection moulding department (partial view only) equipped with 70 Engel machines. Right: Chain conveyors from uni-chains can be used for really heavy duty, e.g. for transporting cars in assembly lines.



Grundfos – Photo on left: Grundfos headquarters in Bjerringbro, Jutland. Photo on right: Grundfos products.

Nordisk Wavin – Scandinavian headquarters Hammel.

3

## Grundfos/Bjerringbro Pumps and Plastics

>> Engel and Grundfos, an Austrian manufacturer of injection moulding machines and a Danish manufacturer of pumps – two companies with completely different products and yet so many parallels. Founded by ambitious, forward-looking individuals in 1945, both companies have developed to become leaders of their respective markets – and both have remained family-run companies right up to the present day. Engel and Grundfos began working together in 1991, when Grundfos set about developing its own capacities and competencies in the injection moulding of engineering plastics.

But let us go back to the very beginning, to the backyard workshop started by Poul Due Jensen in the small town of Bjerringbro on the eastern side of Jutland in 1945. An order from a neighbouring farmer for an electric groundwater pump marked the beginning of Jensen's specializing in the manufacture of pumps. As no pump components were available straight after the war, Jensen had to make everything himself.

The result was the so-called "Foss" (Danish for "flowing water"), an unconventional contraption which Jansen then built a total of 26 times. This reciprocating pump of the company's early years was followed, in 1950, by the invention of the centrifugal pump. Its much simpler design readily met the prerequisites for large-scale automated production, which began in 1952.

Further innovations followed, just one example being the compact circulator pump, an essential component of the central heating systems that became the standard in private dwellings during the 1950s.

A further milestone in the history of the company was the manufacture of submersible pumps from 1965 onwards. With the growing demand for ever more sophisticated output control systems, the outsourced electric motors met Grundfos's requirements less and less. In order to have a better control over the production process and to make better use of existing potential, the company began its own development and production of electric motors in 1974.

Grundfos's experience and competence in the development and manufacture of pumps were the basis on which the company opened up ever new fields of application, e.g. sewage water pumps, industrial service water supply pumps and pumps for special applications – in the chemical industry, for example. Grundfos has also been manufacturing its own electronic components since 1985. Here the focus in recent years has been on efficiency and process cost reduction, tasks to which the 700 or so engineers in the company's innovation centre, inaugurated in 1993, are constantly committed. One of the most radical and yet most environment-friendly developments is an independent pumping station that can be driven by a combination of solar and wind energy.

With an annual turnover of DKK13.42 billion (approximately EUR 1.8 billion), a work



force of 13,400 employees and a production of 10 million pumps per year, the Grundfos Group ([www.grundfos.com](http://www.grundfos.com)) is today one of the world's leading pump manufacturers. The product portfolio is divided into three business units: Building Services, Industry and Water Services and Professional Wastewater. With a share of around 50% in the market for heating system pumps, Grundfos is the world's unrivalled leader in this segment. And Grundfos is impressive not just on account of its technological achievements, but also through its social commitment. Initiating Denmark's first "sheltered workshop" in 1968, Grundfos pioneered the integration of handicapped persons in the world of work.

Plastics are a relatively new category of materials at Grundfos, while metal materials still dominate. What at first glance seems to be based on an altogether conservative man-

ufacturing policy is quite understandable when one compares the required working life of a pump with that of other products. "We expect our pumps to work for 100,000 hours. That corresponds to around 12 years' continuous duty – and often at very high temperatures and with aggressive media," says Jorn Toftegaard Hansen, Head of Plastic Parts Development in the Grundfos Research Centre, and adds: "By comparison, automotive components are expected to give only 10,000 hours' service, which is considered adequate in most cases."

At present, typical injection moulded parts are castors for heating pumps, small pump cases or electrical components. Hansen: "The proportion of plastics is rapidly increasing, as many special requirements, such as corrosion resistance, parts of complex shape, miniaturized components or two-component parts, cannot be met without the use of plastics."

Accordingly, Grundfos's plastics consumption increased from 3,800 tonnes in 2000 to 4,900 tonnes in 2005.

As it is Grundfos's strategic policy to have full control over all the essential processes of pump production, an injection moulding department was set up in 1990. At present there are 25 injection moulding machines in operation at Bjerringbro, with clamping forces ranging from 500 to 3,500 kN, eighteen of which were manufactured by Engel and mostly equipped with automatic mould changing systems. The machines process only engineering plastics, such as PA 6.6, PBT and PPE, primarily with a high glass fibre content.

"We produce over 100 million individual parts per year," says Michael Tronninge, manager of the injection moulding department, when asked about the department's production capacity. As we take a closer look at the machines, we find that most of them are between 10 and 15 years old. Michael Tronninge: "All the machines are still working within the required tolerances and still require only a minimum of maintenance, so there's no reason to invest in replacements." And that brings us back to the theme of "working life": evidently Engel and Grundfos share the same approach to quality – yet another parallel between these two privately owned companies. <<

4

## Nordisk Wavin/Hammel Pipe systems for Scandinavia

>> Hammel, a small town about 25 km west of Aarhus, is the last call on our Denmark trip. We are visiting the Scandinavian headquarters of the Dutch Wavin Group ([www.wavin.dk](http://www.wavin.dk)), Europe's market leader in plastic pipe systems. Wavin – the company's name is formed from "WATER" and "VINyl chloride" – was established in 1955. With a total work force of around 7,300 employees in 40 factories in 27 European countries and sales exceeding EUR 1.3 billion (2005) with as many



Nordisk Wavin – The product range comprises injection moulded pipe fittings and sockets (top photo), extruded pipes, tanks (some rotomoulded) and special fittings (bottom photo).

as 17,500 different products, Wavin also counts among the leading manufacturers of pipe systems worldwide.

The car park in front of the main entrance to the building at Hammel has an impressive backdrop: a vast stockyard of finished products. What is normally housed in an enclosed warehousing system, either inside a building or underground, lies here in the open, sorted according to size and type and ready for dispatch. As we make our way across the factory grounds to the injection moulding department, we cannot but be aware that we are visiting Denmark's largest plastics processor. The 400 employees in Hammel process around 30,000 tonnes of plastic (mainly PP, but also some PVC) in the pipe extrusion department alone. Added to this are 3,000 tonnes of injection moulded parts and around 1,000 tonnes of rotomouldings. As the name "Nordisk Wavin" implies, this Wavin Group company serves the three Scandinavian countries and the Baltic countries. Whereas its pipe extrusion facilities are spread over several sites within Scandinavia, its production of injection moulded parts, such as fittings, sockets, gaskets and service shafts, is concentrated in



Grundfos – Left: "Talking shop" in the Plastic Parts Development Department of the Grundfos Research Centre: Jorn Toftegaard Hansen, Head of Plastic Parts Development (right), and Bjarne Pedersen, Engel's sales engineer for Jutland. – Middle: A typical structural unit: heat exchanger pump for a domestic hot water system. – Right: Typical mouldings from the Danfos injection moulding department.

the Danish factory. In our conversation with Henry Siboska, Production Manager Injection Moulding, we learn that Nordisk Wavin is a competence centre for service shafts. These are in most cases vertical cylindrical shafts installed in pipelines by means of connecting sockets. They permit access to the pipes for cleaning purposes. More than 200,000 service shafts are produced by injection moulding every year, with shaft diameters of 315 and 425 mm (for pipes of 110, 160 and 200 mm diameter). Larger shafts up to 1,250 mm diameter are rotomoulded. As many as 20 injection moulding machines with clamping forces of between 1,000 and 8,000 kN, all of them from Engel, are in service at Nordisk Wavin. The machines process primarily PP on account of its high impact strength at subzero temperatures. Only one of the machines produces PVC parts.

Three machines were purchased in 1998 as two-component production cells equipped with Engel injection moulds for the production of TPE gaskets with PP supporting rings, and have been giving continuous service ever since. "We were the first company in the Wavin Group to convert from SBR to TPE", says Henry Siboska, "and the fact that no subsequent finishing was necessary made for greater overall precision, and that in turn permitted fully automatic gasket assembly. And then when we purchased the tiebarless machines, we were not only more flexible but could also considerably reduce our set-up times. Compared with the older machines in our production facility, which are still equipped with tiebar clamping units, the advantages are considerable. This was one of the arguments in favour of Engel. But what was more important was the immediate availability of Engel service engineers in the event of a problem. So far, 80 percent of all necessary servicing and repair operations could be dealt with on the same day. The replacement parts warehouse in Copenhagen and a local service engineer in Jutland are a competitive advantage that we have come to appreciate."

On our way back across the factory grounds, past the stacks of pipes, sewage tanks, rainwater tanks and, naturally, pallet crates full of pipe fittings of every size and description, we could not help thinking about the environment and wondering what the world would be like today if we didn't have such plastic products as these. <<



Nordisk Wavin – Henry Siboska, injection moulding department manager at Nordisk Wavin (right) in conversation with Bjarne Pedersen, Engel's sales engineer for Jutland.



Nordisk Wavin – Injection moulding of fittings – only Engel machines are used.

>> The main features and/or outstanding advantages of servo-electric injection units have so far been their high movement precision and energy efficiency. Their dynamic performance, however, did not come up to that of hydraulic accumulator units. In order to remedy this, and to offer alternatives both for thin-walled and thin-section parts and for packaging applications, Engel has now completed the next phase in the evolution of its E-Motion concept – the so-called "inline" injection units.

They are available in four sizes: EM 80/.., EM 200/.., EM 310/.. and, with effect from spring 2007, EM 440/.. "In-line" stands for the arrangement of screw and drive spindle directly behind one another.

### Highest dynamic performance through new design

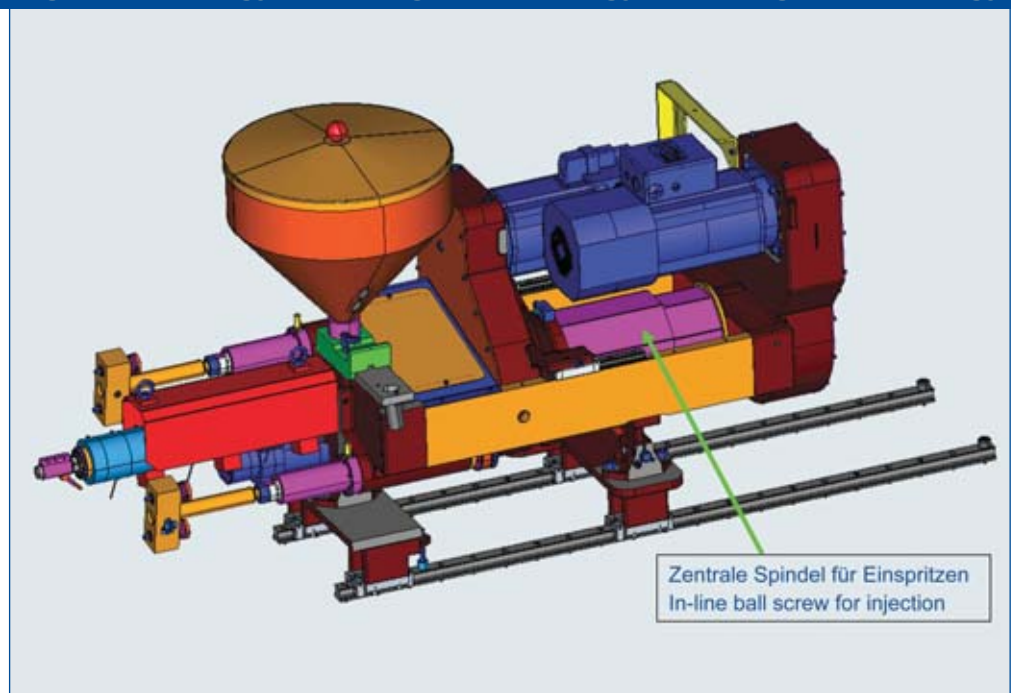
In contrast to the twin-spindle units used hitherto for the screw advance, the screw advance of these newly developed injection units is driven by a single spindle, thus virtually reducing the rotating masses and, by the same token, the dynamic-influencing moment of inertia by 50 %. The result is impressive:

>> The rate of acceleration from zero to maximum speed is – by comparison with its predecessor – considerably faster. For example, the "Premium" version of the EM 200 requires only approx. 50 milliseconds to accelerate from zero to the maximum screw advance speed of 450 mm/s.

This performance places the all-electric ENGEL E-MOTION injection moulding machine in the same performance class as machines equipped with hydraulic accumulator units, but with the added advantage of considerably lower energy consumption:

>> Given the same injection capacity, E-Motion injection units consume only about one third of the energy required by hydraulic accumulator units.

This improvement in performance is a feature of all four sizes of this new "inline" generation of injection units. Each size of unit is available in three different speed ratings: Standard (maxi-



## ENGEL E-MOTION "Inline" Tuned for fast injection



Engel's new "inline" servo-electric injection units, available in three different speed ratings, offer not only greater energy efficiency but also the highest dynamic performance – ideal for applications hitherto reserved for hydraulic accumulator units.

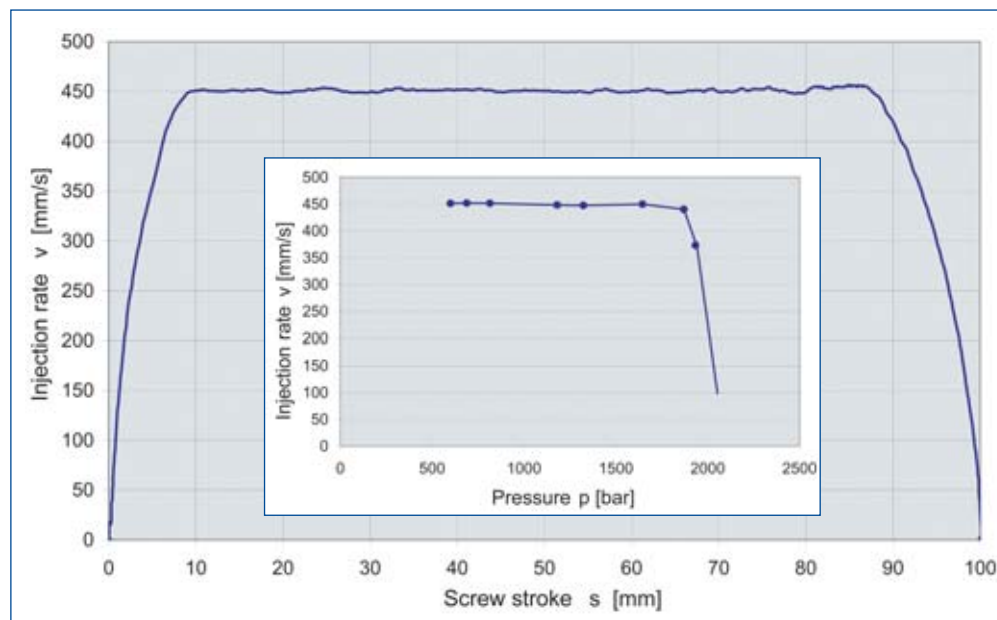
mum injection rate 220 mm/s), High (330 mm/s) and Premium (450 mm/s).

The difference in price between a Standard version and a Premium version, based on the basic price of the machine, is only between 3 and 4 %, depending on the actual size of injection unit.

### Evolution in the truest sense

The service-proved belt drive of the transmission system has been retained. This principle has been adopted both for the screw advance and for screw rotation when metering the melt. The metering drive is combined with the cylinder flange and mounted completely separately from the injection drive on its own supporting plate on the moving carriage. The transmission system has been designed for clean room applications – all belt drives and recirculating ball screws are completely enclosed, preventing the emission of dust and grease particles.

In particular, the advantages of the new "inline" injection units come into their own on the all-electric Combimelt machines. Much "slimmer" than their predecessors, they can be even more readily combined with other units in either L, V or W configuration (see explanation "ENGEL E-MOTION Combi" on page 2 of this issue). <<



Typical features of the servo-electric "inline" injection units of the E-Motion series, taking the Premium version as an example: after the fastest conceivable acceleration, the screw advance speed of 450 mm/s remains constant for the duration of the entire screw stroke (large graph) – and the enormously high injection rate can be fully maintained up to an injection pressure of approx. 2,000 bar (small graph).



G&D's core product range: O-rings in a diversity of sizes and in virtually all types of elastomer - diaphragms - rubber-metal composites - moulded rubber parts (photos in that order from top to bottom). Bottom photo: the two new ENGEL ELAST 250 V machines - vertical injection moulding machines with a clamping force of 2,500 kN.



The cranes towering above the roofs of the freshly painted production buildings tell the visitor that construction work is still in progress. Below: Existing production facilities in the background, the new extension in the foreground - work on the interior is in full swing.

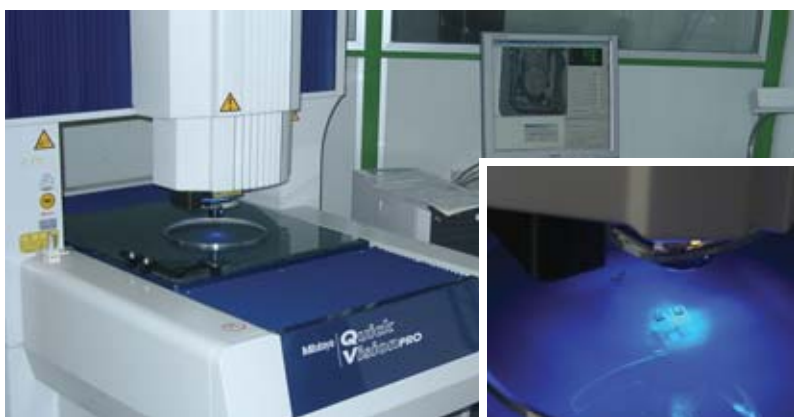


## Guilliard & Dörr, Ochsenbach/Germany It's diversification that does it!

Guilliard & Dörr (G&D) specializes in the production of sealing elements for highly demanding applications and supplies its products to system suppliers operating in the shipbuilding, automotive, mechanical engineering and aircraft industries, in the chemical and gas industry and in a whole multitude of other technologies, such as measuring and control engineering, medical equipment, horticultural machinery and microelectronics. G&D today places its entire stakes on Engel as the supplier of its injection moulding machines.



While we were at G&D, one of the Elast V machines was producing rubber-metal composites in a four-cavity cold runner mould - cylinder head gaskets for large ships' diesel engines (top photo). By comparison, the delicate perfluorine elastomer-stainless steel composites (membranes for micro valves) here being optically measured in the ultramodern quality assurance laboratory are really tiny. A shot weight of only a few grams is sufficient for a 12-cavity mould, including the runner, but then it must be injected with exact reproducibility for this application.



>> We are in the idyllic winemaking village of Ochsenbach, one of the six communities that make up the township of Sachsenheim in the district of Ludwigsburg, not far Stuttgart, the regional capital of Baden-Württemberg. But instead of taking a leisurely stroll through the village's 80 hectares of vineyard, where the grapes for such famous wines as Trollinger, Lemberger, Portugieser and Silvaner are slowly ripening, we make our way straight to Engel's customer, Guilliard & Dörr ([www.guilliard-doerr.de](http://www.guilliard-doerr.de)), a company founded back in 1977 and specializing in the production of high-quality O-rings, diaphragms, rubber-metal composites and moulded rubber parts in all conventional elastomers and in a multitude of special materials for highly demanding applications and a broad spectrum of users. The vulcanized products are produced by compression or injection moulding. G&D is also equipped for the machining of elastomers.

We have come to interview Jürgen Ohr, who together with Martin Auber took over the hundred-strong company early in 2005. "The founders of the company, who had retired for age reasons, had no direct successors in their own families," says Jürgen Ohr, "and as G&D was a well known supplier of special-purpose sealing elements, Martin Auber and I decided to acquire the company. Of course, we knew that we would first have to invest a lot of money in both the building and the production infrastructure in order to further exploit its growth potential."

How, we asked, did they find such courage and confidence at a time when many companies - and especially medium-sized ones - are complaining about ever increasing economic problems in Germany as a manufacturing base? "We are not complaining", says Jürgen Ohr, "G&D's sales have been growing continuously for years and at present the growth rate is clearly over ten percent. We are not affected by the economic ups-and-downs of any particular industry. Our customers are system suppliers serving many different industries. Moreover, our business is not focused on standard mass-produced products but mostly on special products for continuous heavy-duty and high-tech applications. The common denominator, to put it in a nutshell, is diversification."

Here are a few facts and figures that bear out Jürgen Ohr's statement: G&D's turnover of around EUR 8.5 million in 2006 is the result of business with as many as 500 customers. A good 80 % of parts and assemblies are for OEM equipment. The largest demand is for high-quality, special-purpose parts deliverable in medium-sized batches with as short a delay as possible. Typical batch sizes are anything between 20,000 and 50,000, and even as large as 500,000 in the case of diaphragms. Special parts are even supplied in minute quantities of eight or ten.

The company processes over 220 different elastomer blends cost-

ing between 4 and as much as 6,000 euros per kg (e.g. for special perfluorine elastomer blends that are resistant to highly aggressive media). G&D has a stock of 7,000 O-ring, 1,000 compression and 500 injection moulds. At present, 40 % of the parts are produced by injection moulding. Jürgen Ohr aims to increase this percentage.

### Precision + Diversity = High Performance

"When we finally began updating our injection moulding machines", says Jürgen Ohr, "we chose Engel as our supplier because Engel offers us exactly what we need: perfected, high-quality machines and processing technology - both for rubber and LSR and for thermoplastics. The latter is important, as we plan to add thermoplastic parts to our product portfolio in future. And the firm of SI-Industrievertretung in Remseck, which handles the Engel Elast range in our region, is a competent on-the-spot partner for all our servicing requirements."

Engel technology had impressed Jürgen Ohr in other ways, too: "Our new, general purpose Victory Tech gives us much higher metering precision. But that's not all. We also have considerably less flash - flash is never completely avoidable in rubber injection moulding - and that makes downstream finishing much easier." But even in the case of heavier parts, such as the cylinder head gaskets for ships' diesel engines produced on the ENGEL ELAST V, both the metering precision and the high platen parallelism have a positive effect on the result. Jürgen Ohr: "These metal-rubber composites are subsequently electro-phosphated to protect the exposed metal surfaces against corrosion in continuous applications under the roughest conditions. This is where the quality of the injection moulding process comes into its own, as the correct pretreatment of the metal parts is not alone sufficient to ensure a permanently reliable rubber-to-metal bond."

Three of the seven injection moulding machines at G&D come from Engel - and Jürgen Ohr is already planning to place further orders. <<



Jürgen Ohr with the new ENGEL VICTORY 200/40 Tech (400 kN clamping force): "We attach importance to the utmost flexibility. That's why this injection moulding machine is equipped with modules for thermoplastics, rubber and SLR."

## injection

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HL-Award in Gold presented by Georg Tinschert (left) and Dr. Peter Neumann (right) to (from left to right): Jürgen Schneegans, Managing Director, Bärbel Schneegans, wife of the second Managing Director Dieter Schneegans, and Rudolf Gattringer, Technical Director at Schneegans GmbH.



HL-Award in Silver, presented to (from left): Sven Rosenbeiger, Head of Medical Products Development at PARI, Vera Kreuzmann, Project Manager, Medical Products Development at PARI, Erich Steiner, Production Technology Plastics at PARItec, and Klaus Herzog, Quality Technology at PARItec.



HL-Award in Bronze, presented to (from left): Ludwig Huber, Production Manager, Wolfgang Gaigg, Project Manager for Production Development, and Andreas Loibnegger, Head of Process Technology Development at Philips DAP.

>> One of the highlights of this year's Engel Symposium was the presentation of the "Engel HL-Award 2006" during the gala evening on 17th May in the Linz Design Centre. The award was won by Schneegans GmbH, Emmerich, North Germany (Gold), PARI GmbH, Starnberg, South Germany (Silver) and Philips Austria GmbH, Klagenfurt, Austria (Bronze). Certificates of Commendation for the runners-up in places 4 to 6 were awarded – in that order – to: Erwin Quarder Werkzeugbau GmbH, Espelkamp/Germany, McKechnie Plastic Components Ltd., Stamford Bridge, UK, and Scott GmbH, Mattighofen, Austria, the Austrian subsidiary of the US sports equipment manufacturer Scott. This year, the jury also awarded a special prize for continuity of performance. This prize went to Erwin Quarder Werkzeugbau GmbH, which in the last three HL competitions (HL stands for "holmlos", meaning "tiebarless") was always up among the winners. The projects of the winners in places 1 to 3 are presented below. <<

## The HL-Award in Gold

>> The HL-Award in Gold, plus a weekend in Vienna for a group of 15 employees, was won by plastics processor and automotive parts supplier Schneegans GmbH, Emmerich, for its use of tiebarless injection moulding machines in a fully automated production cell for air flow regulators for the air intake systems of V6 and V8 car engines. These are parts produced in an in-mould assembling process of the highest order, with a downstream final assembling station followed by 100 percent testing of the ready-to-install assemblies.

These air flow regulators are injection moulded as complete sets (systems with 2 x 3 regulators for V6 engines and 2 x 4 regulators for V8 engines) in four stages on two 2-component machines linked by linear robots. On the first of the two machines, an ENGEL VICTORY 650H/200W/300 Combi (3,000 kN clamping force), the main body of the part is moulded in PA 4.6-GF15 in a 2+2-cavity mould. It is then transferred by a linear robot to its second injection station in the mould and overmoulded with PPS. It is then demoulded by a robot and stacked

in sets of two on a table. The robot of the second injection moulding machine then picks up the sets and places them in the first injection station of the mould, where a lever is moulded onto the body in the same type of polyamide. This two-component injection moulding machine (1,300 kN clamping force) had to be specially equipped for the combined processing of thermoplastics and rubber, for in the second injection station a rubber seal is vulcanized onto the air flow regulators.

Schneegans has here made optimum use of the large space afforded by tiebarless clamping units – with clamping forces rated exactly to suit the specific application – both for the complex two-component moulds and for the enormous operating space required by the robots, which have to perform complex transfer and demoulding tasks simultaneously. – This innovative application has won Schneegans its second HL-Award: at K 2004, this automotive parts supplier received the HL-Award in Silver for its application of a tiebarless injection moulding machine for the mass-production of a plastic guide tube for a car engine oil dipstick, using water injection technology to realize its complex 3D design. <<



Schneegans: The air flow regulators (top right) for the air intake systems of V6 (top left) and V8 engines are produced on two robot-linked Engel two-component tiebarless injection moulding machines with clamping forces of 3,000 and 1,300 kN respectively. The second injection unit of the 1,300 kN machine is equipped for the processing of EPDM.

# Winners of the Engel HL-Award 2006

## The HL-Award in Silver

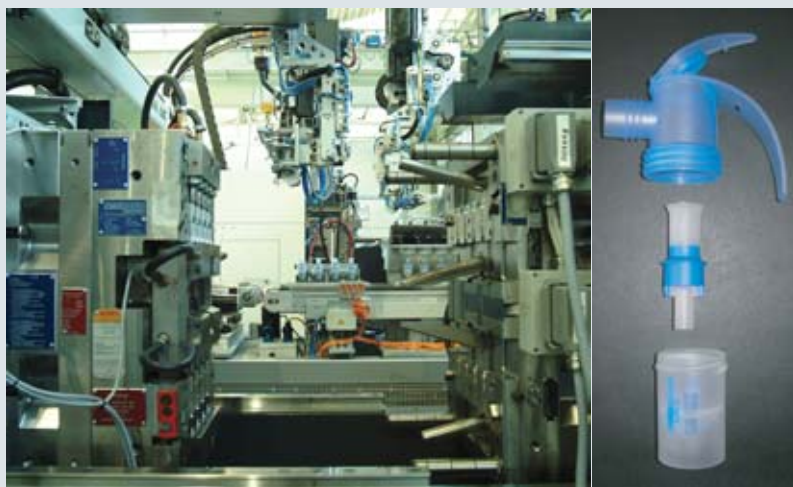
>> The HL-Award in Silver, plus a driving skills training course for 20 employees, was awarded to the South German manufacturer of medical products, PARI GmbH, primarily for its innovative solution to the problem of installing the maximum possible sizes of machine in the extremely limited space of the existing production facility. Three 2-component tiebarless injection

moulding machines produce the essential working parts of inhalers, all of them taking the form of rigid/flexible composites. These inhalers serve as a means of atomizing medicinal preparations and administering same by inhalation. Purchased for the PARI Group's production facility PARItec GmbH in Weilheim near Starnberg, the linear robot-equipped, fully automated production cells could not have been realized without their unrestricted access to the mould from the side

and the amply sized platens of the Victory Combi machines (2,600 and 1,300 kN clamping force). A machine equipped with tie bars could not have been used on account of the very low headroom in the production facility.

The project began with a number of problems, especially with the originally planned injection moulding machine for the top part of the inhaler, as the mould was much too heavy and much too large. Consultation with Engel's mould making experts resulted in the development of a completely new concept: an index plate mould of reduced weight and size for a smaller platen area. This four-cavity mould now weighed 3.2 tonnes instead of 6.5 tonnes, permitting the use of a smaller machine – a 260 tonne two-component machine (with injection units in piggyback arrangement) – which together with the robot would easily operate in the restricted space of PARItec's production facility.

Linked by robot, the two 130 tonne machines produce the nozzle insert and the bottom part of the inhaler. The parts are then subjected to a 100 percent function test on peripheral testing apparatus. <<



PARI: Thanks to Engel two-component tiebarless injection moulding machines, PARI can now produce, assemble and test the three essential component parts of its newly developed inhaler in automated production cells.

## The HL-Award in Bronze

>> The HL-Award in Bronze, plus an "Engel Evening Event" for a group of 25 employees in a restaurant, went to Philips DAP, Klagenfurt, one of the Philips Group's competence centres for domestic appliances and personal care products. The project submitted for the HL-Award was a production machine for the manufacture of the new variant of a so-called cool pack for an epilator. The jury was impressed by the innovative way in which an enormously large mould was installed on an extremely small machine and at the same time could be used as an assembling station: the mould weighing 1,650 kg required a tiebarless machine with a clamping force of only 90 tonnes (900 kN) – an ENGEL VICTORY 330/90, equipped with an ENGEL ERC 23/2C linear robot and other automation peripherals.

The starting point for this innovative application of a tiebarless injection moulding machine was the intelligent design of the new product. Instead of making the cool pack from two half shells which, after insertion of a metal plate and filling

with cooling gel, are welded together, the new design features a one-piece container and a weld-on closure with an integrally moulded metal plate.

The mould designed for this application features an integrated index plate that serves to bring the metal plates into the correct position for injection after the mould has closed. The mould, a 2+2-cavity family mould with a clamping force requirement of only 800 to 900 kN, was originally intended for use on an existing Victory 330/90, but it was found to be too large and, at 1,650 kg, much too heavy.

Having had plenty of experience with Engel tiebarless machines, the injection moulding experts at Philips DAP simply "uprated" the clamping unit for the larger and heavier mould by equipping it with larger platens and larger linear bearings. The clamping unit was also equipped with the next larger FlexLink, thus still ensuring absolute parallelism of the platens.

The result: the uprated machine has now been in operation for a good year, working a three-shift day without any problems and considerably more economically than its predecessor. <<



Philips DAP: The 2+2-cavity index plate family mould for the epilator cool pack (two cool pack containers and two enclosures with integrally moulded metal plates are injection moulded simultaneously) weighs 1,650 kg and fits into an "uprated" ENGEL VICTORY with a clamping force of only 90 tonnes (900 kN).

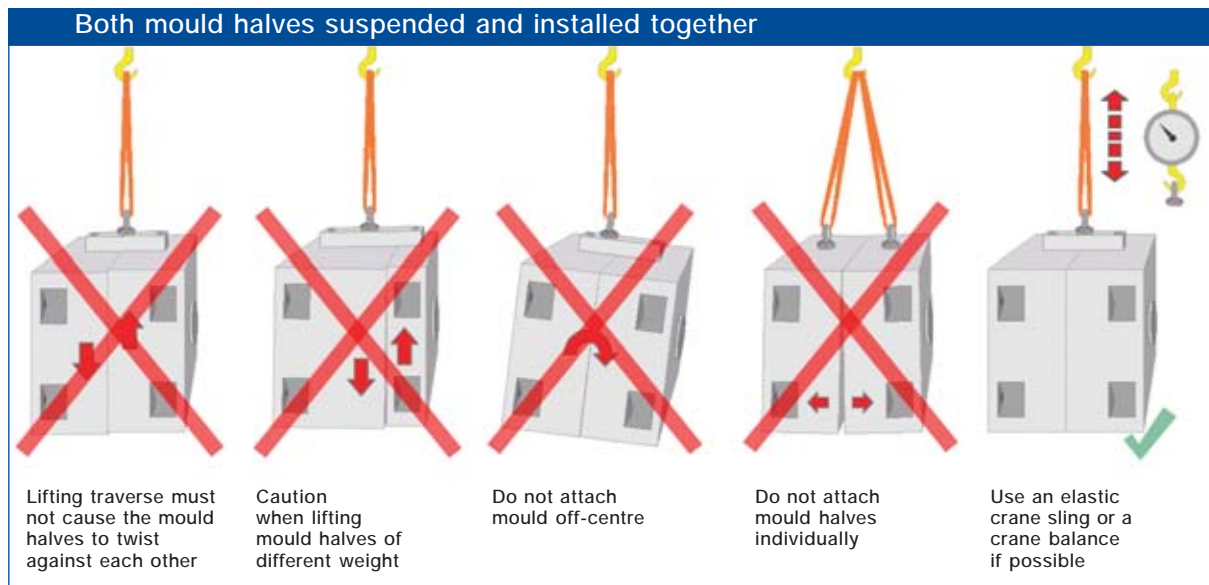
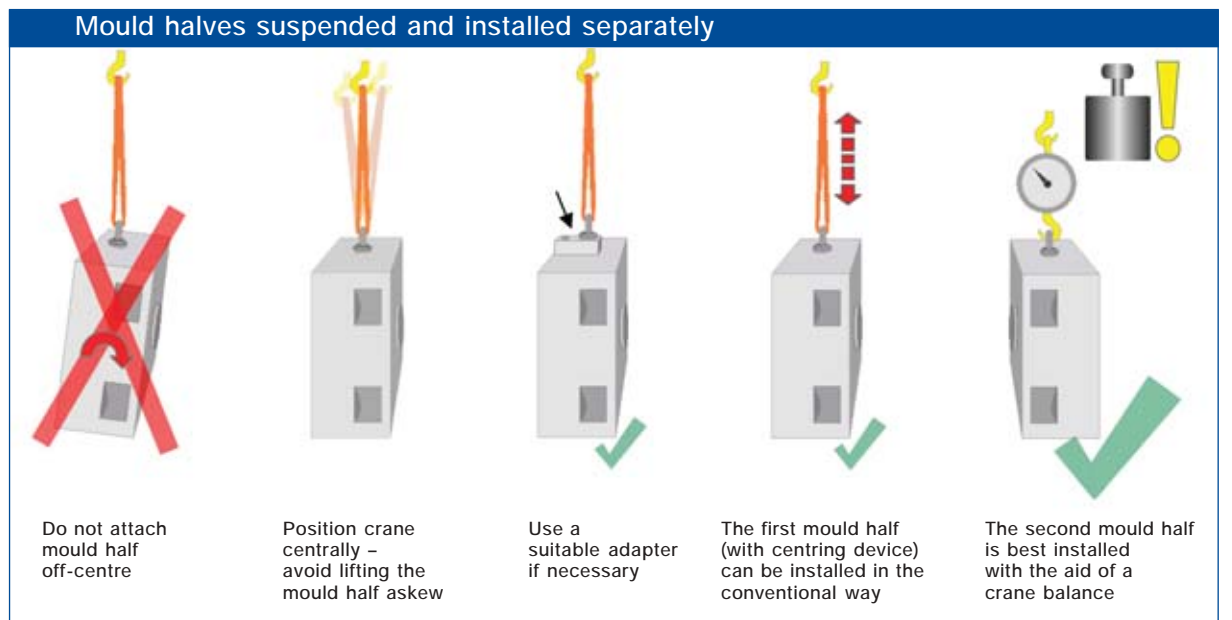
## Correct mounting – better production

A good injection moulding machine and a high-quality injection mould are an absolute prerequisite for efficient production. But it is not the quality of the machine and mould alone that determines the quality of the moulded parts, but rather the way they work together. This is a factor that also decisively influences the working life of the mould.

>> Injection moulded parts are produced by the injection of molten plastic into a closed mould under high pressure. The parts are removed by opening the mould, which usually comprises two mating halves, and either pushing them out by means of ejectors or extracting them by means of a robot. What sounds so easy is in fact a complex process, the success of which depends not only on a perfect command of the process technology but also on a number of seemingly trivial boundary conditions, one of them being the correct mounting and alignment of the mould in the clamping unit of the machine. Failure to observe this requirement can adversely affect the reliable working of

of the pins may cause the two halves of the mould to become misaligned, even distorted. This can happen, for example, if the means used to suspend the mould has not been properly attached. Each half of the mould must be picked up at a point exactly above its respective centre of gravity (mould halves are rarely of equal size and weight). In order to be really sure that the mould halves are properly centred, additional centring devices (centring cones) can be incorporated in the mould parting surfaces.

Once the perfectly aligned injection mould is suspended from the crane in the correct gravity-centred position, it must be lowered into the machine and positioned as accu-



the machine and, more importantly, result in premature wear of the extremely costly mould.

### >> Optimum alignment – what are the benefits?

Basically, the following rule applies: >> The better the two halves of the mould are aligned, the more the wear on the mould inserts and guide elements is reduced – and the more the dimensional precision of the parts is improved. The correct mounting of the mould begins with its transport to the machine. Here it is essential to ensure – besides closing the safety lock (which goes without saying) – that the two halves are accurately and reliably centred during transport. It is not enough to rely of the guide pins of the mould halves, as they must fit into their mating holes with a defined amount of play and cannot therefore serve as means of centring. Indeed, the fitting tolerances

regularly as possible for mounting. Generally, initial alignment is performed with the aid of the clamping unit by introducing the nozzle locating ring into the mating recess in the fixed platen.

An elastic crane sling is recommended for easy handling without causing distortion. This compensates the inadequate positioning accuracy of the vertical movement of the crane. A further improvement in positioning accuracy – especially when handling moulds heavier than 200 kg – can be achieved with a so-called crane balance. Used instead of the elastic sling between the mould and the crane hook, the balance indicates any change in weight in relation to the previously ascertained dead weight of the mould, thus signalling friction caused by misalignment.

In cases where an injection mould cannot be assembled prior to installation on account of the inadequate capacity of the crane and the two mould halves must therefore be

installed one after the other, the same rule applies: gravity-centred lifting and the use of an elastic crane sling. Here it is important to ensure that the crane is positioned exactly above the respective mould half when the latter is being bolted to the platen, thus avoiding possible vertical distortion.

The correct sequence of operations when installing the mould halves separately is as follows: Begin by introducing, centring and fixing the stationary mould half. The second (moving) mould half should be brought into alignment with the stationary mould half using the crane balance. The moving mould half must remain suspended from the crane as it mates with the stationary mould half. Any misalignment will cause friction, which is indicated by a change in weight. This can be remedied by raising or lowering the mould. The mould must then be closed and contact force applied. The moving mould half can now be fixed to its platen.

### >> Mould alignment in tiebarless machines

If the maximum permissible tilting moment (= permissible weight x distance of centre of gravity – see specifications in machine manual) is exceeded, an additional support must be installed underneath the mould. This consists of two additional guide bearings and a support bracket. The moving mould half can be raised or lowered by means of adjusting screws until it is aligned with the stationary mould half.

### >> Influences during production

Even if the mould halves have been mounted correctly, various disturbing influences may still cause their displacement during production, thus resulting in increased wear. These disturbing influences are: >> Grease and oil on the platens may cause one or both mould halves to slide out of their centred position. >> Too large a temperature difference between the two halves of

### >> Rotary table applications are impossible without accurately centred moulds

Centring precision is of even greater importance when it comes to mounting moulds on rotary tables. >> When the moving mould half is rotated through an angle of 180°, any misalignment is doubled in the second moulding station due to the so-called crank effect. The resultant displacement of the mould halves causes increased wear on the guide elements and mould inserts.

This is avoided by providing the moving mould half with a locating ring just slightly smaller, but not by more than 0.05 mm, than the centring hole on the rotary table.

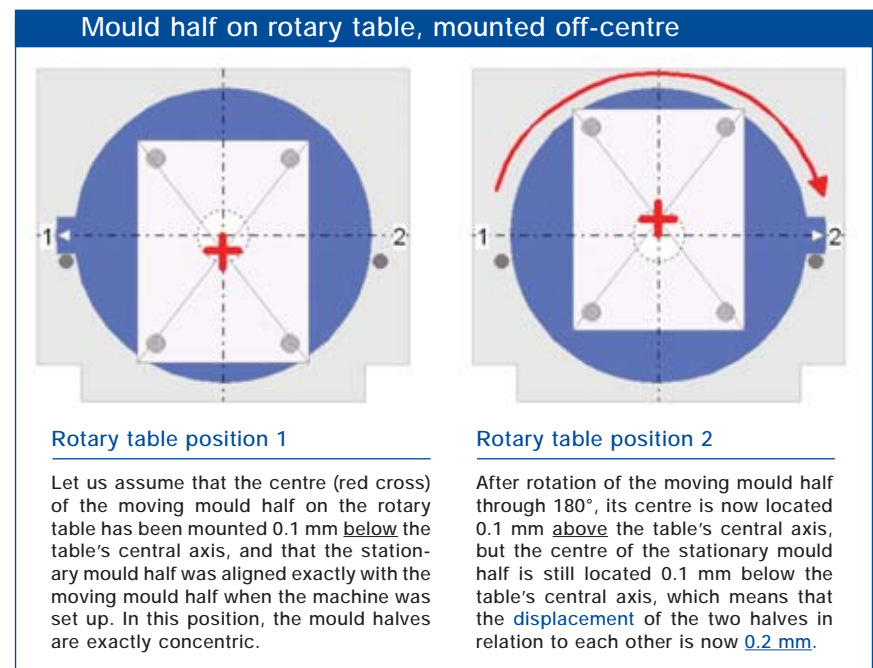
the mould may cause unequal thermal expansion and hence misalignment.

>> Unparallel heat insulation plates cause uneven pressure on the parting surfaces of the mould, causing angular displacement of the mould halves in relation to each other.

>> Asymmetrically arranged cavities cause an uneven distribution of forces inside the mould. This may also result in misalignment in the medium term.

### >> Conclusion: Little things can have a big impact

Many mass production problems are blamed on the injection moulding machine and the mould, but the cause is not infrequently the user's failure to ensure perfect alignment of the mould when setting up the machine. <<





"In ZF Boge Elastmetall we are proud to have such a competent injection moulding specialist as our longstanding partner," says Georg Tinschert, President of Engel Austria (2nd from left), at the ceremony in Damme marking the two companies' 30 years' partnership. Engel's on-the-spot representative Andreas Heckmann (3rd from right) from Engel's Germany branch in Hanover. Also on the photograph are (from left to right): Roland Herwig, Works Manager ZF Boge Elastmetall, Robert Pohlschneider, Head of Plastics Section, Norbert Poschmann, head of Work Planning, and Dr. Olaf Beutler, Head of Mould Construction and Design.

## ... the Dolphin Process?

The newly developed Dolphin Process permits the low-cost, high-speed production of high-quality, soft-touch sandwich components for the automotive industry, such as instrument panels, centre consoles and glove compartments.

>> Compared with the conventional mass production of multilayered foam-moulded parts with soft-touch surfaces, the new Dolphin Process is considerably faster and more economical, less complex and clearly advantageous from a logistical aspect. With the Dolphin process, for example, a dashboard panel for a top-range car can be easily and efficiently produced in one single operation.

The capabilities of the Dolphin Process were demonstrated at this year's Engel Symposium on a machine equipped for the production of sample dashboard panels. Basically, the process is very similar to the two-component injection moulding process: the body of the panel is injection moulded in the first stage of the process in a glass fibre reinforced PBT/ASA blend (Ultradur S4090 IGX from BASF). It is then overmoulded in the second stage with a special polyester (Pibiflex, a readily foamable thermoplastic polyester from P-Group) using the

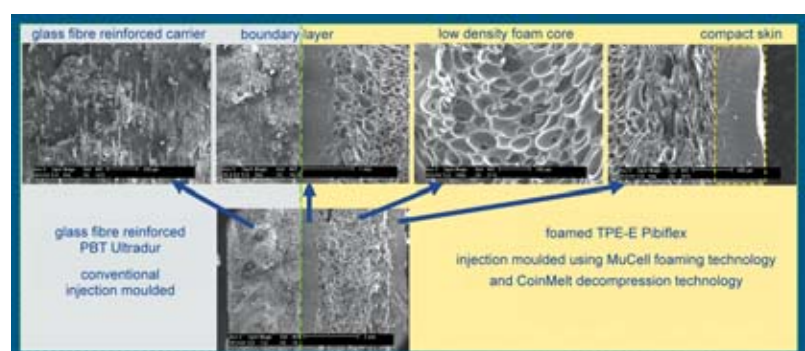
MuCell process. The close chemical affinity between the two materials ensures an optimum bond. The soft-touch outer skin is obtained with the aid of Engel's so-called CoinMelt technology: an injection-compression process specially tailored to the application and used in conjunction with a high-precision platen parallelism feedback control system.

The machine used for production of the sample dashboard panel is an ENGEL DUO 11050/4550/1500 Combi M (15,000 kN clamping force). The particular features of the Combi M model are a rotary module incorporated in the clamping system, a second injection unit mounted on the rear side of the moving platen where the ejector is normally fitted. The rotary module supports the rotating central block of the double daylight mould and rotates it around its vertical axis for the purpose of transferring the PBT/ASA preform from station 1 to station 2, where the preform is then overmoulded with the soft-touch outer layer of Polyester Pibiflex by means of the second injection unit mounted on the moving platen.

The future-oriented Dolphin Process is the fruit of a project undertaken jointly by four companies: the raw material manufacturers BASF, Ludwigshafen/Germany, and P-Group, an Italian group of companies headquartered in Ferrara (represented by P-Group Deutschland GmbH, Filderstadt, near Stuttgart), the mould making firm of Georg Kaufmann Formenbau AG, Busslingen/Switzerland, and Engel as the machine manufacturer. <<



Two-component dashboard panels (samples) with soft-touch surfaces, produced in one single process using the new Dolphin Process.



Cross-section of a PBT/TPE sandwich moulding produced with the Dolphin Process: the microscopic enlargement clearly shows the structure and morphology of the different layers.

## ZF Boge Elastmetall: Engel's partner for 30 years

>> Every company seeks longstanding partnerships with its customers, and Engel is no exception. It is all the more rewarding when such a partnership still thrives after many years – like the one with ZF Boge Elastmetall GmbH in Damme in North Germany. Thirty years have now gone by since the first injection moulding machine made its way from Schwertberg in Upper Austria to Damme in Lower Saxony. The company today operates a total of 87 thermoplastic injection moulding machines, of which as many as 70 machines come from Engel – what could be better proof of a customer's trust? Today it is mostly complete, fully automatic production cells that do their duty round the clock at Damme, making their contribution to ZF Boge Elastmetall's competitiveness as suppliers to the automotive industry. For these production cells, Engel supplies not only the actual injection moulding machines but also all relevant automation components – robots and peripherals – from its own production. Project management all the way through to turnkey installation neatly rounds off Engel's "everything from a single source" strategy.

"Engel, too, has derived long-term advantages from this longstanding relationship", said Georg Tinschert at a small celebration occasioned not only by this partnership of many years but also by the arrival of the first all-electric Engel machine in Damme, and continued:

### ZF Boge Elastmetall GmbH

Together with its foreign subsidiaries, ZF Boge Elastmetall GmbH constitutes the Rubber-Metal Technology Division of ZF Friedrichshafen AG. In close cooperation with car manufacturers in all parts of the world, ZF Boge Elastmetall develops and manufactures vibration control systems and components for chassis and power train suspensions for all kinds of road and track vehicles. Further products include bumper impact dampers and plastic components.

Damme is not only the production site but also the business headquarters of ZF Boge Elastmetall GmbH. Besides its production facilities for rubber-metal composites and plastic components, it also has a large and efficient development and planning centre complete with testing and trial facilities. Founded in 1967 under the name Elastmetall Damme/Oldenburg GmbH, ZF Boge Elastmetall today employs 800 people at its Damme site and more than 3,400 worldwide.

"ZF Boge Elastmetall's ambitious requirements concerning the efficiency and reliability of our machines and their control systems, especially for complex production processes, initiated a great many innovations which we subsequently adopted as standard. Thus it is that this long and trusting partnership has contributed to the continuous development of both companies." <<

## Permanent oil filling with eight years' guarantee for ENGEL VICTORY Electric

>> Engel is the first injection moulding machine manufacturer to offer "permanent oil filling" ex works complete with a guarantee. The fully synthetic machine oil "OMV hyd HLP-SH 46", developed specially for injection moulding machines in collaboration with the Austrian mineral oil group OMV, is rated for a permanent duty of at least 40,000 operating hours. It is immediately available as an option for all new machines of the ENGEL VICTORY Electric series.

>> This newly developed oil now permits an increase in the oil change interval to eight years – and with OMV's guarantee, the only prerequisite being that the user send OMV an oil specimen once a year for analysis. If, contrary to expectations, the condition of the oil fails to meet the required standard of quality, OMV will replace the oil filling free of charge.

In addition to the guarantee, the user will basically enjoy the same benefits as those enjoyed by car drivers when using synthetic engine oils. In spite of the higher price of synthetic oils, the subsequent maintenance costs are

much lower than in the case of mineral oils, which have to be changed much more frequently. Moreover, the highly constant lubricating properties of synthetic oils have a favourable effect on the function and service life of all wearing parts in the lubricating circuit, and this in turn further reduces maintenance and servicing costs. For fast cycling machines, the higher heat resistance of synthetic oil makes for more constant operating conditions.

A "by-product" of the regular oil analyses is the possibility of ascertaining the present condition of the machine's components. In this regard, the oil analysis may be seen as a kind of "life insurance" for the machine and/or a contribution towards quality assurance.

With their improved quality of oil, the hybrid machines now come even closer to the performance and maintenance characteristics of all-electric machines. Engel envisages extending this offer to include all-hydraulic machines at some time in the future. We shall report when the time comes. <<



The management team of Engel Holding (from left to right): Hans Wobbe, Christian Pum, Peter Neumann and Gotthard Mayringer.

## Christian Pum strengthens Engel Holding's management team

>> On 1<sup>st</sup> June 2006, Christian Pum (45) was appointed President of Engel Holding GmbH and Engel Austria GmbH. In this newly created position, Pum will strengthen Engel's branch-related sales activities worldwide. He is now the fourth director on the management board of Engel Holding and joins Dr. Peter Neumann, Chairman, Dr. Hans Wobbe, Technology Director and Gotthard Mayringer, Finance Director.

Christian Pum possesses the best qualifications for his new duties – not only professional competence and longstanding practical experience but also many years in Engel's service. Born in Linz, Christian Pum graduated from the University of Vienna with a master's degree in Business Science. He began his career with two other well-known Austrian companies before joining Engel in 1997 as Sales Manager responsible for the small and medium-sized injection moulding machines manufactured at Engel's Schwertberg factory. He then held the same position at Engel's large-capacity machine factory at St. Valentin and, since 2000, was General Sales Manager responsible for the sale of all sizes and types of machine built by Engel Austria. <<



## Engel CZ moves into new building

>> The 5th September 2006 was a day on which Engel had every reason to celebrate: in the presence of representatives of the owner family, the Engel management and the City Council of Prague, Engel CZ's new four-storey office building at 18 Baarova Street, Prague 4, could at last be officially inaugurated after two years of planning and building work. The new building had become necessary in consequence of Engel CZ's rapid growth. The cramped conditions of the late 19th century building that was hitherto the home of Engel CZ are now a thing of the past. With a current work force of 33 employees, 17 of whom are service engineers, Engel CZ is one of the largest branches of the Engel organization. Its training centre and large technical service capacity enable Engel CZ to serve not just the Czech market but also the entire region of Central and Eastern Europe. There is also ample provision for further growth: only about 40% of the new premises are currently occupied by Engel, the remainder has been let. <<



## Engel Symposium 2006 Record Response!

>> The Engel Symposium on 17<sup>th</sup> and 18<sup>th</sup> May – this is a customer event that takes place traditionally every three years – attracted a record response. Organized this year at Engel's large-capacity machine factory in St. Valentin under the motto "Your changes – Our challenges", was attended by a total of 2,300 visitors from 38 countries, and well over 1,600 guests attended the gala evening on the first day of the symposium at the Linz Design Center. One of its highlights was the presentation of the "Engel HL Award 2006". This prize is awarded in Gold, Silver and Bronze to customers for particularly innovative applications of the tiebarless injection moulding machine. This year's award went to two plastics processors from Germany and one from Austria (see page 9).

The symposium in St. Valentin afforded participants an opportunity to familiarize themselves with injection moulding innovations in five different fields of application. Practical machine demonstrations were accompanied by a series of technical lectures. All of the exhibits at this in-house exhibition attracted much interest, in particular Engel's new and further developments demonstrated for the first time in public, including the all-electric ENGEL E-MOTION Combi (see page 2) and the newly developed Dolphin technology, the world's first processing technology for the time and money saving production of car dashboard panels with soft-touch surfaces in one single operation (see page 11).

## Facing the future with confidence

The concept behind the Engel Symposium – namely to offer the customer a comprehensive platform of information by way of practical machine demonstrations accompanied by a series of technical lectures – has been well received. This has been proved not least by this year's record attendance of 2,300 participants. For Engel, this demonstration of confidence is at the same a confirmation of Engel's strategy of continuous commitment for the benefit of its customers.

This high acceptance also strengthens Engel's status in the market as a globally operating injection moulding machine manufacturer, for even large groups of participants from North and South America, Africa and, to an ever increasing extent, Asia considered it well worth their while to undertake the long trip to Austria.

The next Engel Symposium is planned for 2009. <<



The 500 seats in the "lecture hall" (middle photo) were fully taken, and not just for the opening of the Engel Symposium and the welcoming speech by Dr. Peter Neumann (top photo). The half-day series of lectures were repeated on each of the two afternoons, affording participants enough time for the practical demonstrations (bottom photo).



The social highlight of the Engel Symposium was the gala evening on 17<sup>th</sup> May at the Linz Design Center. Besides a performance of acrobatic dancing, the programme included a presentation of the winning projects of the HL-Award competition and the actual awards ceremony.