Fibre reinforced plastics
Innovative composite technologies
Customers and partners all around the world appreciate ENGEL as a reliable and innovative partner. For several reasons: As a world market leader in plastics processing machines, ENGEL strives to blaze new trails, especially also in the area of lightweight construction composites, and to impress and surprise the industry with continuous evolution.

Headquartered in Schwertberg, Austria, ENGEL offers customised, automated turnkey solutions and ground breaking technologies to help make its customers competitive and successful. Besides state-of-the-art production facilities, a love for detail, and the highest problem-solving competency, the most important factor in ENGEL’s success are its approx. 5,200 employees, who are available to customers and partners in factories and branches throughout more than 85 countries.
With the goal of accelerating the development of new manufacturing processes and technologies for the large-scale production of fibre reinforced plastics (FRP), ENGEL has constructed its own technology centre for lightweight composites in St. Valentin.

Equipped with state-of-the-art technology, the centre is suitable for both thermoplastic and thermoset composite processes, thus representing the perfect base for internal company development projects as well as research projects in cooperation with institutes and universities.

Upon request, ENGEL will also make the centre exclusively available to its customers, thus allowing for the conducting of product-quality customer trials or mould take-over in collaboration with the ENGEL experts, and out of the public eye.

**Equipment Centre**

**ENGEL v-duo 3550/1700**
- Clamping force 17,000 kN
- Max. clamping surface 1,750 x 2,170 mm
- Incl. injection unit
- Incl. articulated-arm robot (7 axes)

**ENGEL v-duo 1560/700**
- Clamping force 7,000 kN
- Max. clamping surface 1,000 x 1,440 mm
- Incl. injection unit
- Incl. articulated-arm robot (6 axes)

**ENGEL Infrared Oven BG5**
- Max. plate size 1,610 x 1,110 mm
- In situ reactive unit
- Processing machine for caprolactam
- High-pressure metering unit for HP-RTM

Hennecke Streamline 65
organomelt composites through thermoforming and injection moulding

Using economical processes to manufacture components with top-quality mechanical characteristics and low weight - this is the demand being met by ENGEL with its organomelt process. ENGEL organomelt combines the processing of thermoplastic, continuous fibre-reinforced, semi-finished products with the proven ENGEL injection moulding technology.

In the course of the production process, organic sheets (continuous fibre-reinforced, consolidated thermoplastic semi-finished products) and unidirectional tapes are brought up to processing temperature in an energy- and cycle-optimised fashion, and then reshaped in the injection mould cavity. With the well-known geometric freedom of injection moulding, additional structures such as ribs and functional elements can subsequently be shaped within the same mould.

On the basis of its product line-up and with components from its in-house production, ENGEL is in the position to offer the most varied system solutions for this process. Every element of the system is fully integrated into ENGEL’s CC300 machine control. This guarantees complete process data recording while being simple and easy to operate.

Your advantages

- quick cycle times
- completely automated process for high efficiency
- functionalisation possible with conventional injection moulding process
- can be used on horizontally and vertically closing machines
- all components from a single source
HP-RTM (High Pressure Resin Transfer Moulding) is especially effective when it comes to defined layer structure and complex geometries. This process can produce flat-surfaced components as well as hollow profiles.

With this fibre composite technology, a dry, pre-formed, semi-finished fibre part is placed into the mould, and then the closed form is evacuated. In the following step, a highly reactive, thermoset resin is injected into the form to soak the semi-finished fibre part. With an increase in pressure and temperature, the material is finally hardened into a high-performance fibre composite plastic.

Thanks to its system competency and extensive product line-up, ENGEL and its partners can provide fully automated system solutions that are tailor-made for this technology. These systems can realise conventional process types as well as process variants with subsequent polyurethane flow coating for coatable surfaces, or process variants for particularly gentle injection such as compression RTM. In addition, software features developed especially for the HP RTM process provide the manufacturer with seamless control over the entire process, and thus a reproducible production.

Your advantages

- complex geometries and hollow profiles realisable
- defined layer structure possible
- coatable surfaces in combination with ENGEL clearmelt
- control integration of all system components
- consistent process and quality control
ENGEL's in situ technology has an extremely wide range of applications: structural parts with a high load-bearing capacity, very thin-walled components, or parts in which appearance plays an important role. The process combines reactive technology for fibre-composite components with all the advantages of classic injection moulding, thus allowing for the fibre-reinforcement to be placed on the part precisely where needed.

During the in situ process, carbon or glass fibres are inserted dry, then soaked with caprolactam. This polymerises to an extraordinarily tough polyamide. The resulting thermoplastic fibre-composite component can then be further functionalised in a second mould, e.g. with bracing ribs or load-optimised mounting points. In the case of contour-oriented injection moulding, since no rework is necessary, components can be installed immediately.

The fully automated caprolactam parts production requires sophisticated process technology. ENGEL has developed an entire line of new machine components specifically for this purpose. Core components for the injection of the thin liquid caprolactam are two electrical precision injection units, which have been optimised for in situ technology. Just like in an injection moulding machine, the hard- and software of the reactive unit are integrated into the overall system. This allows for consistent process data recording and quality-optimised production.
The decisive factor in the organomelt process chain is the optimal heating of the thermoplastic semi-finished products. The semi-finished product must be heated rapidly, efficiently and evenly, without damaging the plastic.

The ENGEL infrared oven adjusts to the requirements of the given components, and is available in various sizes, with or without a sliding table. In order to optimally heat the components, the heating area can be sub-divided into individually adjustable zones. This allows for also efficiently heating smaller components in a large oven, when required. Thanks to the compact design, the oven can be simply installed in any production cell, and can be easily transported by forklift or crane. The controls are completely integrated into the usual ENGEL CC300 control software, and therefore very intuitive and ergonomic for the user to operate. Set-up time is minimal, and the oven can be adapted to different semi-finished products at any time. All process data can be continuously monitored and logged.

Your advantages

- efficient heating of thermoplastic semi-finished products
- flexible adjustment to various semi-finished product sizes
- individually adjustable heating zones
- available with and without a sliding table
- fully integrated into the machine’s control
- user-friendly interface
- continuous process monitoring
- simple storage of process data and heating curves
- easy transport with crane or forklift

| Infra-red Oven 2 x 2 | 360 x 360 |
| Infra-red Oven 2 x 4 | 360 x 900 |
| Infra-red Oven 3 x 6 | 610 x 1,110 |
| Infra-red Oven 4 x 8 | 860 x 1,360 |
| Infra-red Oven 5 x 7 | 1,110 x 1,610 |

Infrared oven

efficient and gentle heating of semi-finished products
v-duo
tailor-made for lightweight construction

To meet the specific demands of lightweight construction and its processes, ENGEL designed the v-duo specifically for the processing of fibre-reinforced plastics. This low-profile machine is based on the successful concept of the two-plate clamping unit, ENGEL duo, and becomes an individually customised turnkey solution through its wide range of applications and a number of equipment options. The proven drive concept ENGEL ecoDrive is standard equipment on this optimally accessible vertical machine. With the single or double sliding table as well as various automation solutions, the machine provides the best basis for an economical process design. Thanks to the optional injection unit, the v-duo is suitable for thermoset as well as thermoplastic composite applications.

Your advantages

- low construction height
- accessibility from four sides
- can be equipped with injection moulding unit
- technology-specific software packages
- single or double sliding table available
- from 4,000 kN up to 36,000 kN
- clamping surface up to 3,600 x 2,400 mm
Efficient Composite Production

**ENGEL insert**
The efficient turnkey solution for your insert application, it optimally fulfils your requirements in terms of productivity, precision, safe operation, floor space and energy efficiency. Whether hydraulic or electrical drive concept, vertical or horizontal injection unit, rotating table, sliding table, or fixed plate – thanks to a wide range of variations, you will receive the perfect system for almost any insert application. From the individual machine with no automation all the way to a complex, highly integrated production cell.

**Advantages**
- Sizes from 300 kN - 4,000 kN
- expandable with rotating table or sliding table
- can be equipped with a variety of injection units
- expandable with sliding table
- ergonomic design and great accessibility

**ENGELElást**
Extreme flexibility in a small footprint. With its modular design, ENGEL elast is suitable for a wide range of application areas, in the tech centre as well as in production. The bottom closing vertical machine is equipped with a servo-hydraulic drive concept that allows it to execute precise, application-specific, power- and position-dependent closing profiles. The optimal operating height of the compact press also makes manual activities easier.

**Advantages**
- small footprint
- high plate stiffness
- optimal energy efficiency
- expandable with sliding table

### clamping force heating plate dimensions tie-bar gap
| ENGEL elast 160 V | 1,600 kN | 500 x 550 | 550 x 295 |
| ENGEL elast 260 V | 2,600 kN | 550 x 650 | 650 x 750 |
| ENGEL elast 400 V compact | 4,000 kN | 710 x 920 | 810 x 1020 |
| ENGEL elast 650 V | 6,000 kN | 800 x 1100 | 900 x 1200 |

/* Available with no heating plates and correspondingly larger clamping surface

**ENGEL victory**
The tie-bar-less ENGEL victory is the proven multi-talent among injection moulding machines. Its flexible modular system is perfectly suited to produce the most varied parts with different technologies and in the highest quality. The innovative, tie-bar-less technology, tried and tested for more than 25 years, allows you to use a comparatively small injection moulding machine, even with large moulds. You only need to invest into the actually needed clamping force - giving you more room for new ideas.

**Advantages**
- Innovative tie-bar-less design
- fast and easy mould changes
- more than 60,000 victory machines on the market
- highest level of energy efficiency
- generous mould area

**ENGEL duo**
The higher the demand, the more well thought-out the solution: The ENGEL duo will always fit your concept perfectly. It stands out through its sophisticated, compact machine concept. Furthermore, the proven two-plate technology, the well thought-out variable injection unit, and the flexible drive concept allow for a rapid progression of all movements. Whether you are producing large-scale parts, manufacturing highly demanding components, or require an absolutely perfect surface on your high-tech products: The ENGEL duo and its compact flexibility are always ready to get to work.

**Advantages**
- fully electrical, hydraulic, and servo-hydraulic drives available
- exposed tie-bars and sliding plate guides
- compact two-plate design
- clamping force from 3,500 kN - 55,000 kN
- parallelism measurement
- multiple injection units possible
ENdEL automation competency

ENdEL will work with you to design a turnkey solution customised to your requirements. Our extensive line of robots covers a wide range of requirements: simple pick & place with the e-pic, highly precise positioning with the viper linear robot, and complex handling with the multi-functional easix six-axis robot. In addition, high quality peripherals such as conveyors, belts, the ENdEL infrared oven, or tools for pre- and post-processing and quality control, ensure efficient workflows and processes. From the design to the commissioning of your system, our many years of project management experience and a networked team around the world guarantee fast execution. Should you require service or maintenance, or if there is anything you need to ask, our team is also happy to support you in the course of operation.

All components will be delivered from a single source and are completely integrated into the CC300 control software. Thus, even complex production systems can be controlled easily via the panel or the hand-held unit. Your operators will benefit from the accustomed intuitive operation of the CC300, which will significantly reduce operator errors and rejects.

Pre-process
- Heating the material with the infrared oven

insert
- Insert dry pre-forms, thermoplastic semi-finished products, or functional elements such as metal inserts

remove
- removal of components after the production process
- fitting, precise and efficient automation solutions for all component sizes

Quality control
- power and position monitoring
- optical inspection (camera systems)
- electrical inspection
- Seal and temperature inspection
- functional tests

Buffer and transport
- Stacking in magazines before and after production
- onward transport
ENGL CC300
smart operation of machine and peripherals

The ENGEL CC300 is based on a simple operator interface and groundbreaking process integration. With this smart control in fully integrated production systems, the machine as well as peripherals such as the infra-red oven, the dosage machine, or the robot, can be steered through the production process as easily as though you were just using your smartphone. Ergonomic design, individual configurability and modern operator control logic make controlling and monitoring highly integrated, automated systems much simpler, safer and easier.

higher productivity
start without a reference run
perfectly synchronised movement progressions

intuitive operation
uniform, clear and logical operation
targeted information with no screen changes, customisation possible
colour guide system to differentiate between machine and robot control

simple adjustment of sequences
Conduct adjustment tasks independently thanks to menu-guided sequence programming
individual assignment of tasks and roles

variable handling
direct, safe and stepless control of all movements with e-move, on the panel or using the ergonomic, lightweight C70 handheld unit

increased safety
perfect, common data management of machine and robot
sign-in by chip card for individual assignment of user roles and tasks

ergonomic design
individually adjustable, functional and robust hardware
with revamped and simplified user interface
individual settings are loaded upon sign-in with chip card

best readability
generous display with excellent contrast
in all light conditions and from any angle
ENGEL services
Always there where you need us

Your concern is our challenge

It is important to always keep your injection moulding equipment in top shape and constantly available. The wide range of services offered by ENGEL ensures that you can produce competitively at any time. It doesn’t matter whether your production cell is a single machine or a complex integrated system solution. ENGEL makes it possible for you to utilise all options for optimisation at any time, and therefore consistently get the most out of your machine over the long term. In addition, we offer professional training for machine operators as well as the fastest delivery worldwide, and experienced installation of spare parts. Diverse maintenance contracts also guarantee top-level machine availability. Because our goal is the best possible performance of your ENGEL machinery.

Support – we assist you on-site
- save costs incurred by downtime
- immediate support around the clock, worldwide
- knowledgeable help from the ENGEL service team
- for ENGEL injection moulding machines of any generation
- for all ENGEL technologies and any control unit version

Upgrade – install reliable added value
- for all ENGEL injection moulding machines
- professional upgrade solutions
- to supplement and optimise
- equip machines for use with completely new applications
- utilise machines with greater cost-effectiveness

Know-How – increase your competence
- thorough training with a comprehensive transfer of know-how
- make optimal use of machine potential
- individual seminars and training programs for you and your staff
- informative events on industry-specific topics
- take advantage of efficient, targeted and practical information, instruction and training
- either at your own facility or at one of the worldwide ENGEL training centres

560 of the best equipped service technicians
55 support hotline technicians
9 production plants
29 sales subsidiaries
60 representatives