Composite Technologies
Innovative solutions for lightweight design
ENGEL is globally recognised by customers and partners alike as a reliable and innovative partner. There are a number of reasons for this. As one of the leading companies in injection moulding machine manufacturing, ENGEL’s goal is to take new paths and to constantly provide developments in our industry including the field of lightweight composites. These trail-blazing enhancements are exciting advancements for our customers.

With nine production plants in Europe, North America and Asia (China, Korea), as well as subsidiaries and representatives in more than 85 countries, we offer tailored, automated, turn-key solutions from a single source, and forward-looking technologies that make our customers competitive and sustainably successful.
ENGEL organomelt allows you to manufacture parts with the best mechanical properties at low weights creating a cost effective process. This technology combines the processing of thermoplastic, continuous fibre-reinforced blanks with ENGEL proven injection moulding technology.

In the production process, organic sheets (continuous fibre-reinforced, consolidated thermoplastic blanks) and unidirectional reinforced tapes are heated to the processing temperature in an energy- and cycle-optimised method and then formed in the injection mould. Further structures, such as ribs and functional elements can then be formed in the same mould using the known geometrical freedoms of injection moulding.

Because of our wide product portfolio, we are able to offer a wide range of system solutions for this process, with components from a single source. All system elements are fully integrated with the ENGEL CC300 machine control unit. This ensures complete process data acquisition with simple and convenient operation.

Small vertical machines: insert
Vertical clamping unit in the low clamping force range

Your benefits
- Small and compact
- All components fully integrated
- Vertical clamping solution simplifies handling of semi-finished products

Small horizontal machines: victory
Tie-bar-less machine for easy accessibility

Your benefits
- Small and compact
- All components fully integrated
- Flexible and easy to configure production cell
- ENGEL viper or easix can be used
- Horizontal & vertical infrared ovens can be used
- Standard injection moulding machine also for conventional injection moulding

Tailor-made production cells
- Clamping force 28 to 500 t

Horizontal two-platen machines: duo
- Clamping force 350 to 5600 t

Vertical two-platen machines: v-duo
- Clamping force 700 to 3600 t

Vertical two-platen machines: v-duo
- Clamping force 700 to 3600 t

Tailor-made production cells
- Clamping force 28 to 5000 t

Small horizontal machines: victory
- Clamping force 350 to 5600 t

Small vertical machines: insert
- Clamping force 30 to 400 t

Vertical two-platen machines: duo
- Clamping force 28 to 500 t

Horizontal two-platen machines: duo
- Clamping force 28 to 500 t
Horizontal two-platen machines: duo
Clamping unit in the high clamping force range

Your benefits
- Flexible production cell featuring the well-known ENGEL duo performance
- All components fully integrated
- Two-platen clamping unit provides a small footprint
- Easy to configure
- ENGEL viper or easix can be used
- Horizontal & vertical infrared ovens can be used

Tailor-made production cells
Customer-specific solutions

The most efficient part design is essential to be able to create parts at an attractive price. In many cases, however, this increases the complexity of the manufacturing process and the production cell. Topics such as functionalisation and multiple thicknesses are increasingly coming to the forefront. Thanks to ENGEL’s comprehensive product portfolio, customers can choose from various modules and customise the production cell to suit the application in hand. A small footprint and full integration are the key factors.

Your benefits
- Combination of various oven solutions
- Integration of many robots possible
- Modular layout using standard components
- Various sheet thicknesses can be handled and processed
- All components fully integrated with the CC300 control unit
Infrared oven
Efficient heating technology with intelligent control

The critical factor for the organomelt process chain is optimal heating of the thermoplastic composite blanks. They must be heated quickly, efficiently and homogeneously without damaging the plastic.

The ENGEL infrared oven adapts to the requirements of the respective parts and is available in various sizes and with or without a sliding table. Depending on the process requirements, we offer you both a horizontal and a vertical heating concept. To heat up the parts in the best possible way, the heating field can be divided into various zones and controlled separately – this means that smaller parts can still be heated efficiently in a large oven if the need arises. The compact design allows easy integration into any production cell and effortless transport by forklift or crane. Control by the CC300 ensures intuitive and ergonomic operation. All process data can be constantly monitored and recorded. In addition, the minimal set-up overhead and the ability to adapt to various composite blanks are major advantages of the ENGEL infrared ovens.

Your benefits
- Efficient heating of thermoplastic composite blanks
- Easily adaptable to different blank sizes
- Individually adjustable control zones
- Available with and without sliding table
- Available in horizontal and vertical layout
- Fully integrated with the CC300 machine control unit
- User-friendly control interface
- Continuous process monitoring
- Simple to save process data and heating profiles
- Easy to transport with a crane or forklift
- Perfectly suited for high-temperature plastics

Horizontal infrared oven
Universally suitable solution

Your benefits
- Can be used for horizontal and vertical clamping units
- Available in various standard sizes
- Adjustable heating field distance
- Robots are idle during the heating process

Vertical infrared oven
Solution on the smallest footprint and with short handling times

Your benefits
- Suitable for very thin preform thicknesses
- Available in various sizes
- Available for single- or two-sided heating
- Positioning next to or on the machine for shortest transfer times
- Small system footprint
- Servo-electrically movable for adjusting to different mould heights and for moving to maintenance positions
The ENGEL tape stacking unit uses a pick-and-place approach to create layups from unidirectionally reinforced composite tapes that can be precisely placed according to the intended component geometry and the load cases. Due to the outstanding flexibility of the system, hybrid layups made of carbon and glass fibre reinforced tapes or layups with different wall thicknesses can be realised. It is also possible to reinforce previously consolidated semi-finished parts locally with tapes.

With the ENGEL tape stacking technology, pre-cut segments are stored in specially developed magazines. These magazines have a separating function which ensures that only one tape is provided to the laying robot. The system works with two high-precision robots that are equipped with an end-of-arm tool, which can pick up the tapes, place them and weld them locally. A high-resolution optical measuring system ensures the exact positioning of the tapes in the layer structure. It is used to measure each tape so that the tapes can be positioned accurately laid. Being aware of the exact position and orientation on the tapes in the end-of-arm tool makes it possible to lay several tapes precisely next to each other.

The consolidation of the locally fixed layer structure is then carried out in the consolidation unit. The heating/cooling process in combination with the special tool technology allows the consolidation of layer structures with a uniform thickness, but also with different wall thicknesses with minimal residual porosity.

Both systems, the tape stacking unit and the consolidation unit, operate in line with the injection moulding machine’s cycle and are therefore suitable for large series production.

Your benefits

- Production of load-optimised and extremely low-cutoff composite layups
- Production of layups with different reinforcement fibres and thicknesses
- Local reinforcement of conventional organic sheets
- Production within the injection moulding machine’s cycle
- Quality inspection during the laying process by optical measuring system
- Consolidation of blanks with different thicknesses
- Manufacturing of blanks with minimal residual porosity
SMC
Processing of thermoset composites

Processing of SMC (Sheet Moulding Compound) is particularly suitable for the production of flat visible components as well as structural components exposed to high stress. The technology enables extensive functional integration and is therefore used for a wide range of high-performance composite components.

- Fully automated system solution for best repeatability and dimensional accuracy of the part
- Realisation of complex geometries
- Additional features possible as ribs, inserts or duroplastic tapes
- Paintable surface quality (Class-A)

The SMC material is processed from the roll. After unwinding, the material is transferred to a cutting table, which cuts precisely layer by layer. The last layer is gravimetrically adjusted if necessary. The blanks are then stacked, weighed and transferred by a robot to the heated mould. Then, the parallelism-controlled press clamps the mould under exact conditions. The resulting heat intake initiates the curing process in the mould. The reactive SMC material changes its viscosity and fills the cavity of the mould. When the curing time is complete, the part is removed and, if necessary, automatically processed downstream.

In order to combine the highest surface quality with maximum processing efficiency, ENGEL develops integrated systems solutions for the mass production of SMC parts that enable fully automated production from coil unwinding to discharging the ready-to-fit part.

Your benefits
- Flexible, energy-efficient two-platen machine
- Continuously parallelism-controlled compression moulding process
- Production of high-precision composite parts with functional integration
- Directly paintable surfaces in combination with in-mould-coating
**HP-RTM**

**Duroplastic composites thanks to Resin Transfer Moulding**

In the HP-RTM process, a preform with a ply setup tailored to the respective application is placed in a heated mould. The mould is then closed. A highly reactive resin (mostly epoxy resin or polyurethane) is injected into the mould and the fibre preform is impregnated during injection. The reactive matrix then cures under increased pressure and temperature to form a strong and durable fibre composite part.

Thanks to its system expertise and extensive product portfolio, ENGEL, along with renowned partners, offers fully automated systems solutions tailored to the respective part for production with the HP-RTM process. The control unit for the Hennecke high-pressure metering unit is integrated into the ENGEL CC300 control unit. In combination with software features specially developed for the HP-RTM process, the user gets reliable and consistent control over the entire process. This allows production to be carried out under repeatable conditions.

The system technology supports the production of complex geometries and hollow profiles as well as to create structures with a large surface area in the Compression-RTM process. Paintable surfaces can also be achieved by subsequent injection of a transparent polyurethane system.

**Your benefits**

- High pressure injection system integrated with ENGEL machine control unit
- Extensive and high-precision compression functionalities
- Complex geometries and hollow profiles can be realised
- Paintable surfaces in combination with ENGEL cleammelt
- Central and constant process and quality inspection
- Compression RTM with parallelism controlled press (v-duo)
- Compensation of pressure fluctuations with predictive pressure switch-off
In-situ
Impregnation process with thermoplastic resin

The range of applications for ENGEL in-situ technology is very diverse and ideally suited for structural parts that face high stress. The process combines reactive technology for fibre composite components with thermoplastic processing. The continuous-fibre reinforcement on the part can be tailored to the load while the thermoplastic matrix of the composite component enables functionalisation through injection moulding.

In the in-situ process, carbon or glass fibre are inserted in a dry state and then impregnated with Caprolactam. The result after completing polymerisation directly in the mould is a highly tough polyamide.

Further process options are possible with in-situ technology. For example, the prefabrication of flat, load-dependent composite blanks, which are then further processed by heating and forming like organic sheets.

Fully automatic production of parts from Caprolactam requires sophisticated process technology. ENGEL has specially developed a reactive unit for this purpose: the core components for the injection of low-viscous Caprolactam are two precision electric injection units, which have been optimised for in-situ technology. The hardware and software of the reactive unit are fully integrated into the overall system, enabling continuous process data acquisition and quality-optimised production.

Your benefits
- Mobile unit can be easily moved around the machine cell
- Combination with different clamping units possible
- Single grade structural elements made of PA and fibre reinforcement
- Full integration with the CC300 control unit
- Fully automated production of composite parts
- Functionalisation by injection moulding possible
v-duo
Vertical clamping unit for lightweight design

To meet the specific demands of lightweight products and its processes, ENGEL designed the v-duo specifically for processing fibre-reinforced plastics. The low-height machine is based on the successful design of the ENGEL duo two-platen clamping unit. It can be customised to your needs thanks to its versatility and choice of equipment options. The easily accessible vertical machine is equipped with the proven ENGEL ecodrive drive solution and is characterised by precisely profile-controlled and parallel movements. Due to the optional design with a single or double sliding table, as well as various automation solutions, the machine sets an example for cost effective process design. The v-duo is ideally suited for both duroplastics applications and thermoplastic composite applications because of the design options with the injection units.

Your benefits
- Low height
- Accessible from four sides
- Adaptation with injection units possible
- Technology-specific software packages
- Clamping force up to 36,000 kN
- Platen surface up to 3,600 x 2,400 mm
- Parallelism-controlled clamping unit with high-precision compression moulding functions
- Optional: Single or double sliding table
Automation expertise
for customer-specific requirements

If you are looking for more than a combination of modular automation components such as robots, conveyor belts, safety enclosures, etc., the ENGEL team is happy to develop system solutions to meet your individual requirements.

Our specialists have access to a comprehensive modular assembly kit system with proven process modules; they implement additional components and functions and integrate your preferred devices.

Professional project implementation
From the first inquiry to providing service for your automation project

Parallel to our global network of subsidiaries for machines, ENGEL automation center in America, Asia and Europe are your local contacts.

Your benefits
- Development of solutions for your individual part requirements
- Design, programming and documentation in line with your standards
- Production and commissioning at ENGEL and in your global plants
- Training of operators and maintenance personnel for your independence
- Service for maintenance and repairs for maximum availability
ENGEL Center for Lightweight Composite Technologies

With the goal of accelerating the development of new manufacturing processes and technologies for the high-volume production of fibre-reinforced plastics (FRP), ENGEL has set up its own Center for Lightweight Composite Technologies in St. Valentin.

Equipped with the latest system technology, the center is well suited for both thermoplastic and thermostet composite processes and is a perfect workspace for in-house development projects as well as research projects in cooperation with institutes and universities.

On request, ENGEL can also offer customers exclusive access to the technology center, enabling them to carry out pre-production testing or mould acceptance tests together with ENGEL specialist personnel without the public being involved.

Equipment
ENGEL Technology Center

v-duo 3550/1700
Clamping force 17,000 kN
Max. platen face 1,750 x 2,170 mm
Incl. injection unit
Incl. articulated robot (7-axis)

v-duo 1560/700
Clamping force 7,000 kN
Max. platen surface 1,000 x 1,440 mm
Incl. injection unit
Incl. articulated robot (6-axis)

Infrared oven BGS
Max. plate surface: 1,610 x 1,110 mm

In-situ reaction unit
Caprolactam processing machine

High-pressure metering unit for HP-RTM
Hennecke MK2

External technology centers

Open Hybrid LabFactory Wolfsburg
- v-duo 16000/3500/3600
  Clamping force 36,000 kN
  Max. platen surface: 3,600 x 2,400 mm
  Incl. 2 injection units

LIT Open Innovation Center at JKU Linz
- duo 2460/350
  Clamping force 3,500 kN
  Incl. injection unit
  Incl. articulated robot (6-axis)
  Incl. infrared oven
  Tape laying cell
  Consolidation unit