LIGHTWEIGHT SOLUTIONS FOR DIFFICULT TASKS.
Fiber composites are essential to modern lightweight construction because they can be customized in many ways. This results in a number of requirements for processing these composites economically. Using our extensive experience in the complete process, we are able to offer the best possible production solutions according to your part and project requirements.

No longer just for the aerospace industry or race cars, composites are now used in a variety of applications. In the automotive industry, electro-mobility and the increasing requirements for sustainability and efficiency are driving factors. FRIMO equipment is already being used successfully in series production for composite structural components such as monocoques, roof frames, wheel rims, and springs. Premium composites are also an essential alternative for the railroad, agricultural, and sports and recreation industries. Because material costs themselves limit profitability, composite part production relies heavily on higher productivity and lower process costs. The potential is driven by choosing an appropriate production concept, and our core business is finding ways to save materials and processing thermoplastic and duroplastic composites profitably. Thermoplastic organo sheets or natural fiber mats offer unique opportunities to integrate functional elements and shorten cycle times through intelligent process combinations. We have innovative solutions for producing fiber-reinforced structural components with a duroplastic matrix in RTM or wet compression processes, as well as solutions for the accompanying preform production.

Minimum weight and maximum performance can go hand-in-hand, and there are many reference projects in which plastic composites have successfully replaced steel and aluminum components. Together, we can find lightweight solutions for difficult tasks.

Why FRIMO? Your advantages:

- One Stop. All Services for all composite technologies
- Manual to fully-automated production solutions
- Solutions for small to large parts in low or high volumes
- Process validation with trials in the FRIMO TechCenter
- Reliable production, reproducible part quality
- In-house sample, prototype, and spare part production
- Retrofitting, relocation, refurbishment, and service for existing machines

A STRONG COMBINATION RESULTS IN INNOVATIVE LIGHTWEIGHT SOLUTIONS.

MAKE THE FUTURE LIGHT WITH FRIMO COMPOSITE TECHNOLOGIES.
LOOKING TO LOSE WEIGHT? **FRIMO PRESSING AND FORMING TECHNOLOGIES** LIGHTEN THE LOAD.

Standard machines or custom production solutions – make the best choice both technically and economically.

**FRIMO Pressing Technology**
- Compression molding
- Heating and calibration presses
- Preform presses
- RTM presses

**FRIMO Tooling Technology**
- NFPP Hybrid & OneShot tools
- Organo sheet injection tools
- Preforming tools
- RTM tools
- WCM tools
- Compression tools
- Forming tools
- Combination tools

**FRIMO Automation**
- Linear transfer
- Handling robots
- Gripper technology

**FRIMO Peripheral Equipment**
- Injection units
- Material transport and cutting
- Mixing and metering equipment
- Tool change systems
- Ventilation systems
- Safety technology

**FRIMO NFPP Machines**
- NFPP Hybrid
- NFPP OneShot
- Special NFPP processes

**FRIMO Organo Sheet Machines**
- Vertical presses
- Infrared ovens
- Robotic automation
- Integration of injection molding machines/equipment
- Custom solutions

**FRIMO Machines for Other Composite Processes**
- RTM and preforming
- WCM / wet compression
- SMC and C-SMC
AN UNBEATABLE DUO
NATURAL FIBER MEETS PLASTIC.

LOOKING FOR SOMETHING INOVATIVE BUT PROVEN?
FRIMO NFPP TECHNOLOGIES ARE TRENDSETTING.

Natural fibers are so attractive for industrial use because of their good mechanical properties, such as rigidity and stability, and combine good insulation properties with lower densities. If there were a formula for success for sustainable lightweight construction, it would be based on combining natural fibers with polypropylene. The composite material NFPP is popular in the automotive industry, particularly for the production of interior paneling, not only because it is lightweight, but also because it is well-suited for many process combinations.

With our NFPP OneShot technology, we combine multiple processes, such as forming, laminating, and trimming. Through our NFPP Hybrid technology, we combine forming, trimming, and back injection, which allows functional elements to be integrated. We are confident we have the right solution to suit your specific needs.

Over the past few years, we’ve produced

>10 NFPP HYBRID MACHINES

>50 NFPP HYBRID TOOLS
NFPP technology is ideally suited for producing semi-structural substrates. This is typically seen in door panels for automotive interiors. To produce these substrates, natural fiber mats with a thermoplastic PP matrix are heated, pre-compressed, and then formed and trimmed in a compression tool.

FRIMO NFPP Hybrid technology combines forming, trimming, and back injection of ribs and fasteners. This maximizes the potential to integrate additional functional elements directly into the part, such as reinforcement or weld domes, and eliminate follow-up processes, such as welding.

A CLEVER COMBINATION – GUARANTEED WITH FRIMO NFPP HYBRID TECHNOLOGY.

Why FRIMO NFPP Hybrid?
Your advantages:
- Custom process combinations possible
- Process validation in the FRIMO TechCenter
- Process-specific filling simulation
- Single or double machine, depending on volume requirements
- Various degrees of automation
- Turn-key complete package from a single source

FRIMO NFPP HYBRID PROCESS

1. Mat insertion from magazine, alignment, and feeding
2. Heating and calibration
3. Transfer to hybrid tool
4. Compression molding and edge trimming
5. Back injection
6. Release and removal
LOW VOLUMES AND LOTS OF TOOL CHANGES?
THE FRIMO NFPP HYBRID SINGLE MACHINE GIVES YOU THE POWER OF FLEXIBILITY.

If you are using many tools for low-volume production, our single-station machines are a great option. They make uninterrupted production possible, even through material changes. Tool changes occur in less than 20 minutes. Machine layouts vary depending on the project. In terms of sustainable production concepts, our main focus is on taking up the least space possible and minimizing your material and energy use.

WHAT CAN WE DO FOR YOU? NFPP machine automation options for door panel substrate compression:

- Double mat magazine for seamlessly switching between materials
- Mat alignment
- Calibration press
- Mat transfer
- Compression molding
- Part removal
- Tool change
- Peripheral options: ventilation, lockout shuttle, cooling station, waste removal system
- Complete machine controls

PRODUCTIVITY TIMES TWO?
NFPP HYBRID DOUBLE MACHINES DO THE TRICK.

If you want your investment for high-volume production to be as profitable and sustainable as possible, we recommend a double machine with two tools. This allows parts with right and left versions to be produced simultaneously without interruption, even through material changes. Extremely fast tool changes (less than 20 minutes) contribute to the highest possible degree of operational availability.
EXPECTING A LOT OF PRODUCT VARIATIONS?
FRIMO NFPP TOOLING TECHNOLOGY HAS NO LIMIT.

We do everything we can to bring all of your design and functional requirements to life. Our tools embody our extensive experience, gained from countless projects with both low and high production volumes. Every tool is unique, although we aim for a high degree of standardization to offer an attractive price/performance ratio. We exclusively use high-quality materials and well-proven parts. Precisely matching the tooling and equipment technology eliminates possible interference.

That’s exactly why our work begins well before design. During the conceptual phase, our Pre-Engineering Team determines how to optimize production of your part and uses this information to develop a suitable tool concept. From the very beginning, we start thinking about a number of factors: detailed part examination, clamp frame technology adjusted to the contour and material, possible slider collisions, formability rating, possible degree of automation, and issues such as targeted over-compression and waste removal. The tool layout is optimized with the help of filling simulations generated from your actual process parameters. We also look into possible process combinations, from the forming/trimming/back injection combination (NFPP Hybrid) developed in the FRIMO TechCenter to laminated surfaces (NFPP OneShot).

Why FRIMO NFPP?
Your advantages:
- Reliable preparatory process validation in the FRIMO TechCenter
- Weight savings of up to 35%
- Short cycle times (approximately 65 seconds)
- Highly automated
- Automatic waste removal
- Simple integration of functional elements with NFPP Hybrid
- Decorative surfaces with NFPP OneShot
- Simple Teflon tape changes
- Adjustable calibration thickness
- Start-up completed by experienced application engineers
- Multitude of reference projects
STRENGTH IN EVERY FIBER BACK INJECTED ORGANO SHEETS.

LOOKING FOR SOMETHING THAT CAN DO IT ALL? WE RECOMMEND FRIMO OSI TECHNOLOGY.

Our fully-developed Organo Sheet Injection process (OSI) features short cycle times for thermoplastic structural components that are not only considerably lighter, but that can also include many functions. Organo sheets are high-performance, semi-finished materials with carbon, glass, or aramid fiber fabrics embedded in a thermoplastic matrix.

Organo Sheet Injection (OSI) occurs after the organo sheet is preheated. During the process, the organo sheet is formed in the tool and back injected within a single step. This translates into noticeably shorter cycle times, tool savings, and therefore increased profitability.

Additional functional elements can be integrated with back injection, including mounting eyes, weld domes/ribs, or targeted reinforcements, and the edges of the part can be perfected. The costs of handling and storage are significantly reduced through combining the processes in one step. Process combinations and the ability to add functional elements make back injected organo sheets particularly attractive and efficient for innovative lightweight construction applications in many different industries.

ORGANO SHEET INJECTION PROCESS

1. Organo sheet insertion from magazine, alignment, and feeding
2. Heating via IR emitter
3. Transfer to hybrid tool
4. Organo sheet forming
5. Back injection
6. Release and removal
OPTIMIZE COST AND PERFORMANCE – FRIMO OSI MAKES IT FASTER AND EASIER.

On land, on water, and in the air

Over 5,000 tools for the aviation industry say it all. Composites have been used for quite a while in airplanes to reduce weight and, at the same time, improve capacity.

FRIMO supplies not only the tools, but also the complementary systems that make fully-automated production possible. One example of this is clips used for the fuselage of the Airbus A350 XWB. Carbon fiber organo sheets replaced the typical aluminum design. The multitude of different geometries, of course, resulted in a multitude of tools. Because the fully-automated tool changes are integrated into the customer’s data logs, thousands of different clips can be produced flawlessly and reproducibly in the shortest cycle time.

Multi-functional testing system

The FRIMO system installed at the Institute for Plastics Technology in Aachen, Germany consists of two separate stations - a heating station and a compression station - that are connected by a shuttle system. It can process sheets up to 500 x 750 mm and produce parts up to 300 mm deep. Along with the classic forming process, various compressed air (diaphragm) forming processes, as well as variothermal direct processes are possible.

Using in-line impregnation technology, custom preforms can be made by individually combining almost any thermoplastic material with reinforcement materials. The preforms are constructed by stacking the films, which are then impregnated in the heating station and transformed into complex, three-dimensional parts using heat. 3D preforms can also be directly impregnated and compressed in a variothermal tool without forming. The multi-functional system in Aachen is available for customer trials.

EXTREMELY LIGHTWEIGHT AND CUSTOMIZED – SPECIAL TOOLING TECHNOLOGY FOR D-LFT TAPE.

Continuous fiber-reinforced thermoplastics in the form of UD tapes offer the most mechanical properties in fiber direction. Direct long fiber thermoplastics (D-LFT), however, provide more design freedom because of their good flow behavior. When both are combined and metal inserts are added, a new degree of freedom is reached and the lightweight potential for hybrid structures can be better utilized. Combining different materials creates special requirements for tooling. FRIMO has developed a special tool concept for this.

In this concept, the pre-heated, compressed UD tapes (tailored blanks) along with the D-LFT strands are placed in the tool cavity and compressed with precision-controlled advancing pins. The advancing pins in the FRIMO Tape-D-LFT tool drape the “tailored blanks” and form the rib structure cavity to be locally overflowed with D-LFT. The additional tool closing movement presses the D-LFT into the ribs. The FRP/metal mixture makes weight savings of up to 25% possible compared to a steel construction, with a cycle time of less than a minute. This doesn’t just turn into weight savings, but also time and money savings.

Why FRIMO OSI? Your advantages:

- Fast process for structural components, short cycle times (approximately 60 seconds)
- Significant weight reduction (up to 30%)
- Better mechanical properties through fiber reinforcement
- Direct integration of functional elements (e.g. screws, inserts, weld areas) for assembly later on
A STRUCTURE THAT IS BOTH LIGHTWEIGHT AND STABLE – FRIMO PREFORMING AND RTM MAKE IT POSSIBLE.

RTM (Resin Transfer Molding) processes offer the best conditions for producing extremely efficient and resilient structural components with maximum potential for weight savings. Fiber fabric preforms are placed in the tool and the closed tool is injected with a reactive resin system under high pressure.

The various matrix materials, such as epoxy or polyurethane-based materials, each create specific process requirements. We provide feedback to help to optimize production of your part and supply not only tailor-made tooling and equipment, but also complete production solutions.

Our focus is on continuing to develop the RTM process and the production process for fiber composites in high volumes. The fastest injection process possible and short amount of time the part spends in the tool contribute to shorter cycle times. The composition of the preform also has a significant influence on the mechanical properties of the part.

MINIMUM WEIGHT, MAXIMUM PERFORMANCE STRONGLY COMBINED WITH FRIMO EQUIPMENT.

Over the past few years, we’ve produced

> 20 HD RTM TOOLS FOR STRUCTURAL COMPONENTS

> 20 PREFORMING TOOLS
The preforms play a key role in the RTM process. The better the preform, the better the structural part. Preforming therefore plays a large role in the configuration and cost-effectiveness of the process.

Preforms are produced in advance by putting the textile materials through a dry preforming process. Producing the preforms in advance eliminates the influence of viscous resin displacement, which considerably raises the reproducibility compared to wet compression. In addition, fiber direction can be optimized for the process and different textile materials can be combined. With targeted material feeding and sophisticated draping methods, even complex geometries are feasible.

We offer systems for compression preforming (contact heating, IR heating, compression molding), handling (transferring and robotics), and preforming tools. We can also implement alternative preforming processes and integrate them into a complete concept.

**TOP QUALITY?**
**PAIRS PERFECTLY WITH FRIMO PREFORMING AND RTM.**

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<td>Material unrolled, cut, and stacked</td>
<td>Material stack heated</td>
<td>Material stack inserted into preforming tool</td>
<td>Preforming</td>
<td>Transfer to RTM tool</td>
<td>Resin injection, curing, release, and removal</td>
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**FRIMO PREFORMING AND RTM PROCESS**
A POLE POSITION IN LIGHTWEIGHT CONSTRUCTION?
COME TO THE VERY FRONT WITH FRIMO RTM MACHINE AND TOOL TECHNOLOGY.

We are very proud of our expertise in monocoque production systems. These single-piece passenger cabins are usually manufactured out of CFK prepregs. FRIMO supplied all of the tools and the system for the very first series production of monocoques in the world that uses the RTM process.

During the process, multiple preforms are combined on the lower tool to create one complete preform. After the tool closes, epoxy resin is injected into the cavity, completely saturating the fiber preform. After the curing period, the monocoque can be removed from the tool.

Although monocoques are a very specific application, they serve as an outstanding example of the capabilities of RTM technology. A monocoque forms the support structure of a vehicle, which must absorb influential forces. All other vehicle elements are mounted to it. As the number of functional elements that need to be integrated increases, so does the complexity of the tool. To keep the cycle times as short as possible, additional automation can be added. We therefore precisely align the tooling and equipment with your project parameters.

Over the past few years, we’ve produced 5 MONOCOQUE TOOLS and 3 MONOCOQUE RTM MACHINES.

Why FRIMO RTM?
Your advantages:
- Large structural components, including carbon fiber
- Lightweight with distinguished mechanical properties
- Mechanical properties can be optimized through fiber direction
- Savings through possible integration of functional elements and parts
- Custom preforming solutions
- Series production-tested machine concepts
- Global project management
- Smart service
MINIMIZED CYCLE TIMES, MAXIMUM PERFORMANCE
FRIMO FULLY-AUTOMATED SANDWICH WET COMPRESSION MOLDING

FRIMO Wet Compression Molding (WCM) machines are fully-automated and capable of producing both monolithic or sandwich-style fiber-reinforced structural automotive components. The WCM process allows the use of fast cure resin systems and therefore offers significant cost and cycle time advantages over RTM processes.

During the first step of the wet compression molding process, a reactive polyurethane or epoxy resin is applied to dry, pre-cut glass, carbon, or aramid fiber material. The impregnated fiber stacks are then automatically inserted into the press. Using pressure and heat, the parts are molded and the matrix materials cure simultaneously.

Compared to RTM, the pressures used for forming are much lower, allowing for integration of lightweight sandwich cores (e.g. pre-milled paper honeycomb), complex 3D PU foam cores, or pre-assembled PET foam pieces. FRIMO offers not only tailored tool and pressing technology, but also custom solutions for automated manufacturing of sandwich cores.

FRIMO WET COMPRESSION MOLDING PROCESS

1. Material unrolled, cut
2. Sandwich preparation
3. Resin applied on stack
4. Transfer to WCM tool
5. Pressing and curing
6. Release and removal

FRIMO WCM technology
- Presses and tools
- Robot automation and gripper technology
- Metering and dosing equipment with optional glass fiber dosing
- Sandwich handling
- Part trimming and assembly
- Quality control, EOL testing

Sandwich core production
- Tooling & equipment for PU foam cores
- Welding and packing lines for 3D PET foam cuts
- Sandwich handling and trimming (milling) for paper honeycombs
LOOKING FOR A COMPLETE SOLUTION? WORKING TOGETHER MAKES IT EASIER.

The Composites Alliance between FRIMO and SCHULER is truly notable in the lightweight construction industry. Within the partnership, both companies use their core capabilities to create custom, complete solutions for lightweight construction projects.

SCHULER’s established compression technology is complemented by innovative tooling and customized automation solutions from FRIMO.

You profit from additional possibilities, fewer interfaces, and continuous, complete processes, including peripheral equipment. The leading know-how of the Composites Alliance comes from an extensive range of references in the automotive and aerospace industries, as well as other applications. We don’t just offer technology, but rather true added value, helping your production reach peak performance.
Lightweight construction is significantly progressing right now in terms of materials, structures, and processes. Research projects play an important role and contribute to identifying more sustainable alternatives to conventional production processes. Hybrid lightweight construction shows high potential for future applications through innovative material and process combinations.

We are therefore strongly involved in both private and cooperative research projects and, along with our own internal research and development efforts, we also look for opportunities to collaborate with universities and institutes. We offer support in the early developmental stage relating to producibility, possible weight savings, and efficient production. During the concept development phase, we take every detail into account to develop a customized production concept. This includes unique tooling and equipment technology and whatever degree of automation you need.

We can help turn your ideas and requirements for both simple and highly complex projects into the perfect composite production system.
We support in every step of the process:
- Engineering
- Project Management
- Prototyping
- Tooling
- Machinery
- Automation
- Service
- Part Production

We provide technology-neutral advice:
- PU Processing
- Flexible Trimming
- Punching
- Pressing/Forming
- Thermoforming
- Press Laminating
- Edge Folding
- Joining/Gluing

ONE STOP. ALL SERVICES.
An unparalleled range of technologies

LOCAL COMPETENCE WITH THE GLOBAL FRIMO NETWORK

Locations
- FRIMO Group, Lotte
- FRIMO Center of Competence:
  - PU & Trim, Lotte
  - Form & Punch, Sontra
  - Surface & Finish, Freilassing
  - Joining, Hamburg
  - Automation
- FRIMO China
- FRIMO Hungary
- FRIMO USA
- FRIMO Mexico
- FRIMO Poland
- B+R Elektro-Steuerungstechnik, Ibbenbüren

Representatives
Bosnia and Herzegovina • Brazil • Colombia • Croatia • Czech Republic • Ecuador • France • Great Britain • India • Indonesia • Ireland • Italy • Korea • Northern Cyprus • Northern Macedonia • Portugal • Serbia • Scandinavia • Slovakia • Slovenia • South Africa • Spain • Turkey