

## INNOVATIVE COMPOSITES MANUFACTURING SOLUTIONS

**AUTOMATED FIBER PLACEMENT (AFP)  
& TAPE LAYING (ATL)**

**PREPREG MAKING & SLITTING**

**FILAMENT WINDING**

**FACTORY AUTOMATION**

**PROTOTYPING CENTER**



## AUTOMATED FIBER PLACEMENT/TAPE LAYING (AFP/ATL)

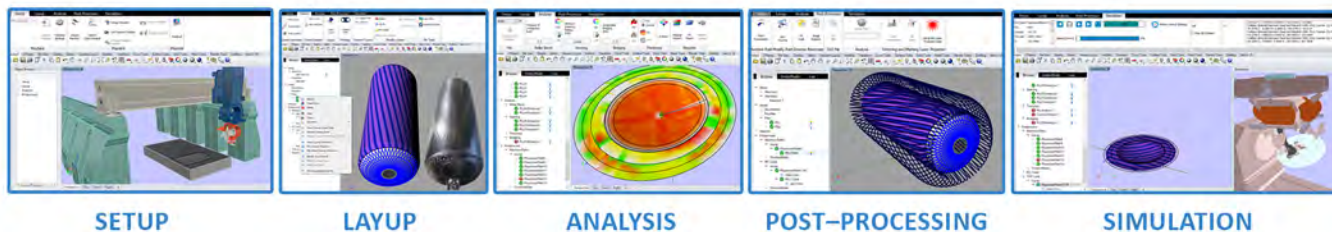


### PROCESS PICTURES



**MikroPlace**  
V4.0

MACHINE-INDEPENDENT OFFLINE SOFTWARE FOR AFP/ATL



HIGHER THROUGHPUT

REDUCED SCRAP MATERIAL, LABOR COST,  
MANUFACTURING TIME

BI-DIRECTIONAL LAYING ON FLAT AND CONTOURED  
SURFACES

VISUAL INSPECTION AND DEVIATION DETECTION

SYSTEMS FOR VARIOUS PART SIZES AND SHAPES  
OR "PART-SPECIFIC" FOR SERIAL PRODUCTION

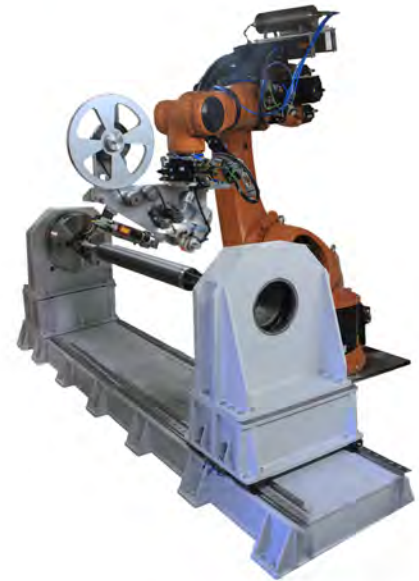
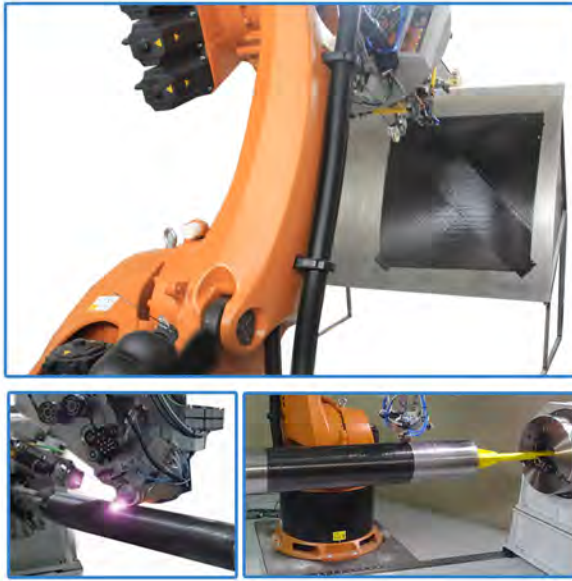
THERMOSET AND THERMOPLASTIC PREPREG LAYING

### GENERAL TECHNICAL CHARACTERISTICS:

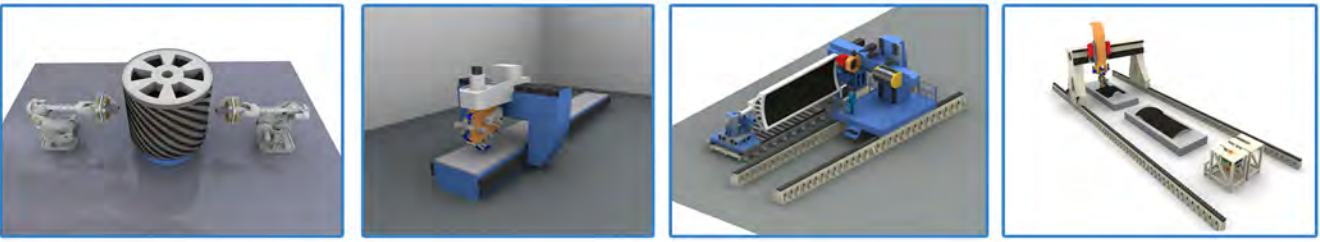
- ▶ Single or multiple heads for AFP/ATL on multiple tools
- ▶ Laboratory and industrial size equipment for different productive work areas
- ▶ Material (tow, UD tape, fabric):
  - Thermoset
  - Thermoplastic
  - Dry
- ▶ Rotary mandrel axis (optional)
- ▶ Heating method
  - Laser
  - Infrared

**AFP**

- Number of tows (1, 2, 4, 8, 16, 24)
- Tow width:
  - 3.175mm (1/8)"
  - 6.35mm (1/4)"
  - 12.7mm (1/2)"
  - 25.4 mm (1") or custom defined
- ON-THE-FLY cutting, clamping and restarting

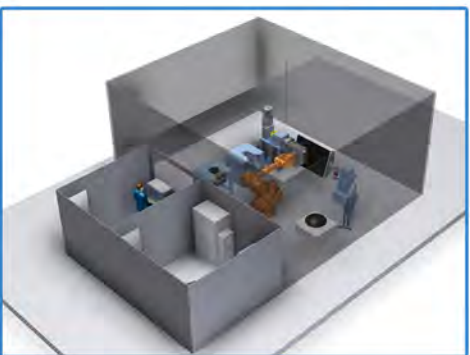


**VARIOUS MACHINE DESIGNS**

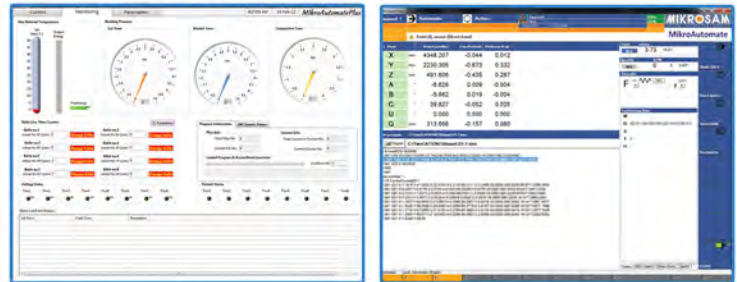


**ATL**

- Tape width:
  - 75mm/3"
  - 150mm/6"
  - 300mm/12" or custom defined
- Free envelope angle of up to +/- 40°
- Flat, 5-axis contoured and 6-axis complex contoured tape placement
- Interpolated dual – knife cutting for complex shape cuts
- Ultrasonic cutting system
- Patented ATL head



**MIKROAUTOMATE**  
Online Motion and Process Control



## PREPREG MAKING

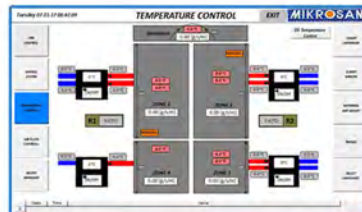
## SOLVENT RESIN SYSTEM



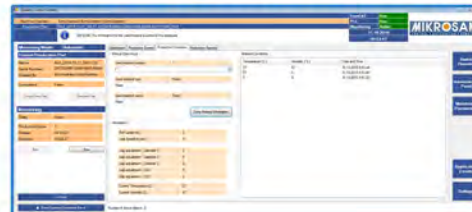
### PROCESS PICTURES



### MIKROPREG



### QUALITY CONTROL SYSTEM - QCS



ON-DEMAND PRODUCTION

LONG-TERM INVESTMENT, SHORT PAYBACK PERIOD

DEVELOP, DEFINE AND APPLY YOUR PROPRIETARY PREPREG MAKING/SLITTING TECHNOLOGY

R&D AND INDUSTRIAL SCALE EQUIPMENT

IN-HOUSE INSTALLED MACHINE FOR DEMONSTRATION AND TESTING

### GENERAL TECHNICAL CHARACTERISTICS:

- ▶ Type of reinforcement (fibers/cloth/paper):
  - Carbon
  - Glass
  - Aramid
  - Hybrid
- ▶ Type of resin:
  - Thermoset
- ▶ Width: up to 2,000mm
- ▶ Weight: up to 1,000g/m<sup>2</sup>
- ▶ Infrared and convectional heating
- ▶ Advanced resin metering and automated mixing
- ▶ System for surface weight measurement of (non-) impregnated material

### MIKROPREG

- ▶ Software with integrated HMI interface
- ▶ Data back-up for prepreg data tracing
- ▶ Quality control and "SCADA" PC application
- ▶ All parameters are recorded on a PC

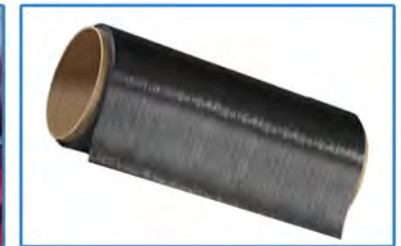
## HOT-MELT RESIN SYSTEM

### GENERAL TECHNICAL CHARACTERISTICS:

- Type of reinforcement (fibers/cloth/paper):
  - Carbon
  - Glass
  - Aramid
  - Hybrids
- Type of resin
  - Hotmelt
- Width of prepreg: up to 2,000 mm
- Process speed: up to 20 m/min
- Coating: double-roller, slot-die, etc.
- Spreading: servo-controlled, bar-type
- Quality tracking: infra-red based, X-Ray based
- Rewinding: tape, tow-prep, slit-tape with plastic film
- Process temperature: 40-250 °C
- Heating/Cooling method: customizable



### PREPREG TYPES: TOW-PREG, FABRIC PREPREG, UNIDIRECTIONAL (UD) PREPREG



## THERMOPLASTIC PREPREG MAKING



### PROCESS PICTURES



AUTOMATIC CONTROL OVER THE PROCESS  
ADVANCED REGULATION OF THE TEMPERATURE  
PRECISE POWDER SCATTERING SYSTEM  
WIDE RANGE OF THERMOPLASTIC RESINS

### GENERAL TECHNICAL CHARACTERISTICS:

- Type of reinforcement:
  - Fabric (glass, carbon, aramid, natural fibers)
- Type of resins:
  - PEEK, PPS, PES, PEKK, PSU, PA6, etc...
- Final prepreg areal weight: up to 800g/m
- Calender rolls
- Thermoplastic areal prepreg width: up to 1,200mm
- Heating temperatures: up to 400°C
- Process speed: 0-10m/min

## PREPREG SLITTING AND REWINDING

### GENERAL TECHNICAL CHARACTERISTICS:

- Multi frame winders
- Wide slit tape width: 20mm – 300mm (ATL)
- Narrow slit tape width (AFP):
  - 3.175mm (1/8")
  - 6.35mm (1/4")
  - 12.7mm (1/2") or custom defined
- Rewinding strategy:
  - Level/Step/Taper winding pattern
  - Pancake coil winding
- Easy spool core fix system for fast replacement and continuous operation
- Splicing function
- Easy adjustable cutting width positions



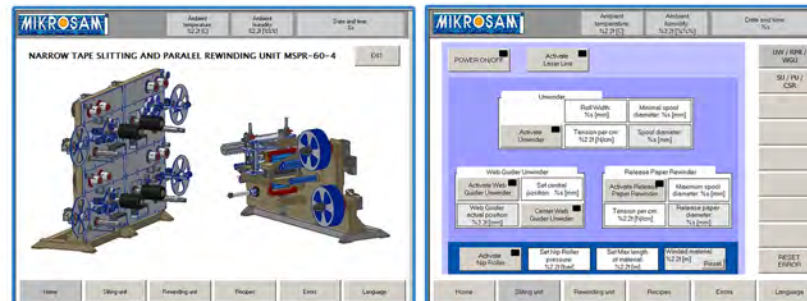
### NARROW AND WIDE SLIT TAPE



### MIKROSLIT

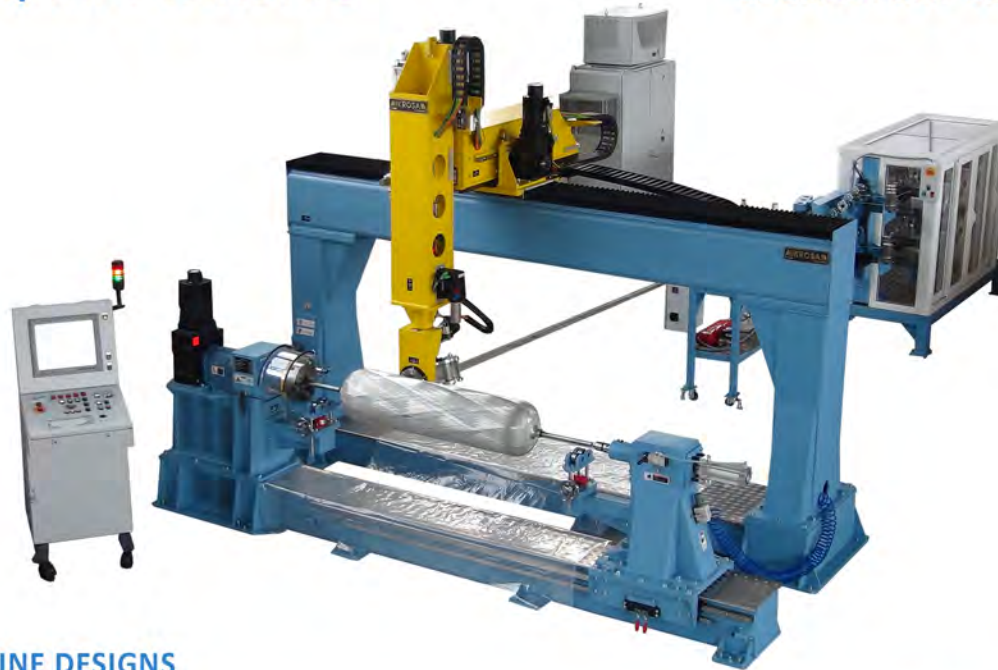
- Set-up of the winding parameters
- Control of the winding tension
- Warning and alarm functions (tape broken, length stop, diameter stop)
- Other functional material management programming

### MIKROSLIT - PROCESS CONTROL



## FILAMENT/TAPE WINDING

## LABORATORY SOLUTIONS



STATE OF THE ART FILAMENT WINDING EQUIPMENT

ADEQUATE FOR R&D LABORATORIES AND INSTITUTES

SUITABLE FOR PRODUCT DEVELOPMENT, TECHNOLOGY DEVELOPMENT, PROTOTYPING AND SMALL BATCH PRODUCTIONS

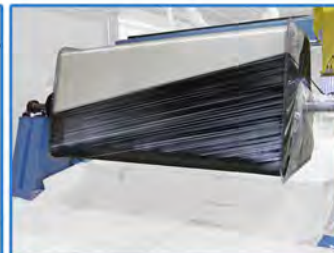
SOFTWARE PACKAGE FOR NON-AXIS SYMMETRICAL SHAPES WINDING

WET AND DRY WINDING

## OTHER MACHINE DESIGNS



## PROCESS PICTURES

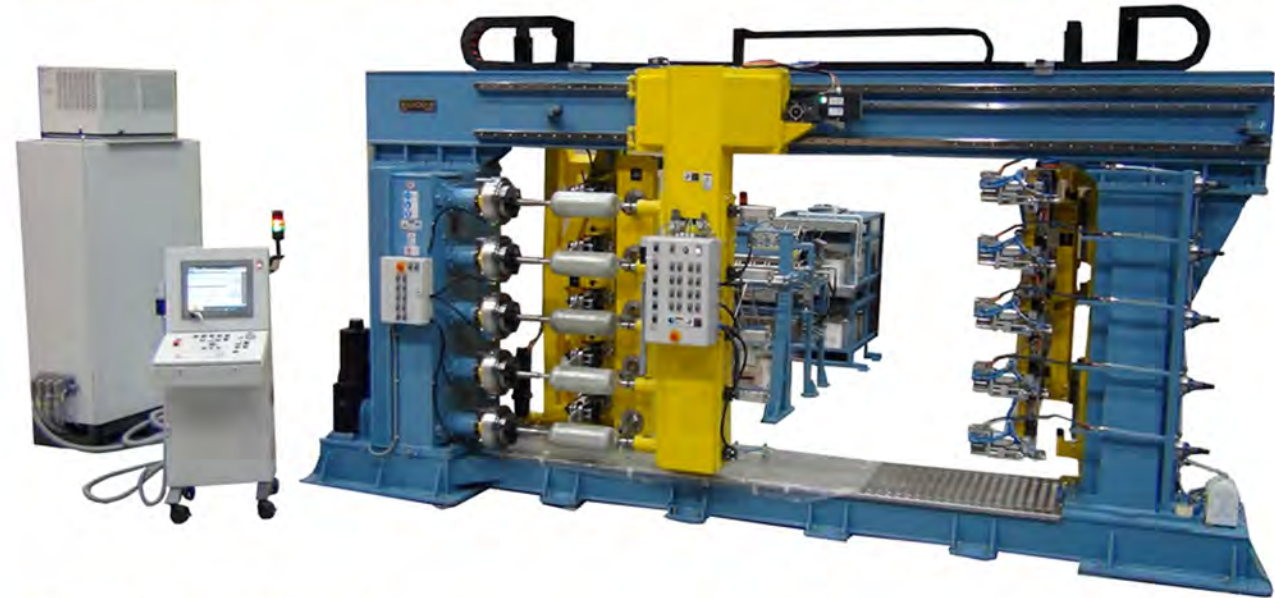


## GENERAL TECHNICAL CHARACTERISTICS:

- Diameter range: 50mm up to 2m
- Length range: 300mm up to 3m
- Max. mandrel weight: 500kg
- Tension range: 5 – 50N
- 0 - 90° winding angle capability
- Up to 6 axes interpolated winding
- Modern CNC computer control system
- Integrated PC-based Winding Commander and Winding Expert™
- Safety integrations in all modes of operation



## MULTI-SPINDLE MACHINES



ADVANCED SOLUTIONS FOR LPG, CNG, HYDROGEN TANKS AND OTHER COMPOSITE PRESSURE VESSELS

LARGE CAPACITY PRODUCTION OUTPUT

SIMULTANEOUSLY WINDING OF UP TO 5 SPINDLES AT THE SAME TIME

TAILOR MADE CONFIGURATION

PATENTED CUT & RESTART SYSTEM

WET AND DRY WINDING

## OTHER MACHINE DESIGNS



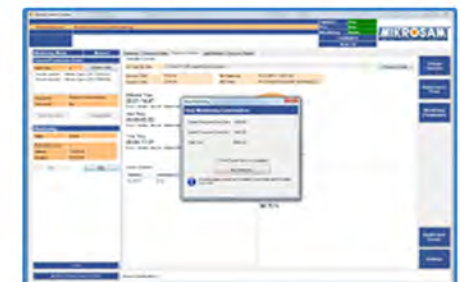
## GENERAL TECHNICAL CHARACTERISTICS:

- Heavy duty design
- Diameter range: 50mm up to 800mm
- Length range: 600mm up to 3m
- Max. mandrel weight: 500kg
- Tension range: 5-50N
- 0 - 90° winding angle capability
- 2 to 5 spindles configurations
- Up to 5 axes of control
- QCS - Quality Control System
- Circumferential (hoop) and helical winding

## PROCESS PICTURE



## QUALITY CONTROL SYSTEM - QCS



## FLOOR BED CONSTRUCTION



ROBUST STEEL CONSTRUCTION

CARRIAGE BED LENGTH ACCORDING TO CUSTOMER'S REQUIREMENTS

POSSIBILITY FOR CARRIAGE MOUNTED FIBER CREEL

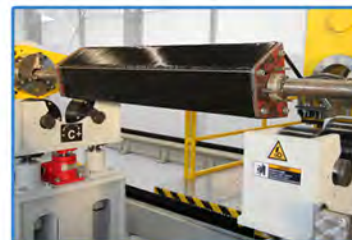
SINGLE SPINDLE CONFIGURATION WITH LARGE DIAMETER CAPABILITIES

WET AND DRY WINDING

## OTHER MACHINE DESIGNS



## PROCESS PICTURES



## GENERAL TECHNICAL CHARACTERISTICS:

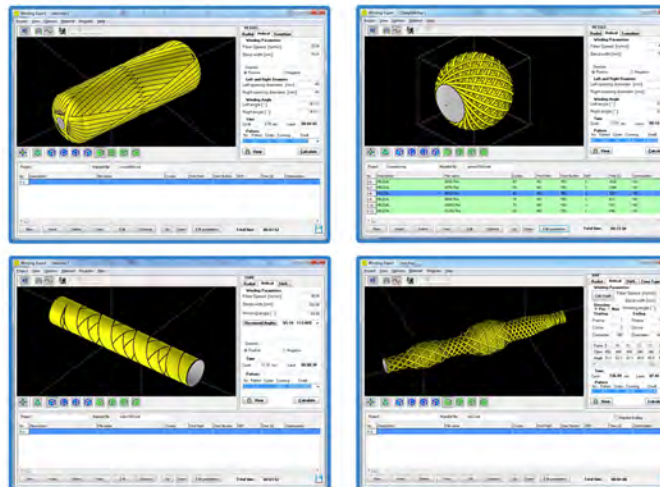
- Diameter range: 50mm up to 4m
- Length range: 1m up to 30m
- Max. mandrel weight: up to 80t
- Tape tension range: 500 – 4,000N
- 0 - 90° winding angle capability
- Up to 5 axis configurations
- Modern CNC system
- Safety integrations in all modes of operation



## AUXILIARY EQUIPMENT

- Fiber creels and tensoning systems
  - Electronic
  - Mechanical
  - Bookshelf
- Resin mixing and refiling systems
- Impregnation baths
  - Roller impregnation
  - Deep impregnation
- Curing ovens
  - Continuous
  - Stationary
- Mandrel extractors
- Mandrels
  - Collapsible
  - Solid

## WINDING EXPERT



## WINDING COMMANDER





AUTOMATED LINES FOR CNG, LPG, HYDROGEN AND OTHER CPVS



TCON



FULLY INTEGRATED IN PLANT PRODUCTION SYSTEM  
FOR CPVS, PIPES, STORAGE TANKS, DRIVE SHAFTS

PARTIAL AND COMPLETE AUTOMATIZATION  
DESIGNED FOR MAXIMUM EFFECTIVENESS

HIGH – VOLUME PRODUCTION

MINIMAL DOWNTIME

QUALITY CONTROL AND PRODUCT TRACKING

LOWER MATERIAL WASTAGE

ENERGY EFFICIENCY

ENVIRONMENTAL FRIENDLY

INCREASED PROFITABILITY

#### STANDARD OFFER

- Annual production: 30,000 – 1,000,000 units
- Automatic transport system, loading/unloading sections and buffer zones
- 5 – spindle filament winding machine
- Automatic cut & restart (patented)
- Automatic resin mixing system
- Fiber creels with electronic tension control and broken fiber detection
- Continuous curing oven with air-exchange control

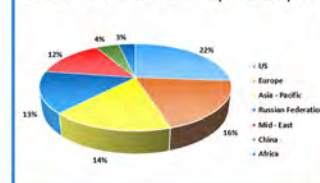
#### TCON

- Top level automation control system, supervision and quality control of each unit from one place

## FACTORY AUTOMATION



Global Natural Gas Share by Consumption

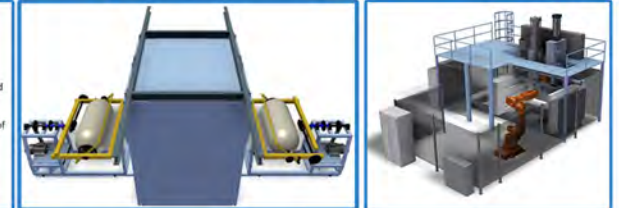


Turnkey Solution (Certification + Market Analysis)

**Certification to applicable standards:**

- ☐ ISO 11119-1(-2-3), EN 12245, ISO 11515, ISO 17519 – General for CPV.
- ☐ EN 14427 - LPG equipment and accessories. Transportable refillable fully wrapped composite cylinders for LPG. Design and construction.
- ☐ EC 79, GTR, HGV – Hydrogen (FCEV).
- ☐ ISO 11439:2013, Gas cylinders. High pressure cylinders for the on-board storage of natural gas as a fuel for automotive vehicles.
- ☐ ECE R110, NGV – CNG on-board storage.
- ☐ ...

Market analysis, penetration, distribution, promotion assistance



## ADDITIONAL SUPPORT

- Equipment
  - Roto/blow molding
  - Testing
  - Assembling stations
  - Surface treatment
  - Other auxiliary equipment
- Development of the cylinder
  - Design of the liner and connections
  - Design of the composite laminate
  - Certification
- Marketing
  - Market research
  - Applicable standards
  - Sales prospects

## FINAL PRODUCTS

- HYDROGEN, CNG, LPG, air and water storage pressure vessels
- Oil & gas transport pipes and storage tanks
- Electrical hollow insulators, lighting poles, transformer coils
- Automotive drive shafts, bearings, springs

## FINAL PRODUCTS



## PROTOTYPING CENTER



### SERVICES

- ▶ Prototyping
- ▶ Testing and supervising
- ▶ New product/technology development
- ▶ Comparative analysis of different technologies and machines
- ▶ Software engineering
- ▶ Technical consulting
- ▶ Machine and software operation training
- ▶ Market research
- ▶ Feasibility and evaluation reports
- ▶ Certification assistance
- ▶ Project management and start-up assistance
- ▶ Know-how and technology transfer



### LABORATORIES

- ▶ Composites manufacturing laboratory with in-house installed equipment
  - Automated fiber placement
  - Filament winding
  - Prepreg making
  - Prepreg slitting/rewinding
- ▶ Motion and process control laboratory
  - Programming, testing and merging motion and process control platforms
- ▶ Software development and simulation laboratory

## COMPANY PROFILE

Mikrosam AD, based in Prilep, Macedonia, is a globally - recognized leader in developing customized machines and know – how for the composites industry. With more than 27-years of existence, Mikrosam has recognized mastery in developing specialized software solutions, control systems and highly advanced equipment for processing and manufacturing parts of composite materials:

- Automated Fiber Placement (AFP)
- Automated Tape Laying (ATL)
- Prepreg Making
- Prepreg Slitting/Rewinding
- Filament Winding
- Factory Automation

With over 60% engineers of the workforce, including doctorate, master degree and university professors, Mikrosam provides the highest technical value and the most extensive machine design flexibility in the industry. Our experts have been working in composites production for over 40 years, and they very well know that every customer has unique industrial setting, production outcome, product design and level of automation.

Mikrosam's innovative solutions guarantee long-term competitiveness and success of the customers across the aerospace, automotive, energy, marine, civil engineering, oil and gas transport, defense, research segments and others.

In an R&D prototyping center with installed composite machines, MIKROSAM offers prototyping, testing, product design, technology development and expert consulting to help you conquer the world markets where delicate applications, full automation and control are the initial pattern of the custom made state-of-the-art equipment.

### WORKING WITH US OUR CUSTOMER ARE RELAYING ON:

- **Experience and Expertise** – Over 40 years working with composites;
- **Flexibility and Diversity** - Over 200 different production lines delivered;
- **Trust**– Satisfied customers' in over 40 countries around the world;
- **Support** – 24/7 on-line and off-line technical assistance before and after delivery;
- **Great industry coverage** - Over 10 end markets served.



WE PARTNER WITH OUR CUSTOMERS, DEVELOPING INNOVATIONS THAT BRING SUSTAINABLE SUCCESS!



**MIKROSAM A.D.**

Krusevski pat bb.  
7500 Prilep, Macedonia  
Tel.: +389 (0)48 400 100  
Fax: +389 (0)48 411 886  
[sales@mikrosam.com](mailto:sales@mikrosam.com)

総代理店

アルテック株式会社

Tel: 03-5542-6753

Fax: 03-5542-6767

[www.altech.co.jp](http://www.altech.co.jp)

