THE RFID FACTORY

PRODUCT OVERVIEW
MUHLBAUER GROUP

State-of-the-art Technologies and Solutions for Smart ID

Production Solutions Worldwide
The Mühlbauer Group is the only one-stop-shop technology partner for the production and personalization of cards, passports and RFID applications worldwide. With around 3,200 employees, technology centers in Germany, Malaysia, China, Slovakia, the U.S. and Serbia, and a global sales and service network, we are the world’s market leader in innovative equipment- and software solutions, supporting our customers in project planning, technology transfer and production ramp-up.

Exclusive Manufacturer Service
35 production and service facilities on five continents, worldwide spare parts repositories and individual service and financing concepts enable us to provide an unique service quality with a reaction time down to 2 hours.

See & Believe
In the technology centers all over the world, such as in Germany, Malaysia, China and the U.S., we exhibit our complete range of ePassport, Smart Card and RFID production and personalization systems. Almost any system is available and ready for demonstration. Additionally the company’s know-how can be experienced in the TECURITY EXPRESS show truck, an unrivalled mobile high security production center. Convince yourself of the superior Mühlbauer technologies.

Technology and Market Leadership
To ensure and expand the technology and market leadership, Mühlbauer continuously invests in innovative products and processes. Our research and development centers with over 400 highly qualified engineers and technicians collaborate closely with customers and research institutions in order to efficiently launch reliable solutions in increasingly shorter development and production cycles.

Open Communication
While aiming to extend our technology leadership, we ensure strict privacy in all projects and serve as a reliable partner for sophisticated industries, convincing by high speed, best quality and clear customer orientation.

TECURITY*: Tailor-made Security Solutions
Mühlbauer specializes in innovative one-stop solutions encompassing the production, personalization and issuance of ePassports, ID Cards and other card related security documents, and fully automatic border control systems. The business unit TECURITY® bundles the extensive know-how of the development of tailor-made security solutions. In the last 30 years we have installed more than 88,000 systems and modules across the globe, and have been intensively involved in over 300 government related ID projects.

AUTOMATION: Innovative Systems & Software
More than 100 different highly sophisticated production systems in combination with intelligent software solutions for production management and personalization are the core of the business unit AUTOMATION. In addition to the turnkey solutions for high-quality ID document-, Smart Card- and RFID smart label production, we develop and manufacture innovative Die Sorting systems for the semiconductor industry. Moreover we produce laser and board handling systems for the traceability of electronic components, highly sophisticated vision inspection systems for various applications as well as innovative production technologies for flexible solar cells.

Precision Components from PARTS & SYSTEMS
Mühlbauer's PARTS & SYSTEMS segment produces high precision components both for the manufacturing of Mühlbauer machines and as a supplier for exacting industries such as aerospace, motorsports, semiconductor and medical engineering.
One-Stop Shop Technology Partner

Comprehensive Competence in End-to-End Systems

The Mühlbauer Group provides a complete one-stop shop for end-to-end production of solutions and systems for the smart card, ePassport, semiconductor industry and inspection technology. We incorporate significant competence in providing optimized and state-of-the-art technology as well as customized equipment. Our products merge the main three factors for our customers' success story:

- In-house development and research
- In-house production and assembly
- In-house training and technology transfer
At Mühlbauer, the promise of know-how transfer is not just an empty phrase. Dozens of experts have already been successfully educated at the Mühlbauer RFID Academy. Every customer who chooses a Mühlbauer RFID Factory receives comprehensive training and know-how transfer in several areas:

- Specifics of HF/NFC and UHF technology
- Design rules, performance simulation and verification of customized antenna designs
- Criteria, references and recommendations for optimal material selection
- Selection of a qualified vendor base for your individual application
- Education on process flows and process parameters
- Qualification for perfect equipment operation, maintenance & production ramp up
- Individual needs as specified by the customer

We need to be independent - to make you independent!

From the very beginning, Mühlbauer machines have been setting global technology standards in terms of speed, quality and flexibility. It is our mission to always provide our customers the best price-performance ratio coupled with the certainty of always being at the cutting edge of technology.

We know the materials, requirements and applications in this area – with an unique worldwide competence and equipment portfolio that has grown through 25 years of high-volume, high quality RFID production. It is our daily business to plan, install and ramp up complete RFID factories together with our customers – a real partnership that is growing from day one.

Let’s raise the limits to a new level and realize your RFIDeas together.

1985 Development of our core competence Chip Handling: Specialization on small chips, high speed and high accuracy for Flip Chip technology.

1988 First turnkey production solutions for Smart Cards

1995 Development of world first RFID Inlay Production System (TAL 1500). Since then, Mühlbauer has been a major driving force for the RFID production technology.

2004 Mühlbauer draws up the strategy to become a turnkey solution provider for the complete RFID FACTORY. Our target is to provide our customers the most efficient and competitive RFID production and personalization solutions.

2014 The RFID FACTORY is completed: The lastest innovations “Antenna Production Systems APS & ACS”, the revolutionary “Direct Die Attach System DDA 20000” and the latest “Personalization Technologies” are presented to the market. The Mühlbauer Group releases its new roadmap “CONCEPT 2020” during the 1st “RFID Innovation Days” event.

2018 The DDA 40000 is launched. A roadmap to 100 000 UPH is available for wide web application.

2020 Realization of “Concept 2020”

Experience drives innovation.
The **RFID FACTORY**

Your Partner for the Complete **RFID FACTORY**

Nobody knows which business opportunities will come along in the future and which RFID technology they will require. But at Mühlbauer we know how to support our customers in realizing any opportunities with the right technology.

Whether it is for low or high-volume, for narrow or wide web, for direct chip attach or strap technology, for inlay manufacturing or converting including personalization... or whether you are looking for all of it.

Mühlbauer will provide you with a uniform equipment platform, with which you can cover all technologies for all your business opportunities - whether you need labels, tickets, tags, cards or ID documents...

The most efficient production solution, ideally, would be only one piece of equipment - realizing all production steps consecutively. Although this is not quite possible yet, it is essential that all individual pieces of equipment and processes match perfectly. All interfaces must be defined to achieve the best product quality, output yield, production flexibility and highest efficiency - and this is what Mühlbauer guarantees for any tailored customer solution. All of our equipment and the respective processes for antenna production, inlay assembly, converting and personalization fit together like a puzzle to form the most efficient RFID production solution. The uniform equipment design furthermore enables easy operation and maintenance and allows the minimization of spare parts stock.

**CONCEPT 2020**

The Future of **RFID Manufacturing**
**ACS 100/350**

**Antenna Cutting System**

**Efficient Green Way of Antenna Production**

**ADVANTAGES**
- Supply Chain Compression
  Ship your new RFID label in 24 hours!
- Just-in-Time Production
  for high volumes up to 500 Mio./year
- Rapid Prototyping
  less than 3 hours from idea to sample
- Small Footprint

**BENEFITS**
- up to 50% Process Cost Reduction
  “compared to alu etching”
- 75% Time Saving
  “antenna on demand - in 1 hour”
- 100% Environmental Friendly
  “sell also your alu flakes”
- Less Inventory / Dead Capital / Working Process

**FEATURES**

**Workstations**
- Unwinder
- Antenna Cutting Unit
- Quality Verification
- Upwinder

**Product Requirements**
- Tape width
  up to 100 mm (APS 100)
  up to 350 mm (APS 350)
- Material
  PET/Alu

**Throughput**
- Up to 30 m/min
- ACS 100: up to 80 000 UPH (20 mm pitch, single row)
- ACS 350: up to 250 000 UPH (20 mm pitch, 4 row)

**M / MIN**

<table>
<thead>
<tr>
<th></th>
<th>ACS 100 DIMENSIONS</th>
<th>ACS 350 DIMENSIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length (mm)</td>
<td>4500</td>
<td>6000</td>
</tr>
<tr>
<td>Depth (mm)</td>
<td>1600</td>
<td>3000</td>
</tr>
<tr>
<td>Height (mm)</td>
<td>1900</td>
<td>2860</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>2470</td>
<td>2900</td>
</tr>
</tbody>
</table>

**Mühlbauer’s Antenna Cutting Systems ACS 100 & ACS 350 produces reliable UHF aluminum antennas on PET. The reel-to-reel system uses a two layer input material with a bottom material of PET and a top layer of aluminum. In the core process of cutting, the milling wheel mechanically removes all the unnecessary aluminum parts from the aluminum layer and leaves the desired antenna pattern, while the PET layer remains untouched. For a flexible production of different antenna patterns, the magnetic cylinder can be easily equipped with a different cliché. The integrated cleaning station fixed with fixed brushes and a suction system frees the web and cliché of unwanted particles. Now, the antenna is produced and the quality verification process starts. The contactless UHF test system verifies the antennas by means of an electrical test and a loop simulation. The subsequent Vision process includes a full vision inspection of the complete antenna and a specific inspection of the antenna gap. Finally, an inkjet printer marks bad antennas with a black dot during the machine operation.**

**Mühlbauer’s Antenna Cutting Systems**

**The RFID FACTORY**

**RFID COMPETENCE**

**ANTENNA PRODUCTION**

**INLAY ASSEMBLY**

**CONVERTING**

**PERSONALIZATION**

**SOFTWARE SOLUTION**
The completely new approach of the APS makes it possible for Smart Label suppliers to print their own antennas in-house on demand. The new process is cleaner and faster than all the conventional antenna technologies currently on the market. With APS 100 up to 20,000, with APS 350 even 80,000 silver or copper ink antennas per hour on paper can be produced, undergoing an integrated quality assurance system. Especially for Smart Label producers that underline fast reaction times, the APS is an interesting tool as they can produce antennas within hours instead of weeks.
INLAY ASSEMBLY

Technology Overview - Inlay

<table>
<thead>
<tr>
<th></th>
<th>TAL 15000</th>
<th>DDA 20000</th>
<th>DDA 40000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Web Width</td>
<td>30 - 150 mm</td>
<td>Narrow Web</td>
<td>Narrow Web</td>
</tr>
<tr>
<td></td>
<td>100 - 350 mm</td>
<td>Wide Web</td>
<td></td>
</tr>
<tr>
<td>Technology</td>
<td>Pick &amp; Place (Dual Head)</td>
<td>Direct Die Attach (Single Head)</td>
<td>Direct Die Attach (Single Head)</td>
</tr>
<tr>
<td>Max. UPH</td>
<td>13 000</td>
<td>20 000</td>
<td>40 000</td>
</tr>
<tr>
<td>Yield</td>
<td>&gt;99.7%</td>
<td>&gt;99.7%</td>
<td>&gt;99.7%</td>
</tr>
<tr>
<td>Wafer</td>
<td>Size 6&quot;, 8&quot; or 12&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Frame Metal &amp; Plastic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dies</td>
<td>min. 0.3 x 0.3 mm</td>
<td>0.3 x 0.3 mm</td>
<td>0.3 x 0.3 mm</td>
</tr>
<tr>
<td></td>
<td>max. 3.0 x 3.0 mm</td>
<td>1.5 x 1.5 mm</td>
<td>1.5 x 1.5 mm</td>
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<tr>
<td></td>
<td>optional up to 5.0 x 5.0 mm</td>
<td>up to 5.0 x 5.0 mm</td>
<td>up to 5.0 x 5.0 mm</td>
</tr>
<tr>
<td>Thickness</td>
<td>75 µm to 300 µm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adhesive</td>
<td>ACP</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>NCP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antenna</td>
<td>Copper, aluminum, silver antenna</td>
<td>Copper, aluminum, silver antenna</td>
<td>Copper, aluminum, silver antenna</td>
</tr>
<tr>
<td>Output</td>
<td>Single Row</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Multi Row</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sheets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frequency</td>
<td>UHF</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>HF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accuracy</td>
<td>Machine ± 15 µm</td>
<td>± 15 µm</td>
<td>± 15 µm</td>
</tr>
<tr>
<td></td>
<td>Die Attach ± 30 µm</td>
<td>± 30 µm</td>
<td>± 30 µm</td>
</tr>
<tr>
<td></td>
<td>Post Cure ± 50 µm</td>
<td>± 50 µm</td>
<td>± 50 µm</td>
</tr>
</tbody>
</table>

Thanks to continuous development efforts, our chip attach machines have beaten the 40 000 UPH limit, both for strap as well as for inlay production. The DDA 40000 for single row as well as the TAL 15000 for wide web are today's benchmark in the area of inlay assembly. Our state-of-the-art machines demonstrate leading edge performance for the entire product range, down to 0.3 x 0.3 mm dies and up to the highest yield of >99.7%. Roadmaps up to 100 000 UPH are available.

DIRECT CHIP ATTACH TECHNOLOGY

Process Flow

Adhesive Apply
- Latest generation of adhesive jetting technology available
- Glue savings approx. 25% compared to dispensing system
- Highest flexibility for all antenna formats

Pre-Bonding
- Machine accuracy ± 15 µm, die attach accuracy ± 30 µm
- Die handling from 0.3 x 0.3 mm up to 5.0 x 5.0 mm
- Full throughput with 100% vision control for highest yield

Final Bonding
- Smallest & most efficient thermode generation 0.5 N to 5 N ± 10%
- Best thermode coplanarity ± 5 µm/mm
- Highest process accuracy ± 30 µm (after final bonding)

Testing & Unit Marking
- 100% tested output quality
- In-house customized reader antenna design

Upwinding or Slitting
- Single or multirow reels for label / ticket conversion
- Sheets for contactless plastic card production

Suitable for every application
TAL 15000

Flip Chip Assembly Line for Wide Web (with optional Multi Component Placer for Active Sensor Tags)

The world's benchmark in RFID inlay production systems

ADVANTAGES
- Proven Technology
- Fast Changeover
- All Web Layouts
- High Accuracy

BENEFITS
- Cost Reduction
- Yield 99.7%
- High Efficiency
- Fast Return of Investment

FEATURES

Workstations
- Unwinder
- Adhesive Jetting
- Pre-bond (Flip Chip) module
- Final bond (curing) module with tester and marker
- Upwinder

Configuration flexibility
- Slitting unit
- Sheet-cutting unit
- Interleave paper handling
- Handling of small dies down to 0.3 x 0.3 mm
- Web width up to 350 mm
- Glob top module

Option
- Component Placer for Multi Component Tags like Active Tags, Sensor Tags etc.

TAL 15000 DIMENSIONS

<table>
<thead>
<tr>
<th>Length (mm)</th>
<th>Depth (mm)</th>
<th>Height (mm)</th>
<th>Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8660</td>
<td>1650</td>
<td>2070</td>
<td>7285</td>
</tr>
</tbody>
</table>

The TAL 15000 inlay production system is the current benchmark and represents the most proven generation of Flip Chip RFID inlay production with a throughput of up to 13,000 inlays per hour. This wide web system is characterized by its extremely high level of efficiency, flexibility and quality - and is suitable for the complete range of HF and UHF inlays. All processes are covered in one modular platform: antenna web handling, epoxy jetting, Flip Chip die attach, final curing, testing and bad unit marking as well as sitting into single antenna rows. Furthermore, a sheet cutter is available as an option to address the requirements of the contactless card market.
Simplicity is the ultimate sophistication!

ADVANTAGES
- Performance 20k / 40k
- 100% Vision Control
- Consistently High Uptime
- Small Footprint
- Independent from chip supplier

BENEFITS
- Cost Reduction up to 50% / 80%
- Very High Productivity
- Yield 99.7%

UPH

10 000 20 000 30 000 40 000 50 000 90 000 100 000

ROADMAP

10 years ago, the Direct Die Attach concept was born in Mühlbauer’s development department and constantly optimized. The patented technology beats the 40 000 UPH with only one place system and a 30% smaller footprint. The significantly higher throughput and the reduced complexity result in 80% less die attach costs, an outstanding quality and highest reliability. This system redefines the high-volume production and provides high potential for further cost and performance optimization.

DDA 20000 & DDA 40000

Enter into a New Dimension for Chip Attach

FEATURES

Workstations
- Unwinder
- Adhesive Jetting
- Pre-bond (Direct Die Attach) module
- Final bond (curing) module with tester and marker
- Upwinder

Roadmap / Future Outlook
- DDA Wide Web / Multi row system with up to 100 000 UPH
- Handling chip sizes down to 0.2 x 0.2 mm, independent of chip supplier
- Antenna on paper or preprinted material

DDA 20000 DIMENSIONS

<table>
<thead>
<tr>
<th>Length (mm)</th>
<th>Depth (mm)</th>
<th>Height (mm)</th>
<th>Weight (kg)</th>
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</thead>
<tbody>
<tr>
<td>5850</td>
<td>1600</td>
<td>2000</td>
<td>3600</td>
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</tbody>
</table>

DDA 40000 DIMENSIONS

<table>
<thead>
<tr>
<th>Length (mm)</th>
<th>Depth (mm)</th>
<th>Height (mm)</th>
<th>Weight (kg)</th>
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</thead>
<tbody>
<tr>
<td>6850</td>
<td>1600</td>
<td>2000</td>
<td>3660</td>
</tr>
</tbody>
</table>
## STRAP TECHNOLOGY

### Technology Overview - Strap

#### DDA 20000 / 40000 - Strap

Strap Production System with Direct Die Attach

<table>
<thead>
<tr>
<th>Workstations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unwinder</td>
</tr>
<tr>
<td>Adhesive Jetting</td>
</tr>
<tr>
<td>Pre bond (Direct Die Attach) module</td>
</tr>
<tr>
<td>Final bond (curing) module with tester and marker</td>
</tr>
<tr>
<td>Upwinder</td>
</tr>
</tbody>
</table>

### High-speed strap production

- Worldwide highest throughput for strap production system
- Patented Direct Die Attach Technology
- Fully automated and most simplest process flow
- Complexity level reduced to the minimum
- Best cost/performance
- >99.7% yield

### Input Materials

<table>
<thead>
<tr>
<th>Tape</th>
<th>Strap tape 12 mm</th>
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</thead>
<tbody>
<tr>
<td>Pitch</td>
<td>4 mm</td>
</tr>
<tr>
<td>Material</td>
<td>suitable PET or Paper</td>
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<tr>
<td>Wafer size</td>
<td>6&quot;, 8&quot;, or 12&quot;</td>
</tr>
<tr>
<td>Die size</td>
<td>0.3 x 0.3 mm, 1.0 x 1.0 mm</td>
</tr>
<tr>
<td>Die Thickness</td>
<td>75 up to 150 µm</td>
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</table>

### Adhesives

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<tr>
<td>ACP</td>
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<tr>
<td>NCP</td>
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</tbody>
</table>

### UPH

- Max. UPH: 23 000 / 43 000
- Yield: >99.7%
- Frequency: UHF

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![DDA 20000 / 40000 - Strap](image_url)
RFID Converting

Technology Overview

<table>
<thead>
<tr>
<th></th>
<th>CL light</th>
<th>CL 30000</th>
<th>CL 60000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. Speed</td>
<td>10 m/min (semi-rotative)</td>
<td>10 m/min (semi-rotative)</td>
<td>30 m/min (rotative)</td>
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<tr>
<td>Max. Reel Diameter</td>
<td>400 mm, Inlay 300 mm</td>
<td>400 mm, Inlay 300 mm</td>
<td>600 mm</td>
</tr>
<tr>
<td>Web Width</td>
<td>250 mm</td>
<td>250 mm</td>
<td>250 mm</td>
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<tr>
<td>Glue Processing</td>
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<tr>
<td>Transfer Glue</td>
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<td>Hotmelt</td>
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<tr>
<td>Input Materials</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liner</td>
<td>[ ]</td>
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</tr>
<tr>
<td>Face</td>
<td>[ ]</td>
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<tr>
<td>Compensation Layer (4-Layer)</td>
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<tr>
<td>Dry Inlay</td>
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</tr>
<tr>
<td>Wet Inlay</td>
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<tr>
<td>Bad Inlay Reject</td>
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<tr>
<td>Dry Inlay</td>
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</tr>
<tr>
<td>Wet Inlay</td>
<td>[ ]</td>
<td>[ ]</td>
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</tr>
<tr>
<td>Inlay Placement Accuracy</td>
<td>± 0.5 mm</td>
<td>± 0.5 mm</td>
<td>± 0.5 mm</td>
</tr>
<tr>
<td>Die Cutting Accuracy</td>
<td>± 0.5 mm</td>
<td>± 0.5 mm</td>
<td>± 0.5 mm</td>
</tr>
<tr>
<td>Technique</td>
<td>Semi-rotative, rotative</td>
<td>Semi-rotative, rotative</td>
<td>Rotative</td>
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<td>Liner-Face Control</td>
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<tr>
<td>Tension Control</td>
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<tr>
<td>2nd Die Cutter</td>
<td></td>
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<tr>
<td>Testing</td>
<td>[ ]</td>
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<tr>
<td>Testing HF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Testing UHF</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Performance Test</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vision Monitoring System</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>100% Tested Output Quality</td>
<td></td>
<td></td>
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<tr>
<td>Bad Unit Marking</td>
<td>[ ]</td>
<td>[ ]</td>
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</tr>
<tr>
<td>Bad Single Ticket Reject</td>
<td>[ ]</td>
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<td>[ ]</td>
</tr>
<tr>
<td>UID &amp; TID Logging</td>
<td>[ ]</td>
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<td>[ ]</td>
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<tr>
<td>Output</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>Single</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>On Reel</td>
<td>[ ]</td>
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</tr>
</tbody>
</table>

Lamination
- Transfer adhesive or hotmelt
- Cold lamination
- Register controlled

Die Cutting
- Rotative or semi-rotative die cutting process
- Fast and accurate
- Pitch controlled

Testing & Marking
- 100% tested output quality
- In-house customized reader antenna design
- Marking or rejection of bad units

Inline Read Range Verification/Performance
- Inline performance test of UHF-inlays, -labels, -tickets etc. with Voyantag Tagurance system
- Frequency test range (e.g. 860...960 MHz) instead of one fixed frequency in standard test procedures
- Characteristical performance curve over the test range for judgement of quality & tolerances
**CL light**

Entry Level RFID Converting Line

**ADVANTAGES**
- Low Investment Cost
- Easy to Operate
- High Precision Inlay Placement
- Small Footprint
- Quick Product Change Over

**BENEFITS**
- Semi-Rotative / Rotative Die Cut
- Fast Return of Investment
- Reduced Production Time
- Reduced Production Costs

**CL Light DIMENSIONS**

<table>
<thead>
<tr>
<th>Length (mm)</th>
<th>Depth (mm)</th>
<th>Height (mm)</th>
<th>Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3650</td>
<td>1200</td>
<td>1700</td>
<td>1250</td>
</tr>
</tbody>
</table>

**FEATURES**

**Workstations**
- Reel-to-reel process (output label rewinder)
- Transfer glue process
- Wet inlay application
- Semi-rotative die cutting unit

**Configuration flexibility**
- Output test and marking HF and UHF

**Your applications**
- Wet inlay
- Self-adhesive label
- Ticket on reel

The CL light is characterized by a successful combination of cost efficient design together with a high flexibility in output configurations. It is possible to convert dry inlays as well as wet inlays in reel-to-reel mode. All processes are in one modular system: antenna web handling, label lamination, die cutting as well as output testing. The system has a throughput of up to 10 m/min for semi-rotative cutting respectively 30 m/min for rotative cutting. With an optimized change-over time between different products paired with lowest tooling costs, this converting system is perfectly suited for a production with smaller lot sizes and at the same time fast changing applications. The friendly user interface, the intuitive handling of this converting machine and the low initial investment makes the CL light especially interesting for start-ups entering the RFID converting market.
CL 30000

New

Entry-Level RFID Converting Line

Best price/performance ratio for small & mid-range volumes

ADVANTAGES
- Low Investment Cost
- Easy to Operate
- High Precision Inlay Placement
- Small Footprint
- Quick Product Change Over

BENEFITS
- Semi-Rotative / Rotative Die Cut
- Fast Return of Investment
- Reduced Production Time
- Reduced Production Cost
- Dry Inlay and Hot Melt Possible

FEATURES

- Workstations
  - Reel-to-reel process
  - Inline hotmelt or transfer adhesive process
  - Dry inlay die cutting
  - Semi-rotative die cutting unit

- Configuration flexibility
  - Dry inlay off-pitch placement
  - Dual hotmelt station
  - One step production from inlay to Smart Label

- Your applications
  - Wet inlay
  - Self-adhesive label
  - Ticket on reel

CL 30000 DIMENSIONS

<table>
<thead>
<tr>
<th>Length (mm)</th>
<th>Depth (mm)</th>
<th>Height (mm)</th>
<th>Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4910</td>
<td>1200</td>
<td>2000</td>
<td>2100</td>
</tr>
</tbody>
</table>

The CL 30000 is characterized by a successful combination of cost efficient design together with a high flexibility in output configurations. It is possible to convert dry inlays in reel-to-reel mode. All processes are in one modular system: antenna web handling, label lamination, die cutting as well as output testing. The system has a throughput of up to 10 m/min for semi-rotative cutting respectively 30 m/min for rotative cutting. With an optimized change-over time between different products paired with lowest tooling costs, this converting system is perfectly suited for a production with smaller lot sizes and at the same time fast changing applications. The friendly user interface, the intuitive handling of this converting machine and the low initial investment makes the CL 30000 especially interesting for start-ups entering the RFID converting market.
CL 60000

RFID Converting Line for High-Volume Production

Fast and modular converting solution

ADVANTAGES

- Highest Application Flexibility
- High-Volume System
- Upgrade Possibilities
- Easy Product Charge Over

BENEFITS

- Price/Performance Leader
- Yield 99.7%
- Highest Level of Customization
- Lowest Cost of Ownership

FEATURES

Workstations

- Unwinder for dry and/or wet inlay
- Unwinder for top and bottom material
- Flexible inlay separation, bad unit rejection and transfer
- Top and bottom material registration and lamination
- Rotary die cutting
- Test module for functional test incl. bad unit marking
- Upwinder

Configuration Flexibility

- Transfer Adhesive or Hotmelt
- Second Die Cutter
- Ticket Output
- 4-Layer Handling
- Performance Testing Inline
- Vision System

Your applications

- Wet inlay
- Self-adhesive label
- Ticket on reel
- Single Ticket / Hang tag

CL 60000 DIMENSIONS

<table>
<thead>
<tr>
<th>Length (mm)</th>
<th>Depth (mm)</th>
<th>Height (mm)</th>
<th>Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8000</td>
<td>3600</td>
<td>2500</td>
<td>5600</td>
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</tbody>
</table>

Mühlbauer’s CL 60000 Converting Line represents a flexible, fast and modular concept covering a high range of converting possibilities. Smart Labels and Smart Tickets from reel-to-reel or from reel-to-foil or to fanfold. Various input materials like dry inlay, wet inlay and even compensation layer (4-layer) can be converted. All processes are in one platform: reel-to-reel antenna web handling, label/ticket lamination, die cutting as well as output testing - of course, with leading edge performance, state of the art quality and the best cost/ performance ratio available on the market. Mühlbauer's converting machine CL 60000 is perfectly suited for high-volume RFID label and Ticket production, where the issues of fast change over times and high quality are taken into account.
RFID Personalization

Technology Overview

<table>
<thead>
<tr>
<th>Feature</th>
<th>PL 8000</th>
<th>PL 30000</th>
<th>PL 60000</th>
</tr>
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<tbody>
<tr>
<td>Scope of Operation</td>
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<tr>
<td>Barcode Reading</td>
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<td>☑</td>
</tr>
<tr>
<td>Chip Encoding</td>
<td>☑</td>
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</tr>
<tr>
<td>Variable Data Printing</td>
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<tr>
<td>UV Curing</td>
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<tr>
<td>Camera Inspection</td>
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<tr>
<td>Barcode Verification</td>
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<tr>
<td>Bad Tag Removal</td>
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<tr>
<td>Auto Removal of Rejects</td>
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<tr>
<td>Frequencies</td>
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<tr>
<td>Chip Encoding Method</td>
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<tr>
<td>From Barcode</td>
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<tr>
<td>From Combination of Dataset and Barcode</td>
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<tr>
<td>Chip Based Serialization</td>
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</tr>
<tr>
<td>MÜHLBAUER ENCODE or Impinj ItemEncode</td>
<td>☑</td>
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<tr>
<td>Input Materials</td>
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<tr>
<td>Max. Product Width</td>
<td>101.6 mm</td>
<td>250 mm</td>
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<tr>
<td>Labels on Reel</td>
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<tr>
<td>Tickets on Reel</td>
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<tr>
<td>Singulated Tickets/Tags</td>
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<td>Barcode Reading</td>
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<tr>
<td>Linear Barcode</td>
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<td>2D Barcode</td>
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<tr>
<td>Printing</td>
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<tr>
<td>DoD UV Inkjet Printer with 360dpi</td>
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<td>☑</td>
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<tr>
<td>DoD Inkjet Printer with 600dpi</td>
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<tr>
<td>Print width</td>
<td>up to 142 mm</td>
<td>up to 142 mm</td>
<td>up to 142 mm</td>
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<tr>
<td>Data printing</td>
<td>Static and dynamic text, barcodes (1D, 2D)</td>
<td>Static and dynamic text, barcodes (1D, 2D)</td>
<td>Static and dynamic text, barcodes (1D, 2D)</td>
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<tr>
<td>Single Color (Mono-Chrome)</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
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<tr>
<td>Multi Color</td>
<td>☑</td>
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<tr>
<td>Quality Monitoring</td>
<td>☑</td>
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<tr>
<td>Chip Data Verification</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
</tr>
<tr>
<td>Print Data Verification</td>
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<td>☑</td>
</tr>
<tr>
<td>Barcode Grading</td>
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<tr>
<td>Automated Reproduction</td>
<td>☑</td>
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<tr>
<td>Multiprof Handling</td>
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<tr>
<td>Output Format</td>
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<tr>
<td>Single Color</td>
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<td>☑</td>
<td>☑</td>
</tr>
<tr>
<td>Multi Color</td>
<td>☑</td>
<td>☑</td>
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</tr>
<tr>
<td>UPH</td>
<td>up to 25 000</td>
<td>up to 30 000</td>
<td>up to 70 000 with small pitch</td>
</tr>
<tr>
<td>Speed</td>
<td>30 m/min</td>
<td>27 m/min (printer limitation)</td>
<td>27 m/min (printer limitation)</td>
</tr>
</tbody>
</table>

Chip Encoding & Print Personalization

Process Flow

Encoding
The Mühlbauer chip encoding solutions offer the possibility to electronically encode data to each tag's RFID chip at production speed. The encoded data is linked to a data base containing all pertinent information on the product. Mühlbauer's inherently modular solutions also allow for advanced encoding features such as password lock, perma lock and more.

Printing
After the RFID chip has been successfully encoded, a high-speed digital print system prints the corresponding information on the face of the label in mono chrome or full colour. Its Variable-Data Printing (VDP) capability coupled with our encoding solution guarantees that every label is fully personalized, both visually and electronically.

Verification & Testing
Every label will be tested for RF functionality and/or visual defects and/or data match. Depending on the customer's requirements, bad labels can either be visually marked or completely removed from the roll.

MÜHLBAUER ENCODE for Maximum Flexibility and Independence (MCES)

The personalization software MÜHLBAUER ENCODE is based on Microsoft Dynamic Link Library (DLL) and therefore allows the adaption to any RFID Chip and encoding algorithm.

Your Advantages:
- Suitable for all chip types with unique ID (TID or UID)
- For all frequencies (hF & UhF & NFC)
- Encoding algorithm is freely programmable

The DLL is based on Microsoft Visual C#. At the Mühlbauer Academy customers receive specialized developer trainings for the coding of the DLL. Our developer workstations are equipped with an offline RFID-Reader kit for HF and UHF frequencies and are available for testing and debugging.
PL light **NEW**

Single Ticket / Reel-to-Reel Personalization Line

Mühlbauer’s personalization line PL light represents the ideal machine for the encoding, labeling and verification of tickets and tags for low and medium volumes. The efficient set-up and fast changeover allows for rapid changes of orders, either reel-to-reel or ticket-to-ticket. Also, a multiple handling of jobs is possible. Each ticket is tested and automatically reproduced when rejected in order to guarantee flawless quality. PL light’s small-sized footprint allows it to be placed even in the smallest spaces, e.g. in an office environment. Furthermore, this economically-priced system is available with the license-free Mühlbauer ENCODE, which additionally saves costs during operation.

**ADVANTAGES**
- 100% Process Control
- Print on Demand Flexibility
- 600 dpi Print Solution
- Fast Process

**BENEFITS**
- Multi Job Handling In One Batch
- High Efficient -Personalization Line
- Low Investment Cost

**FEATURES**

**Workstations**
- Unwinder / Unstacker
- Reader for UID and/or Barcode
- Electrical encoding
- DWD Printing
- Verification
- Upwinder / Single output

**Configuration Flexibility**
- Thermal Inkjet (waterbased)
- UV Inkjet
- Visual verification of print
- Up to 600 dpi printing

**Your applications**
- Individually Personalized Single Tickets / Hang tags
- Individually Personalized Labels / Tickets on Reel
- Wide Range of Chip encoding formats: UHF and limited HF / NFC
- Single Ticket / Hang tag

**PL light DIMENSIONS**

<table>
<thead>
<tr>
<th>Length (mm)</th>
<th>Depth (mm)</th>
<th>Height (mm)</th>
<th>Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1700</td>
<td>880</td>
<td>1630</td>
<td>330</td>
</tr>
</tbody>
</table>

Mühlbauer's personalization line PL light is the ideal machine for the encoding, labeling and verification of tickets and tags for low and medium volumes. The efficient set-up and fast changeover allows for rapid changes of orders, either reel-to-reel or ticket-to-ticket. Also, a multiple handling of jobs is possible. Each ticket is tested and automatically reproduced when rejected in order to guarantee flawless quality. PL light’s small-sized footprint allows it to be placed even in the smallest spaces, e.g. in an office environment. Furthermore, this economically-priced system is available with the license-free Mühlbauer ENCODE, which additionally saves costs during operation.
Mühlbauer’s personalization line PL 30000 represents the ideal machine for encoding, labeling and verification of tickets and tags for medium and high volumes. The efficient set-up and fast changeover allows for rapid changes of orders in a reel-to-reel or reel-to-ticket process. The PL 30000 can handle all common UHF / HF / NFC frequencies. Each ticket is tested and automatically reproduced when rejected in order to guarantee flawless quality. PL 30000’s economically-priced system is available with the license-free Mühlbauer ENCODE, which additionally saves costs during operation.

**FEATURES**

**Workstations**
- Unwinder
- Buffered 5-fold encoding unit (stop and go with flexible encoding times)
- DoD Printing
- Simultaneous verification of print (visual) and chip data
- Upwinder

**Configuration Flexibility**
- UV printing (also available in color)
- Thermal Inkjet printing (waterbased)
- Wide range of chip functionality (UHF / HF / NFC)

**Your Applications**
- Reel-to-Reel personalization
- Reel-to-Ticket personalization
- High volume UHF / HF / NFC Encoding

**PL 30000 DIMENSIONS**

<table>
<thead>
<tr>
<th>Length (mm)</th>
<th>Depth (mm)</th>
<th>Height (mm)</th>
<th>Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4010</td>
<td>1600</td>
<td>1900</td>
<td>1835</td>
</tr>
</tbody>
</table>
The ideal solution for your service bureau

- For UHF applications only
- For specific chip types only
- Reel-to-reel
- TIJ (Thermal Inkjet) or DoD (Drop on Demand)
- Encoding Technology: Impinj’s ItemEncode
- Up to 70,000 UPH

**MB INCAPE**
Integrated Production Management Software

**KEY FEATURES**

- The only software solution worldwide to combine personalization data management, complete production control and material management
- Covers the full production control requirements
- Highly automated workflows with little operator interaction
- Streamlined web-based user interfaces with easy localization / internationalization support

**UPH**

<table>
<thead>
<tr>
<th>UPH</th>
<th>10,000</th>
<th>20,000</th>
<th>30,000</th>
<th>40,000</th>
<th>50,000</th>
<th>60,000</th>
<th>70,000</th>
<th>80,000</th>
</tr>
</thead>
</table>

**PROCESS FLOW**

- Data Connector
- Production Management
- Reporting / Audit / Statistics

**DATA FLOW**

- Warehouse
- Personalization
- Mailing
- Manual QA
- Shipment

**MATERIAL FLOW**

**CORE MODULES**
- User Management
- Data Preparation
- Production Management
- Data Persistence (SQL Database)
- Data Collection / Import
- Material Management
- Offline Personalization Support

**ADDITIONAL MODULES**

- Content
- RFID Competence
- The RFID FACTORY
- Antenna Production
- Inlay Assembly
- Converting
- Personalization
- Software Solution
Monitor your production in real time and generate real production statistics with your preferred KPIs.

- Improve cost transparency.
- Gain better data to investigate, understand and portray process flows and relationships.
- Run your production with improved security and optimally employed staff.
- Intuitive and easy to use web interface
- Responsive user interface design allows optimal presentation on any chosen device
- Data collection from the shop floor of Mühlbauer equipment and also third party equipment
- State-of-the-art big data software architecture ensures future reliability

**PalaMax.Monitor**

Real time performance monitoring of your machines on the shop floor, e.g. state of machine or metrics in order to react efficiently in time.

**PalaMax.Stats**

Easily analyze historical data with your desired time interval and get customized statistics, e.g. OEE, yield, performance and availability.

---

Our RFID Competence Centers

Realizing RFIDEas Worldwide

- ANTENNA PRODUCTION
- INLAY ASSEMBLY
- CONVERTING & LAMINATION
- PERSONALIZATION

KEY FEATURES

- MB PalaMax®
  - Total Process Transparency

**RFID COMPETENCE**

**ANTENNA PRODUCTION**

**INLAY ASSEMBLY**

**CONVERTING & LAMINATION**

**PERSONALIZATION**

**NEwPORT NEwS**

**RODING GERMANY**

**DRESDEN GERMANY**

**MELAKA MALAYSIA**

**WUXI CHINA**
CONTACTS WORLDWIDE

Mühlbauer Germany
Mühlbauer Group
Josef-Mühlbauer-Platz 1
93426 Roding, Germany
Phone: +49 9461 952 0
Fax: +49 9461 952 1101
Mail: info@muelhbauer.de
Web: www.muehlbauer.de

Mühlbauer Serbia
Mühlbauer Technologies d.o.o.
Evropska 17
22300 Stara Pazova, Serbia
Phone: +381 22 215 5100
Fax: +381 22 215 5130
Mail: serbia@muehlbauer.de
Web: www.muehlbauer.de

Mühlbauer Slovakia
Muehlbauer Technologies s.r.o.
Novozámocká 233
94905 Nitra, Slovakia
Phone: +421 37 6946 000
Fax: +421 37 6946 501
Mail: info@muehlbauer.sk
Web: www.muehlbauer.com

Mühlbauer USA
Mühlbauer Inc.
226 Pickett’s Line
Newport News, VA 23603-1366, USA
Phone: +1 757 947 2820
Fax: +1 757 947 2930
Mail: info@muelhbauer.com
Web: www.muehlbauer.com

Mühlbauer Malaysia
Mühlbauer Technologies Sdn. Bhd.
No. 3 Jalan TU 62
Taman Tasik Utama,
75450 Melaka, Malaysia
Phone: +60 6 2517 100
Fax: +60 6 2517 101
Mail: info@muelhbauer.com.my
Web: www.muehlbauer.com.my

Mühlbauer China
Muehlbauer Technologies (Wuxi) Co., Ltd.
No 23, Huayi Road
Wuxi New District
214135 Wuxi, Jiangsu, China
Phone: +86 510 8190 0100
Fax: +86 510 8190 0101
Mail: info@muehlbauer.cn
Web: www.muehlbauer.cn

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