



Advanced Products and Solutions for Battery Manufacturing



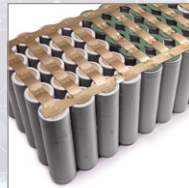
Develop and Manufacture Next Generation Batteries

Cutting Edge Technologies for Advanced Applications Across Multiple Industries



Battery Tab Welding

- Laser cleaning
- Laser welding
- Resistance welding
- Micro TIG welding



Battery Modules and Packs

- Laser and resistance welding of current collector to busbars
- Laser and resistance welding of tabs

Industries



Medical



Automotive



Consumer electronics



Wearables



Solar

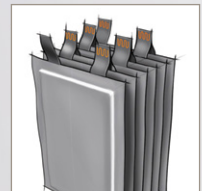


Aerospace



Battery Can

- Laser welding lids to cans
- Diaphragm assembly
- Pressure vent



Electrode Cutting

- Laser cutting leads



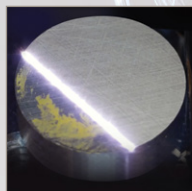
Part Identification

- Serial numbers
- Barcodes
- 2D codes



Terminal Welding

- Wire compacting
- Laser cleaning
- Laser, resistance and microTIG welding



Laser Cleaning

- Surface roughening
- Remove dirt, grime, impurities
- Better weld results

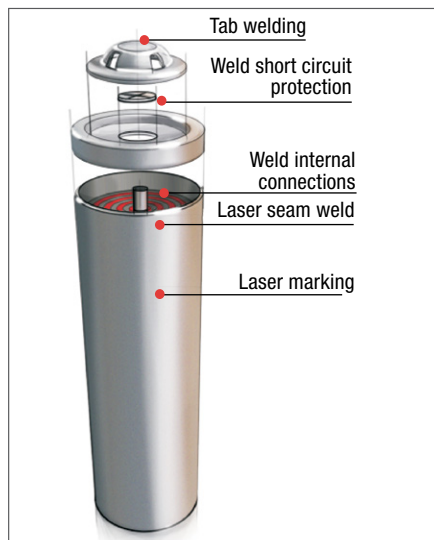


Internal Connections

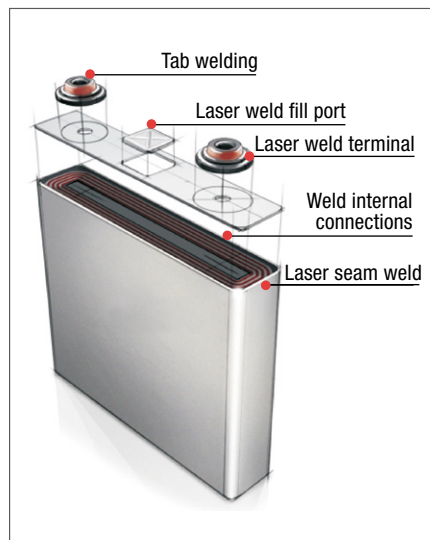
- Laser welding
- Resistance welding

Batteries & Materials

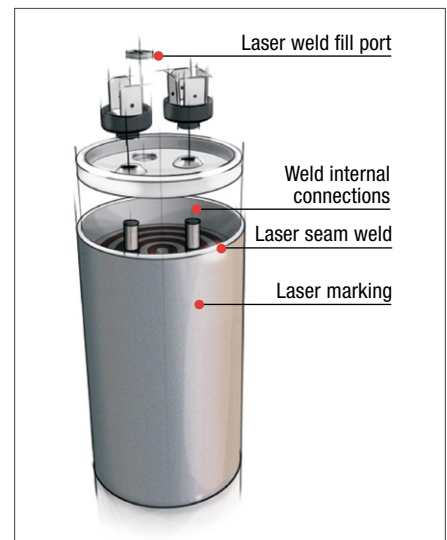
For each type of battery manufactured, AMADA WELD TECH offers a production solution: resistance welding, laser welding, laser marking, laser cutting and micro TIG welding. We have in-depth knowledge of, and experience with each category and application, including welding internal connections, battery tab welding, can sealing, marking for identification and more. Recent advances have been made in laser welding of dissimilar metals and battery tab design optimization. Our in-house applications labs enable proven processes to be delivered with optimized systems.



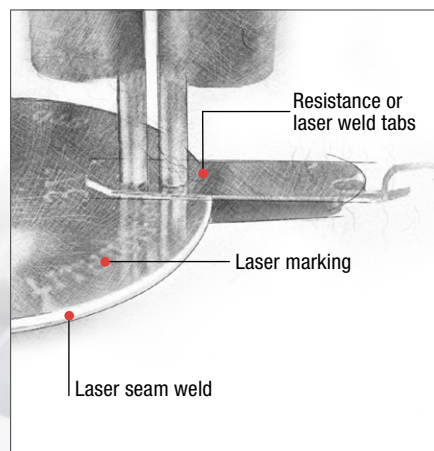
Cylindrical



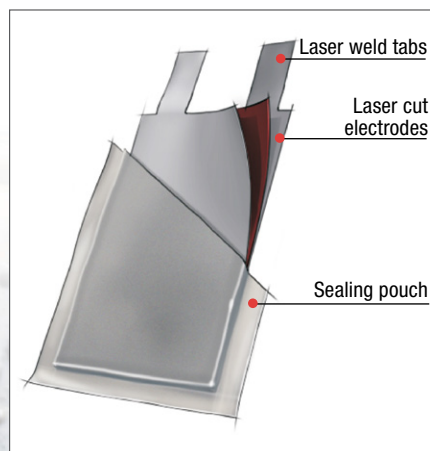
Prismatic



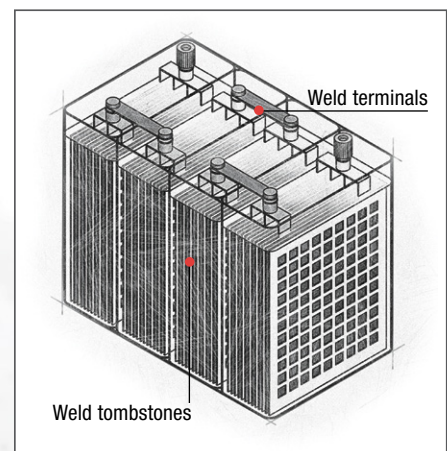
Ultracapacitor



Coin



Pouch



Lead acid



Battery and Battery Pack Designs

Today's batteries and battery packs need to be more efficient, to charge faster, and those charges need to last longer. In order to meet these demands, battery tabs are thicker, more conductive, and, rather than using pure nickel, manufacturers are starting to utilize materials made of copper sandwiched by stainless steel and nickel up to 0.5mm (0.020") thick, or changing to more conductive materials like bare copper and aluminum.

Battery Tab Welding • Tab to Terminal Welding • Battery Can Sealing Dissimilar Metal Joining • Lead Acid Battery Welding • Wire Compacting



Tab weld



Dissimilar metal welding



Spiral welding battery tab

AMADA WELD TECH has over 50 years of experience helping customers improve their battery welding applications including material selection, tab design (projections, slots), part fit up/tooling, and laser cleaning. We have developed innovative solutions like cascade welding to address multiple locations within battery cells - including clamping multiple tombstone locations. In addition, we have developed laser welding solutions for joining dissimilar materials - including spiral welding - to enhance material options and weld joint integrity.

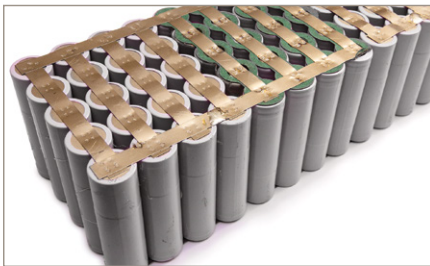
In addition, because we manufacture a breadth of joining technology products, we can present an unbiased solution to meet your manufacturing and budget requirements.



Reliable Connections for Higher Current, Increased Reliability and Improved Performance

As world electrification continues to grow, so will the demand for high performance batteries to power it. The challenges encountered in bringing these batteries to market include the demand for reduced weight, expanded life, faster charge times and lower costs. Translated into manufacturing goals, the batteries need to possess higher capacity with negligible energy loss, higher current carrying capacity for charging, and be made of light-weight, lower cost materials. Since the market is so rapidly expanding, there are additional manufacturing challenges, including the demand for higher throughput and quality. Some of these goals can be achieved by improved cell chemistries and battery pack design, but others can be improved only by considering the joint quality between the batteries and the current collectors. That's where AMADA WELD TECH comes in!

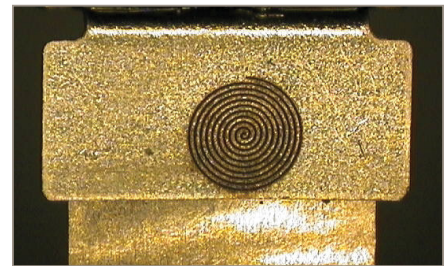
**Battery Tab to Cell Welding • Tab to Terminal Welding • Dissimilar Metal Joining
Tab/Current Collector to Busbar • Battery Can Sealing • Lead Acid Battery Welding**



Battery modules and packs






Prismatic battery cans



Battery tabs

AMADA WELD TECH offers a range of welding technology solutions for battery manufacturing including resistance welding, laser welding and micro TIG welding. As the materials and thicknesses continue to change, the right technical solution to join the materials also may change. With wide ranging expertise, AMADA WELD TECH recommends the best technical solution to join your new challenges - and helps to develop a robust production solution.

The table below compares the three technologies for some of the current process and manufacturing considerations.

		Welding Dissimilar Materials	Address Thicker Tab Materials	High Speed Positioning	Tooling Design	Process Monitoring Capability
	Resistance Welding	● ●	● ●	● ●	● ● ●	● ● ● ●
	Laser Welding	● ● ● ●	● ● ●	● ● ● ●	● ●	● ● ●
	MicroTIG	● ●	● ● ●	● ●	● ●	● ● ●

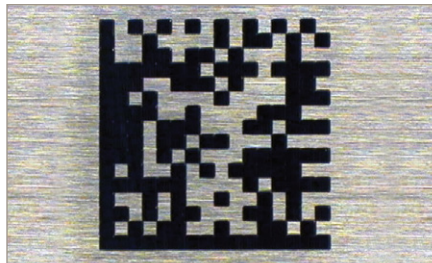
Part Identification: Global Tracking & Tracing

Today's battery manufacturers know that part identification and traceability are critical for success. Most batteries need to be marked with both human and machine readable characters which may be alphanumeric (serial numbers, etc.), datamatrix codes, or both in order to facilitate branding and identification. Lasers are uniquely suited for this application as they are a direct, non-contact part marking method capable of delivering precise energy to parts with a minimal heat affected zone resulting in high throughput and image quality, thereby eliminating rework and post-processing steps.

High Contrast, Durable Marks • High Throughput • Traceability • Ensuring Quality



Product identification - alphanumeric text strings



2D data matrices



Graphics and logos for safety and compliance information

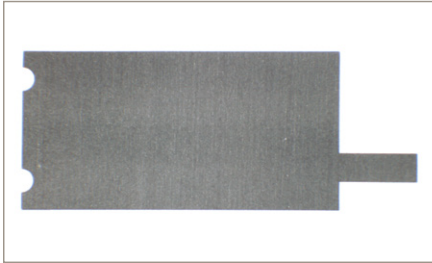
AMADA WELD TECH provides laser engines for automation, desktop and floor standing Class I systems for low volume production and R&D processes, and fully automated custom systems for higher volume production with consistent product quality. Every laser is delivered with a process developed by our experienced applications engineers, informed by your requirements. Enhance your productivity with: barcode job loading, tie to ERP/MRP, industry 4.0 ready, and vision and fixtureless marking.



Laser Cutting Thin Foil Battery Electrodes

In 1995, the pouch cell surprised the battery world with a radical new design. Rather than using a metallic cylinder and glass-to-metal electrical feed through for insulation, conductive foil tabs welded to the electrode and sealed to the pouch carry the positive and negative terminals to the outside. These pouch cells offer a simple, flexible and lightweight solution to battery design which makes efficient use of space and achieves 90-95% packaging efficiency, the highest among battery packs. Elimination of the metal enclosure also reduces weight. Laser cutting is a fast, clean way to cut these electrodes.

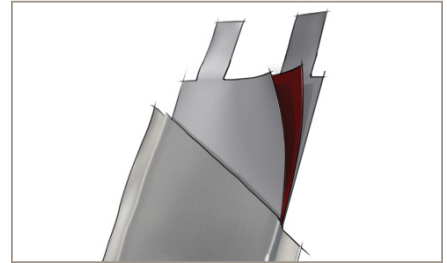
Pouch Cells



Laser cut electrodes



Weld pouch cell tabs



Welding anode and cathode foil material

AMADA WELD TECH provides technology solutions to the world's leading battery manufacturers according to the customer's unique application, manufacturing facility, and budget, including laser cutting systems configured for single operator, semi-automated or automated production.



Surface Cleaning of Anode and Cathode Ensures High Quality Welds

Cleaning of the battery anode and cathode can greatly improve success of the welding process by creating a pristine, repeatable surface for joining. Whether using resistance welding, laser welding, or another joining method, laser cleaning *before* welding can significantly improve the process and quality.

Laser cleaning works by focusing a laser onto a substrate to remove material on its surface. The amount of material removed depends on the intensity, pulse width and wavelength of the laser, as well as the material itself which absorbs the laser light and breaks down the chemical bonds in the area. It can be achieved with either a pulsed nanosecond (fiber) laser or a continuous wave laser, although the former is more commonly used due to the high level of laser intensity.

Fast • Safe • Cost-effective

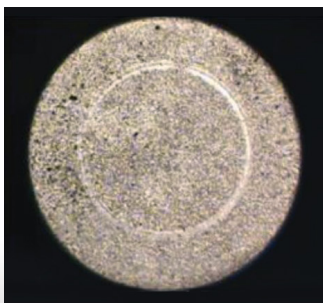


Image of battery cell surface before ablation

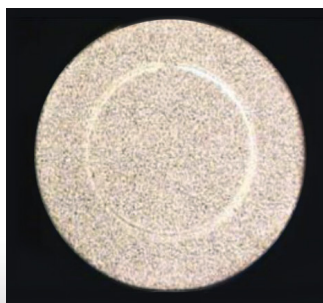
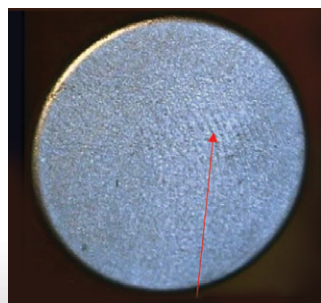
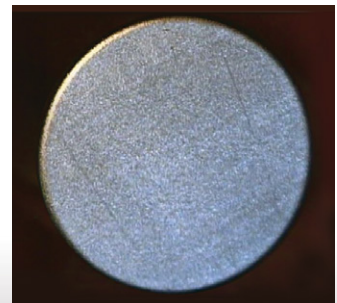


Image of same surface after ablation

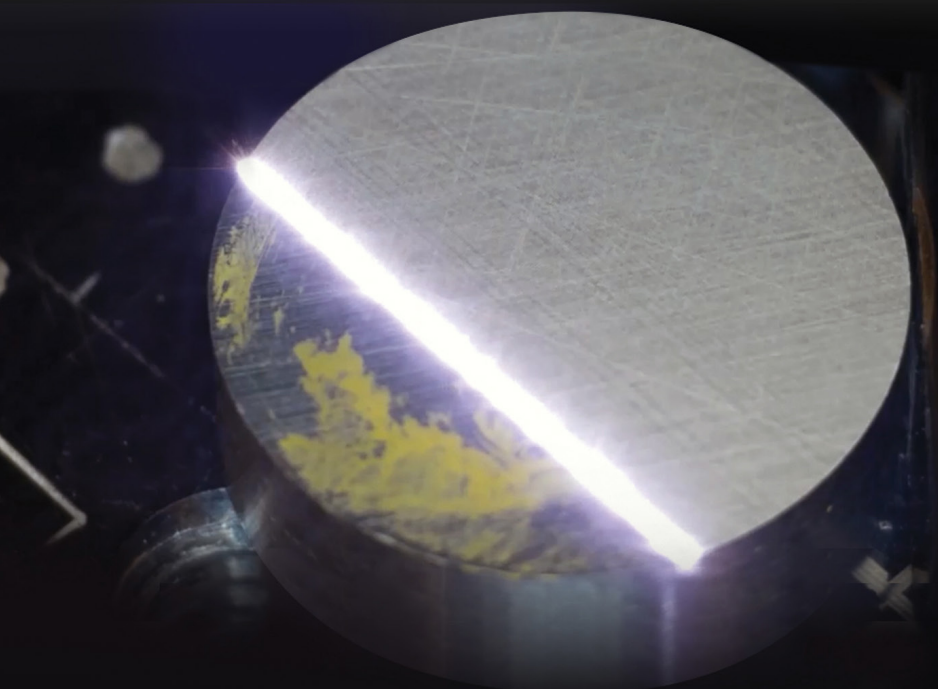


Before – note fingerprint



After – clean and no fingerprint

AMADA WELD TECH offers a range of fiber lasers and workstations for laser cleaning applications. The exact products selected will depend on many factors including materials, size of parts, and factory space.



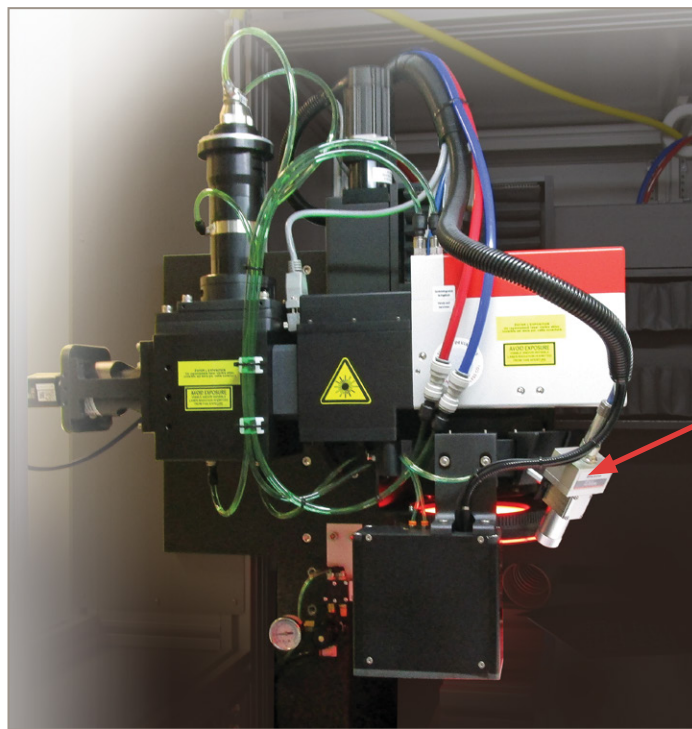
Ensuring Manufacturing Success with Process Monitoring

Product failure. Upset customers. Product on stop shipment. For the process manufacturing engineer, it's a worst-case scenario. When this situation occurs, it requires swift attention and accurate resolution: do you know the fundamental underlying issue? Can you calmly and expertly identify the source of the problem and what to do to get back on track? This is where process monitoring comes in. By observing and measuring the process, it is possible to discern good from bad product and, when bad occurs, specify defect signatures. In fact, process monitoring can help manufacturers avoid this situation altogether.

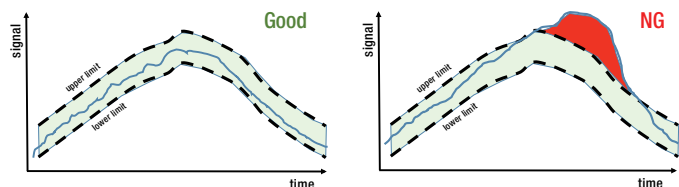
For laser welding, detect and record thermal signals and set an envelope (min/max) to determine good and bad welds by identifying errors such as gaps between parts, missing parts, over-penetration, incorrect focus, and cover gas absence. For resistance welding, monitor parameters like weld current, voltage drop across the electrodes, workpiece expansion and deformation, electrode force, electrode movement (displacement) and more.

The monitor data can also be used to develop better manual or automated workstations that can avoid weld inconsistencies. Plus, data collected with monitors can provide value *after* a product is sold in case of a recall or similar situation, as weld data can be correlated with serial numbers.

Improve Quality • Reduce Downtime • Reduce Scrap



Laser weld monitoring



Graphical representation of an instantaneous judgement of measured waveform versus limits that were determined during a DOE. The Good signal results when the newly measured waveform falls within acceptable values. The NG occurs when the waveform falls outside those limits.

AMADA WELD TECH offers real-time process monitors for **laser welding, resistance welding, micro TIG welding and hot bar reflow soldering**. These stand-alone monitors are invaluable tools for product development, improving quality and throughput in production, and storing data for traceability.

Off-axis laser weld monitor



Portable resistance weld monitor with a touchscreen interface

Innovative Products for Manufacturing

Since 1948, AMADA WELD TECH has worked to achieve one goal: to solve customers' manufacturing challenges. Knowing there is no one solution that fits all, we strive to provide customers with innovative and reliable manufacturing technology solutions in an effort to be their single source provider.

At the heart of every system we build is one or more of our industry-leading products for advanced manufacturing. The technology selected will depend on your specific application and factors like materials, part accessibility and desired throughput. AMADA WELD TECH has expertise in a number of core technologies ensuring you get the right product for your application, floorspace, and budget.



Core Technologies

Resistance Welding

- High frequency DC power supplies
- Mid frequency DC power supplies
- Linear DC power supplies
- Capacitive discharge power supplies
- Alternating current power supplies
- Motorized electromagnetic weld heads
- Motorized servo weld heads
- Pneumatic weld heads
- Manual weld heads
- Resistance weld process monitors

Laser Welding

- Fiber lasers
- Nd:YAG lasers
- Blue diode lasers
- Laser weld process monitors

Laser Marking

- Fiber lasers
- UV nanosecond lasers
- Picosecond lasers

Laser Cutting

- Femtosecond lasers
- Fiber lasers

Laser Micro Machining

- Femtosecond lasers
- Picosecond lasers
- UV nanosecond lasers
- IR fiber lasers

Laser Soldering

- Direct diode lasers

Hot Bar Reflow Soldering

- Power supplies
- Hot bar reflow soldering heads
- Hot bar reflow soldering process monitors

Hermetic Sealing

- Projection welders
- Parallel seam sealers
- Gloveboxes

Micro TIG Welding

- Power supplies
- Torches
- Micro TIG weld process monitors

Our Philosophy: Define - Design - Deliver

Developing a unique solution geared for advanced manufacturing is complicated. Our approach? Define-Design-Deliver. This methodology helps us design the ideal system to meet your manufacturing needs and budget while maximizing your equipment ROI and meeting your production goals.



Process Assessment

- Determine part usage and success
- Optimize part designs
- Select material

Sample Qualification

- Process sample parts
- Determine optimal production settings



Equipment Specification

- Meets production, quality, and budget criteria
- Product flow
- Customer requirements

Product Assembly

- Engineer oversees project
- Work with customer & technicians



Test and Verification

- Rigorous testing
- System acceptance
- Customer directed

Installation and Support

- Install system and verify functionality
- Train engineers and operators
- Provide continual, ongoing support



Value Added Services

Training

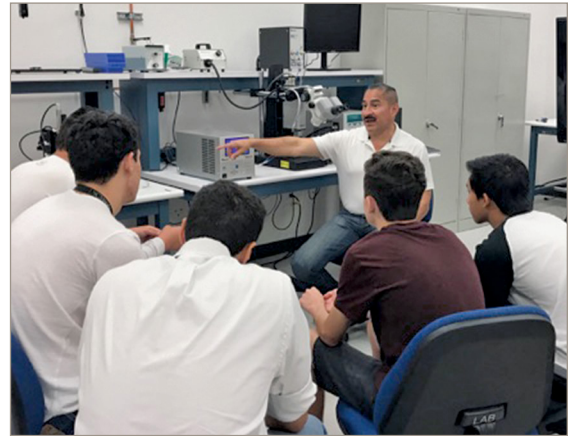
We offer application support and process development services at our Technical Centers in Monrovia, California; Wixom, Michigan; High Point, North Carolina, or on-site at your facility. These services can be tailored to meet your specific needs and may include hands-on equipment training.

Topics

- Technology fundamentals
- Developing process success
- Equipment troubleshooting

Location Options

- On-demand webinars
- Live webinars with Q&A
- Factory hands-on
- On-site training (specific to your equipment)



Around the Clock Service Support to Minimize Downtime

Inevitably something may go wrong. This can be caused by a multitude of reasons, but ultimately the longer that the product is out of order, the larger the impact to your business.

We are there when you need us.

24/7 Field Service

- +1-866-751-7378
- service@amadaweldtech.com



Our Resources, Your Success

Understanding the product and the process - ensuring success! Not sure your application is feasible? Want to know which technology is best suited to your process? Does your existing process require some modification or re-optimization? Our experienced team of Application Engineers are ready to provide assistance!

Technical Centers

- Western Technical Center
- Monrovia, CA
- Midwest Technical Center
- Wixom, MI
- Eastern Technical Center
- High Point, NC

- **Range of Beam Delivery Options** - Fixed, 2D and 3D galvo-scanning, wobble head, trepanning head, multi-axis taper-free cutting head
- **Range of Resistance Welding Power Supplies** - Linear DC, High Frequency, Cap Discharge, and AC Resistance Spot Welding Controls (5 A – 100,000 A)
- **4 and 5 Axis Laser Welding and Laser Micromachining Workstations**
- **Gloveboxes for Processing in an Inert Atmosphere**

Experienced Application and Process Engineers

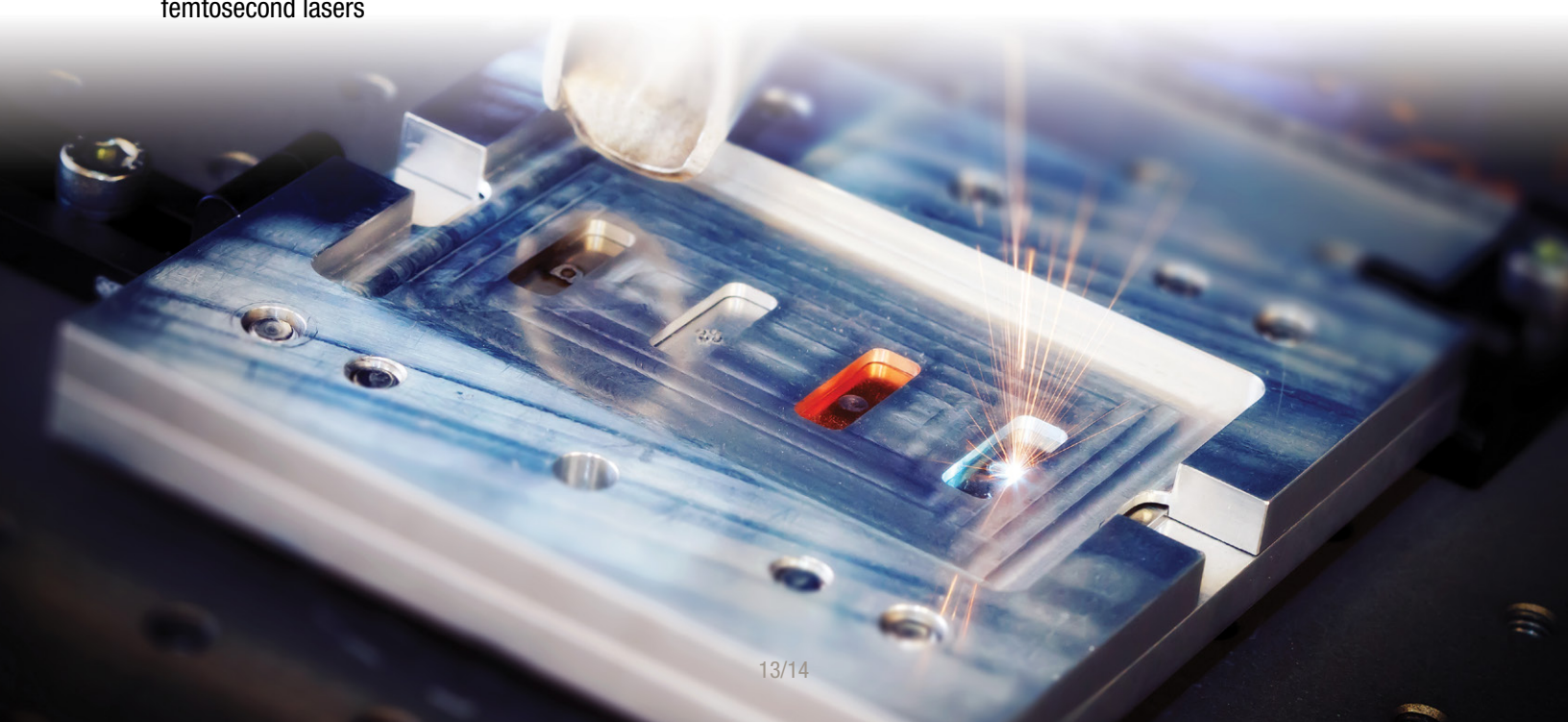
- 12 full-time application engineers and technicians

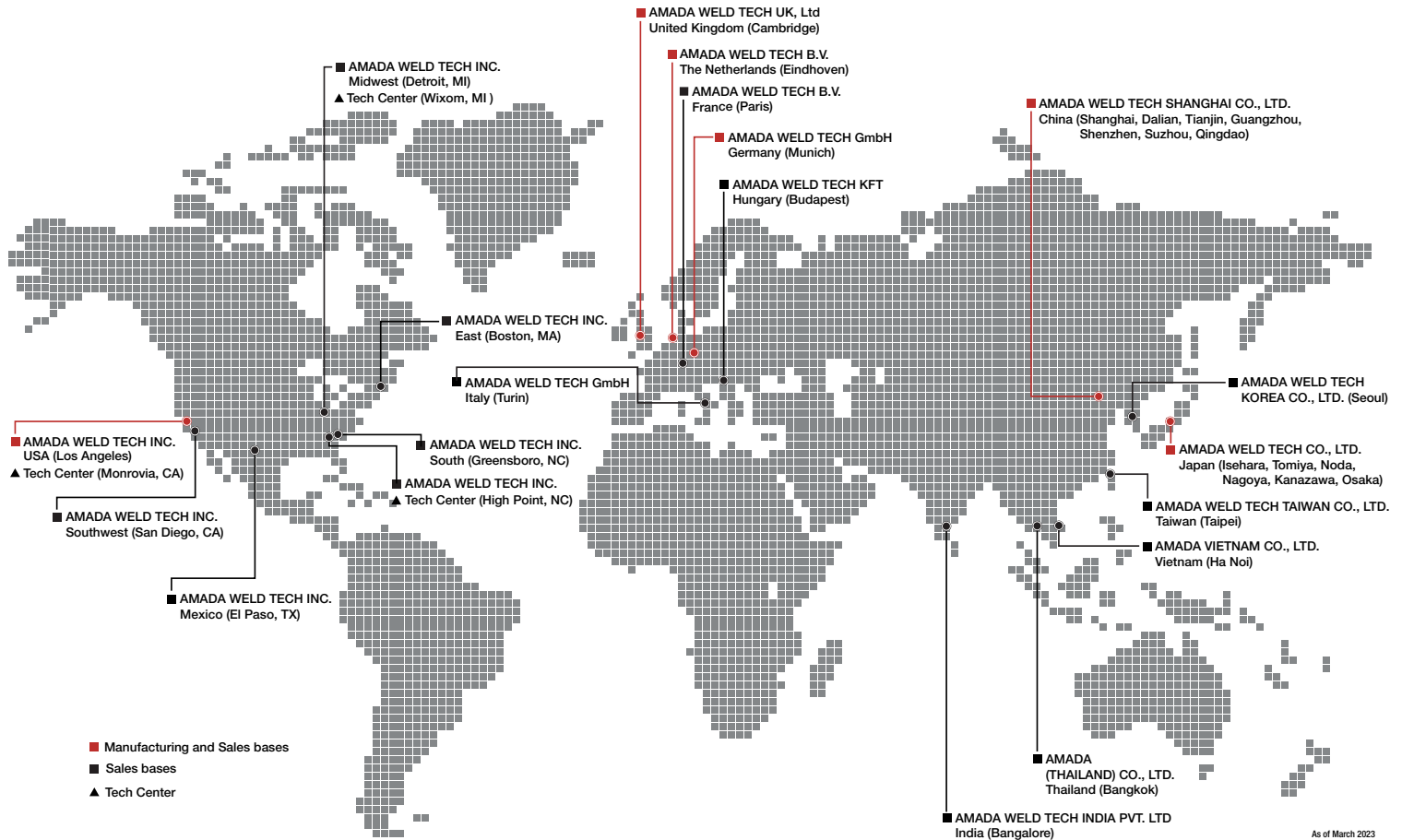
Dedicated Development Resources

- **Core Technologies** - Laser welding, resistance welding, laser marking, laser micro machining, laser tube cutting, micro TIG welding, reflow soldering, hermetic seam sealing
- **Facilities** - 10 state-of-the-art application labs for all core technologies
- **Range of Lasers** - CW, QCW and dual beam fiber lasers, diode-pumped solid-state (DPSS) lasers, Nd:YAG lasers, picosecond lasers and femtosecond lasers



Western Technical Center





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