



**Manufacturing  
Technology, Inc.**

[MTIwelding.com](http://MTIwelding.com)

## MANUFACTURING SERVICES

MTI offers an affordable, single-source turnkey solution to accommodate your applications by developing and producing your parts to save you time, money, and mitigate risk to your parts program.

## A SINGLE-SOURCE TURNKEY SOLUTION

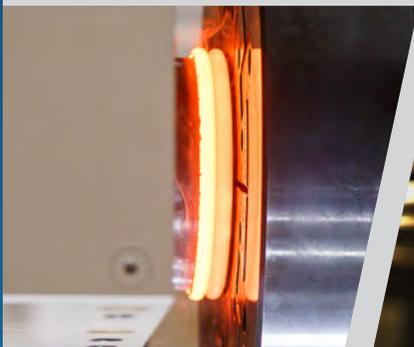
As one of the world's largest, most experienced friction welding machine builders and integrators, MTI is positioned to be your single source turnkey solution to any Contract Friction Welding need. By providing you access to an array of in-house value-added services to accommodate your applications, we have the ability to process your parts using the latest in friction welding and part handling technology.

We also maintain the widest range of friction welding equipment available. Only MTI offers all three types of rotary friction welding. With over 117,000 square feet of production space, we can produce friction-welded parts ranging anywhere in size. From small military aircraft rivets to 55-foot-long Friction Stir Welds, MTI is uniquely qualified to handle all your contract welding needs with the quality you expect.

Take advantage of our in-house value-added services including custom design engineering, research and development resources, and pre- and post-weld processing.

## TECHNOLOGIES

As the world leader in the design, manufacture and installation of Friction Welding machines, MTI is able to offer world-class Friction Welding contract services that include:



Rotary Friction  
Welding



Linear Friction  
Welding



Friction Stir  
Welding



Plug Welding

## QUALITY ASSURANCE

We calibrate and maintain our machines to keep them at optimum performance so that your last welded part is of the same high quality as your first. Plus, we can have your parts certified to meet your internal quality and production standards.

**We are certified to the following industry quality standards:**

- ISO9001
- AS9100
- Nadcap AS7003



**"We hold individual stringent welding approvals from companies such as Hamilton Sundstrand, GE Aircraft Engines, Boeing, and Honeywell. MTI also adheres to the MIL-STD-1252, Inertia Friction Welding Process Procedure and Performance requirements."**

# HOW MANUFACTURING SERVICES WORK FOR YOU.

## Part Manufacturing

We use friction welding technology as the base for production, from pre-weld (cutting, machining, heat treat) and post-weld (weld flash removal, turning, milling/ grinding, heat treat) to processing, we manufacture parts that meet your company, industry, and quality standards. And, we have the certifications and experience to support it.



## Metallurgical Evaluation & Testing

Our on-staff experts include a Chief Metallurgist with decades of experience. Because of this, we offer a full-range of detailed metallurgical testing and evaluations to confirm physical properties of the part and the weld zone.



## Application Development & Process Optimization

Explore new applications and markets without a large investment in capital equipment by having us optimize your development & production process, without the extensive, expensive, and time-consuming trial and error of going it on your own.



## Research & Development

Explore new designs and applications without work flow disruptions in your manufacturing facility. We recommend, design, and prototype unique and innovative solutions to the product development and improvement process that can expose additional savings and technical value to new and existing designs.



## Tooling

We offer custom design manufacturing and tooling services, and we maintain a large inventory of Friction Welding fixtures and part-contact tooling for all development and production machines. Plus, by using our existing tooling crib when applicable, we can save you considerable time and money on your project.



## MTI IN ACTION: THE SPACE PROGRAM

A leader in the development and manufacturing of aerospace propulsion systems, Aerojet Rocketdyne (AR), secured a contract with NASA to develop a next generation rocket engine to be used in deep space exploration. AR was tasked with developing a cryogenic liquid hydrogen- and liquid oxygen-propelled rocket booster engine for NASA's Space Launch System (SLS).

The SLS program – along with the RS-25 engine being developed by AR – is scheduled to initially operate in cis-lunar space supporting what NASA calls the “proving ground” where we evaluate ways to operate independent of Earth supporting eventual missions to Mars in the early 2030s. The SLS will carry both cargo and astronauts.

### A Blast From The Past: The Challenge

As part of AR's process to recertify the RS-25 engine, a special **vertical rotary friction welding machine (VRFW)**, built by MTI in 1981, was brought out of storage. It had originally been used to friction weld the Powerhead Main Injector on the Space Shuttle Main Engine (SSME), which was used on all 135 Space Shuttle Flights.

The machine, using early '80s technology, naturally would not meet the modern production standards necessary to accomplish AR's goals, so AR sought out MTI to come up with the best way to utilize the VRFW.

### Success & Setting Records: The Solution

After having the VRFW for only 22 weeks, MTI was able to complete the refurbishment. This quick turnaround saved AR vital time and money. The MTI team also benefited from a close collaboration with AR and its staff – both past and present.

“With a cost savings of \$1 million and the lead time cut in half, Aerojet Rocketdyne and MTI agreed that refurbishing and upgrading the Vertical Rotary Friction Welding (VRFW) machine originally built in 1981 would be the most cost-efficient and time-saving option to develop a next generation rocket engine for NASA.”

**ROCKETDYNE CUSTOMER STORY**  
[mtiwelding.com/stories/aerojet-rocketdyne/](https://mtiwelding.com/stories/aerojet-rocketdyne/)

# THE PRE-WELD & POST-WELD PROCESSES.

SEND US YOUR DRAWING AND WE'LL FIND A TURNKEY SOLUTION FOR YOU.

MTI offers services from concept to finished product and everything in between. Like our overall business, MTI's Manufacturing Services operation is highly customer-driven. And, we tailor our services to meet the needs of each customer. This means that for some customers we may procure material and provide a finished product that's ready to go. While for others, we may simply provide an in-process solution.



## Supply Chain Management

Think of MTI like a supermarket. We serve as a one-stop shop for all your joining needs so that you don't have to go through the trouble of ordering, shipping, and storing materials. You can even provide us with a material, and we'll ensure it's correct from a metallurgical standpoint.



## Metallurgy

Our Chief Metallurgist has decades of experience. While dissimilar materials can bring concerns when it comes to forging, MTI knows the necessary steps to take beforehand. MTI's Process Engineers work with the in-house metallurgists to develop the weld procedure so that optimum conditions produce optimum joint strength.



## A Key Location

Our central location in South Bend, Indiana means there's several heat treat shops and manufacturing shops all around us. When we're managing your supply chain, our convenient location saves you valuable money and time.



## Quality throughout the Process

Friction welding is our core competency. With Nadcap accreditation for welding and AS9100 certification, which places strict procedural requirements on welding operations, MTI has the technical know-how.



## Infinite Post Weld Processing

From final stress relief to final machining, MTI's new 117,000 square foot facility has the capacity to accomplish your needs.



## Shipping the Finished Product

To keep the process seamless, MTI also manages testing logistics and then ships the finished product to you. MTI even handles the paperwork so that you don't get held up at customs.

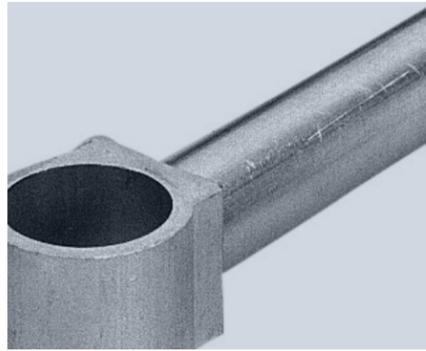
117,000 SQUARE FEET OF PRODUCTION SPACE.

# PARTS GALLERY.

FIND YOUR TECHNOLOGY FIT.

## Aluminum Suspension Link

This experimental aluminum suspension link is made from aluminum alloys using rotary friction welding. It is a tube to plate geometry. ▶



## Lift Screw

Using near net parts, we produce lift screws by friction welding a threaded rod to a flange rather than machining the entire screw out of a solid bar of metal--which is time consuming and produces lots of waste. ▼

## Aluminum Plate

We produce Friction Stir Welds up to 55 feet long, meaning we can easily join aluminum sheets produced at the mill. This allows us to increase sheet widths while maintaining plate thickness tolerances. ▶



## Heat Exchanger

Below, Friction Stir Welding is used to join a hybrid vehicle aluminum plate to a cast aluminum heat exchanger box for a water tight seal. ▼



## Clevis

A flexible forging, the length of this part can be changed without any additional tooling or capital expenses. ◀



## Water Pump Hub & Shaft

Rotary Friction Welding is used to join this bar to plate geometry ▶



## Bi-Metallics

Joining dissimilar materials is just one of the many unique advantages of friction welding. Here, Linear friction Welding is used to join a copper alloy block to an aluminum plate. ▼



## Transmission Gear

A finished spiral bevel gear is welded to a tubular shaft using Rotary Friction Welding. ◀



All of our parts have a unique story behind them. Explore our expansive online collection of sample parts to uncover applications, materials, technology and geometrical fittings that might be right for your next project.

**VIEW EVEN MORE PARTS**  
[mtiwelding.com/parts](http://mtiwelding.com/parts)

## Drive Shaft

A critical aspect of automotive production, Friction Stir Welding can be used to reduce the weight of the final vehicle. This is known as lightweighting and results in significant cost savings along the way. ◀



# BI-METALLICS.

One of the key differentiators between friction welding and other welding techniques is the ability to join dissimilar metals or two different materials that may be impossible to join by other techniques. Doing so is a cost effective way of getting the benefits from both materials. Typically we can use any of the friction welding technologies to weld dissimilar metals.



Bi-Metallic	
<b>Application</b>	Bi-metallic application linear friction welding of copper alloy block to aluminum plate
<b>Materials</b>	Aluminum, Copper
<b>Technology</b>	Linear Friction Welding
<b>Geometry</b>	Bar to Plate



## BI-METALLIC COMBINATIONS.

### COPPER & COPPER

For electrical conductivity, we can use two different types of copper. A softer copper alloy that is much less expensive can be mounted to a harder copper alloy using rotary friction welding. Since the harder alloy is more expensive, you can selectively put it only in the spots where it is needed — where there will be wear characteristics on the finished part.

### ALUMINUM & INCONEL

For rocket transition points, it is absolutely critical to have a leak-proof joint between two different materials. Instead of using a mechanical joint, friction welding offers a simpler and dependable alternative.

### GEAR STEEL & STANDARD STEEL

In certain applications, it is necessary to have a gear mounted to a steel cylindrical base. For parts such as this, manufacturing the part as an assembly is not cost effective. It is much easier to cut the gear teeth before welding, then weld the two materials together.

### CARBON STEEL & STAINLESS STEEL

A submersible pump motor with a bi-metallic motor shaft needs the magnetic properties of a carbon steel but also the corrosive resistant properties of a stainless steel.

### HEAT RESISTANT STEEL & WEAR RESISTANT STEEL

Engine valves, such as high-stressed exhaust valves, utilize rotary friction welding to bond heat resistant steel for the valve head with the abrasive wear resistant steel for the valve stem.

**CAN YOUR MATERIAL BE FORGED?**  
[mtiwelding.com/weldable-materials](http://mtiwelding.com/weldable-materials)



ALUMINUM TO COPPER

Bi-Metallic	
<b>Application</b>	Bi-metallic application rotary friction welding of steel tube to aluminum tube.
<b>Materials</b>	Aluminum, Steel
<b>Technology</b>	Rotary Friction Welding
<b>Geometry</b>	Tube to Tube



## LEARN MORE - WHITEBOARD WEDNESDAYS

Join MTI's executives for a series of practical walk-throughs focusing on friction welding technologies and processes. Learn first-hand, the best applications for Rotary, Linear, and Friction Stir Welding.

**LEARN MORE**  
[mtiwelding.com/video-center](http://mtiwelding.com/video-center)





**MTI Model 40 "Tabletop" Rotary Welding Machine**

The Model 40 is our miniature workhorse. It's used to produce parts ranging from super small bimetallic titanium specialty aircraft rivets 3/16" diameter x 1/2" long, to aerospace satellite heat dissipation tube assemblies 8" long x 1/2" diameter. This rotary friction welder truly does fit on a table top, but has the force and motion to handle a wide range of smaller parts.

**MTI Model 250 Rotary Friction Welding Machine**

This rotary friction welder is a workhorse equipped to handle a wide variety of parts. Playing an important role in the aerospace industry, the MTI Model 250 successfully joined copper to titanium for the TIRS-02 Cryocooler. An essential component, the TIRS-02 Cryocooler is part of a NASA initiative which uses thermal infrared sensors (TIRS) to measure the Earth's temperature.



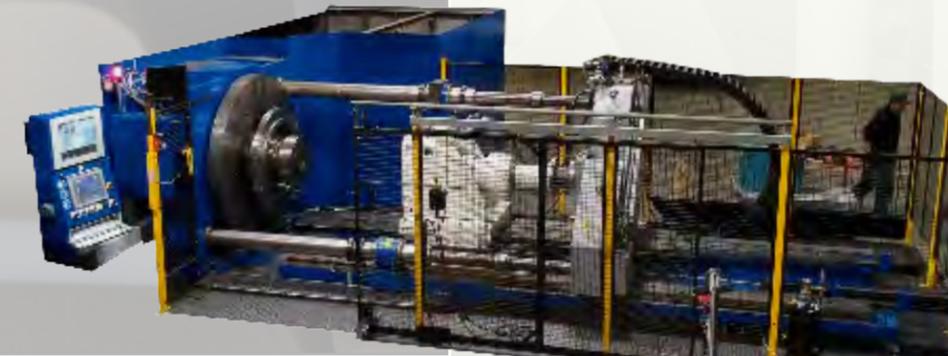
**MTI LS1 Dual-Headed Friction Stir Welding Machine**

One of the longest friction stir welding machines in the world. It's used for joining flat panels, plates, sheets, or extrusions of varying widths and lengths up to 55' long, and can be modified for longer lengths if required. The dual head capability allows for top and bottom welds simultaneously, thereby simplifying production. Ideal applications for this machine include extrusion joining, decking for ships and aircraft, railcar and truck trailer components, and general large-sheet, long-length or wide-width fabrication.



**MTI Model 400 Certified For Aerospace Applications**

The only machine of its kind, the model 400 is the **world's largest inertia friction welder available for contract welding**. Designed specifically for big jobs, this machine has up to 450 tons of weld force. We also maintain a large assortment of tooling for a wide span of weld forces. Plus, the 400 is ideal for "special" higher force large part applications.



"With over 800 MTI welding machines in operation today, MTI understands that each challenge might have its own unique solution, always making innovation a top priority."

"We maintain the widest range of friction welding equipment available, and with over 117,000 square feet of production space, we can produce friction-welded parts spanning from the smallest to the largest in the world."

MTI's Friction Stir Welding process development and part production is making a dramatic impact across many industries.



Quality is at the core of our ingenuity. MTI meets the stringent requirements of ISO9001, AS9100 and Nadcap AS7003.



Bimetallic parts allow us to put the expensive materials only where needed for cost-effective parts.



## — AT A GLANCE —

### MTI Single-Source Advantages

Joining & Welding Services	A wide array of equipment & processes to ensure rapid, quality turnaround times.
Feasibility & Prototype Studies	We know what works and what doesn't.
Metallurgical Evaluations & Testing	With an experienced metallurgical team, we offer a full-range of detailed testing & evaluations to confirm physical properties of the part & the weld zone.
On-site Metallurgist	Our staff Chief Metallurgist has 30+ years experience in metallurgy, including friction welding applications & heat-treating various metals.
R&D	With several <b>mechanical and product design engineers</b> on staff, we can alleviate your R&D manufacturing work-flow disruptions and provide innovative development & process solutions that can add savings & value to new and existing designs.
Process Optimization	Our staff of <b>process engineers</b> will partner with you to optimize part development & production processes so you don't have to face those daunting tasks alone.
Application Development	We work with you to make the transition from prototype to full production a smooth one, reducing time-to-product & cost.
Part Development	We offer you the increased flexibility for part development without interrupting your production.
Tooling	We maintain a large inventory of fixtures & tooling for all development and production machines; we stand ready when you are.

## -TAKE ADVANTAGE OF THE MTI DIFFERENCE-

### Your Partner and Advisor

1

Our desire to be your joining-solutions partner begins when you first meet with our team and continues throughout the life of your manufacturing process. Our team consists of fully knowledgeable mechanical, product design, and process engineers, as well as metallurgical support. As your partner, you'll have complete access to our engineering expertise to help you solve design and manufacturing problems so you can achieve your production goals.

### Ingenuity

2

**Innovative. Genuine. Continuity.** For four generations, Ingenuity has been the engine that drives MTI to achieve extraordinary success in solving our customers' most difficult manufacturing problems, always with an eye on them achieving stellar ROI.

### We Ask the Right Questions

3

Effective listening keeps us in-tune to you and your concerns. This sensitive ear-to-the-customer approach means we will provide the correct tooling to quickly and properly friction weld your parts. Through our customer intimate commitment, you'll quickly see how our production process know-how benefits you in every part we make.

### Ongoing Support Services

4

Partnering with us offers you many benefits, like our **Parts Assurance Program** that keeps your tooling warm. We can build your parts while your machine undergoes scheduled maintenance, is on order, or if you need extra production capacity. Additionally, we can manage your complete parts supply chain, and even adapt and streamline your process for developing new parts in the future. This enables you to get your new part to market faster than the competition.

“With our extensive experience and resources, we can produce tooling specific to any application.”



# OUR PROCESS THE MTI DIFFERENCE.



## QUALITY VERIFICATION

With ISO 9001, AS 9001, and Nadcap Aerospace certification, plus welding approvals from major jet engine and aerospace companies, you can rest assured the solutions we provide you are of the highest quality.

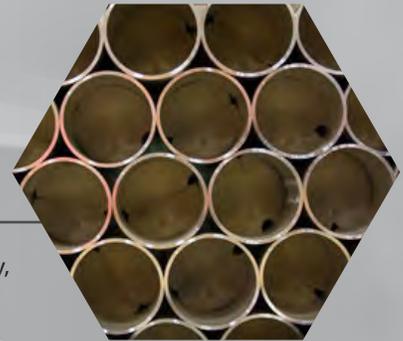
## METALLURGICAL EVALUATIONS

To help you assess the strength, durability and general integrity of weld zones, our staff metallurgists can provide you with a full range of detailed and quantified metallurgical evaluations.



## MATERIAL PROCUREMENT

To save you time and money, and ensure a superior end-product, we work with a variety of suppliers to secure the ideal materials and alloys to get the job done.



## COST CONFIRMATION

Whether you're investing in a friction welding machine, integrated automation, or you require parts development and production from our Manufacturing Services group, we guide you through all the costs involved to ensure you know where your money is going.



## CONTACT SALES

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## MANUFACTURING SERVICES

574.233.9490 | 44.1384.277502 | [MTIwelding.com](http://MTIwelding.com)

Peace of mind is complete confidence, knowing you have the finest contract welding team in the world, backed by unparalleled support at all times. It's knowing that obstacles to keeping your part production operating at optimum output will be met with a quick, sure-handed response.

