

# ROTATIONAL FRICTION WELDING

MANUFACTURING TECHNOLOGY, INC



MTI is a world leader in designing and manufacturing friction welders, and offers a full line of all three main types of Rotational Friction Welding machines – Inertia, Direct Drive, and Hybrid.

## WHAT IS ROTATIONAL FRICTION WELDING?

Rotational Friction Welding is a solid-state joining process that produces coalescence in metals, or non-metals using the heat developed between two surfaces by a combination of mechanically-induced rotational rubbing motion and applied load. Under normal conditions, the fraying surfaces do not melt.

There are three basic types of Rotational Friction Welding: Inertia Welding, Direct Drive Welding, and Hybrid. Other variations include: Radial, Orbital, Linear or Reciprocating Welding and Friction Stir Welding.

## WHY ROTATIONAL FRICTION WELDING?

Rotational Friction Welding does not compromise the integrity of the parent materials during welding – resulting in stronger welds, more uniform part properties, and higher joint efficiencies. Even materials and geometries deemed unweldable are able to be joined using Rotational Friction Welding.

## UNIQUE ADVANTAGES – SAVES COST, TIME, MATERIAL

- Since dissimilar metals can be joined, a significant cost savings is possible.
- Expensive forgings and castings can be replaced with less expensive forgings welded to bar stock, tubes, plates, etc.
- Significantly faster than conventional methods of welding.

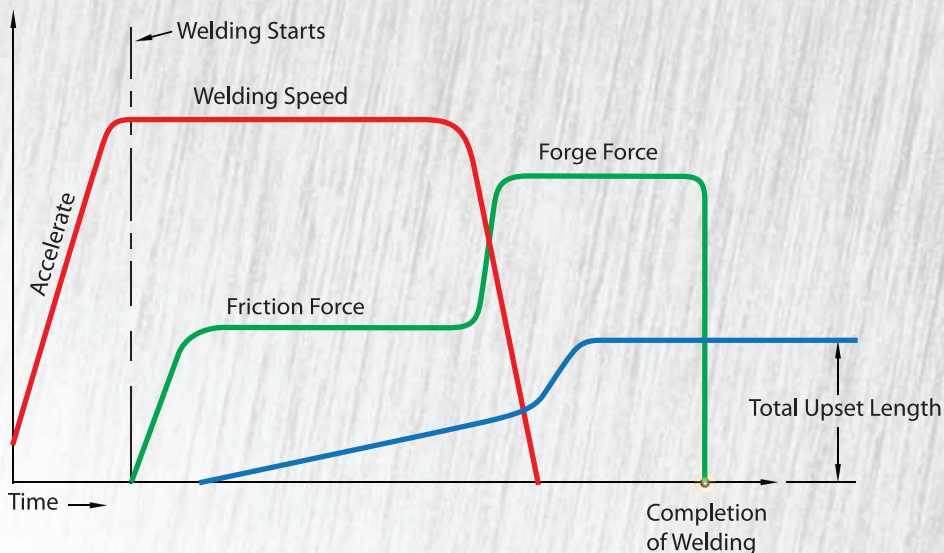
## TOP TEN ADVANTAGES:

1. The machine-controlled process eliminates human error—weld quality is independent of operator skill.
2. Dissimilar metals can be joined—even some considered incompatible or unweldable.
3. Consumables are not required—no flux, filler material, or shielding gases are needed.
4. Only creates a narrow heat-affected zone, which results in more uniform properties throughout the part, higher joint efficiencies, and stronger welds.
5. The 100% bond of the contact area creates joints of forged quality.
6. Reduces raw material and machining costs when replacing forgings.
7. Environmentally friendly, producing no smoke, fumes, or slag.
8. Energy efficient, using the least energy consumption of all welding processes.
9. Provides strong welds for all geometries.
10. Joint preparation isn't critical—machined, saw cut, and even sheared surfaces are weldable.

I N E R T I A - D I R E C T D R I V E - R A D I A L - L I N E A R - S T I R - R E S I S T A N C E

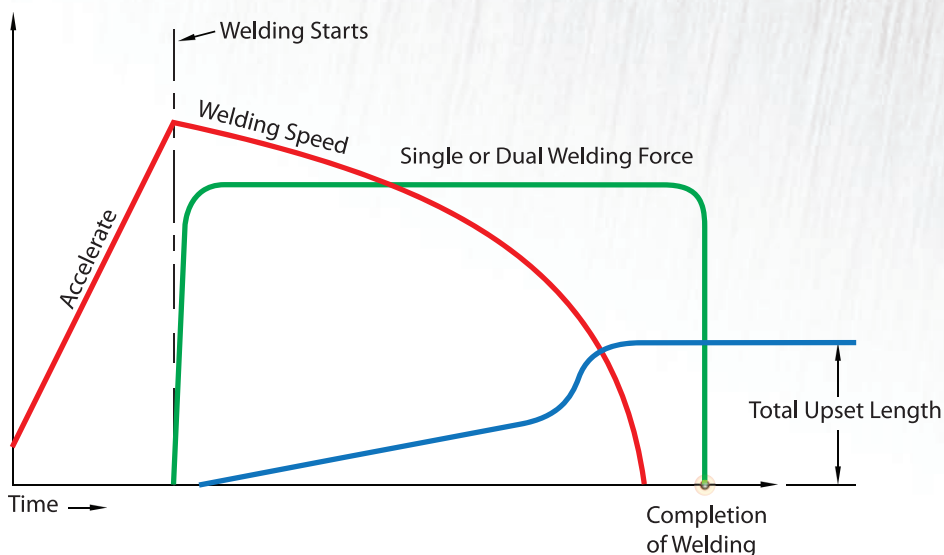
[www.mtiwelding.com](http://www.mtiwelding.com)

## DIRECT DRIVE



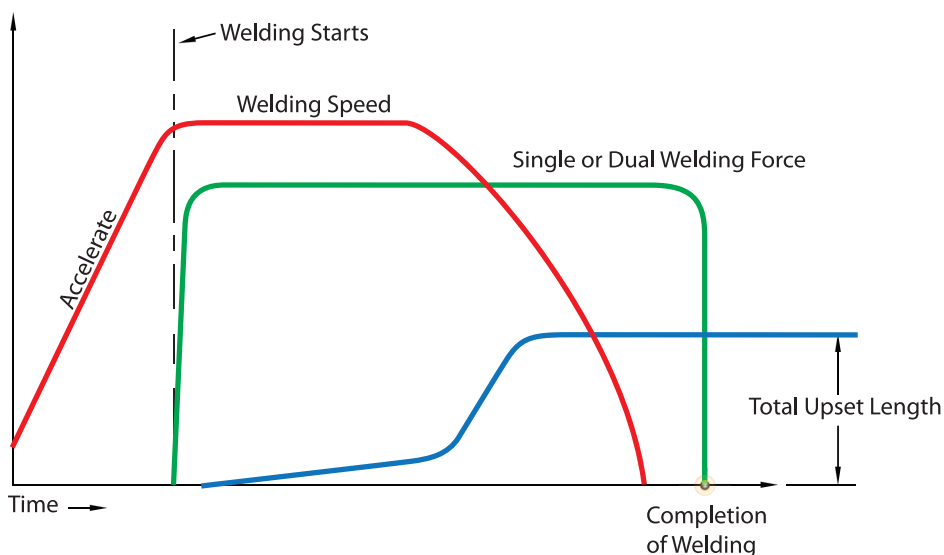
The welding energy is infinite coming from a Direct Drive motor. Parameters (variables) are: RPM, Friction and Forge Force, Time and Distance, and Breaking Time. This weld process is best applied for solid diameter bars up to 250 mm. To improve weld quality, the spindle can turn during the forge phase. Flash turning is easier than on an Inertia welder.

## INERTIA DRIVE



Welding energy is stored in a flywheel. Parameters (variables) are normally reduced to two: RPM and Force. Friction Pressure equals Forge Pressure. This process is best applied for large tubular sections, without the need to consider the size of the spindle drive. It also has advantages for plate to tube applications, which need high energy pulses at the beginning of the weld cycle to penetrate the plate material. The flywheel effect intermixes more hot metal at the end of the weld cycle than in Direct Drive.

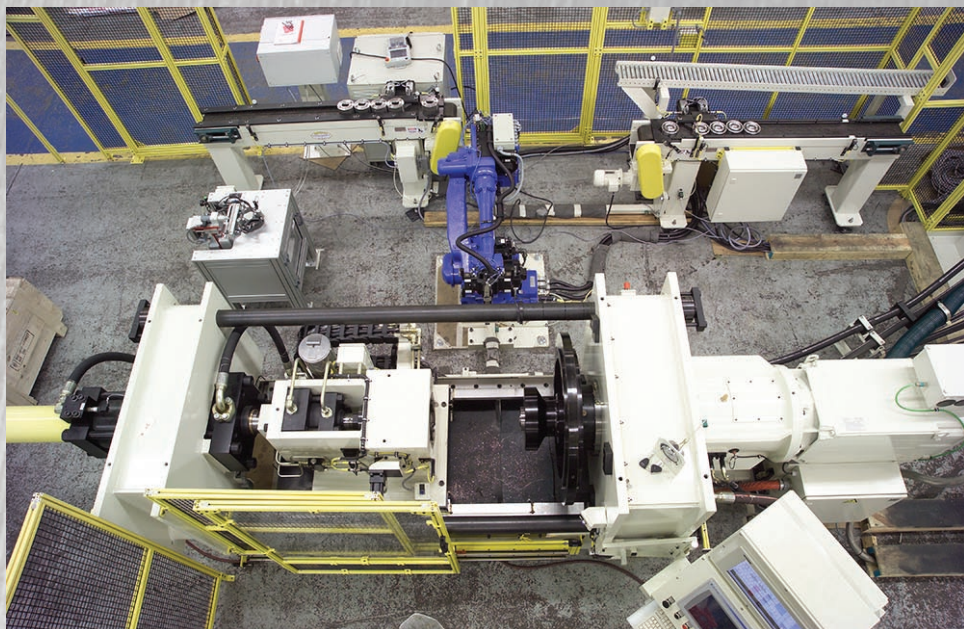
## HYBRID DRIVE



This variation combines the infinite weld energy source of the Direct Drive with the flywheel effect of Inertia. It is best applied for pre-heat on materials which need slower post-weld, cooling rates or materials which are brittle at ambient temperatures. The Hybrid process is also used for various super-alloy combinations such as large ship diesel valves or turbochargers.

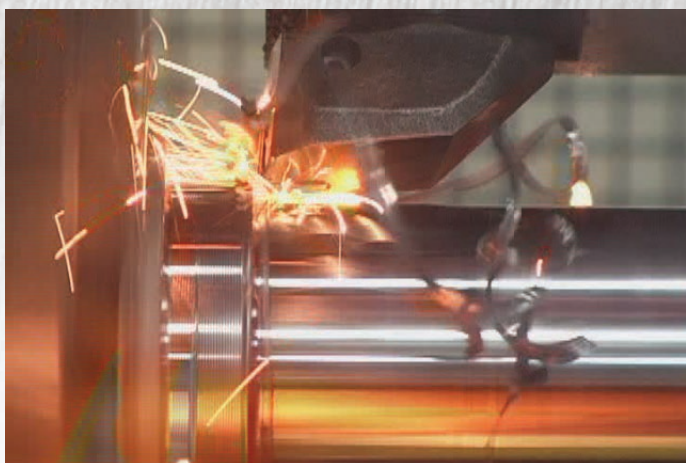
## AUTOMATION

Automation using robots, gantries, or pick-and-place systems are available. MTI offers integration and turn-key systems.



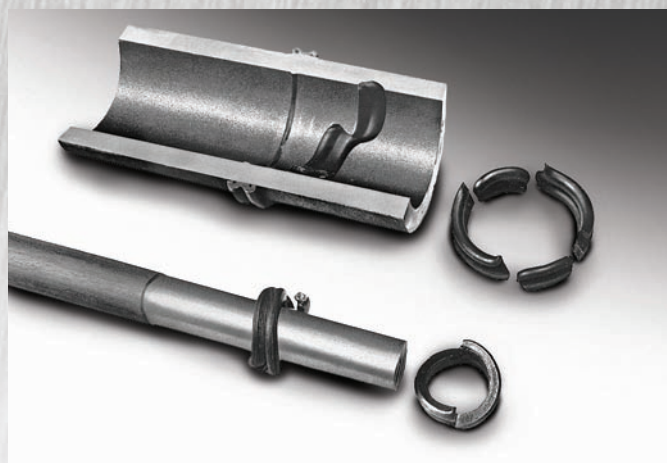
## FLASH TURNING

On-machine Flash Turn Off (FTO), or plunge-cut, is available to remove post-weld flash.



## FLASH REMOVAL

If applicable, inside diameter or outside diameter flash can be sheared off directly in the machine.

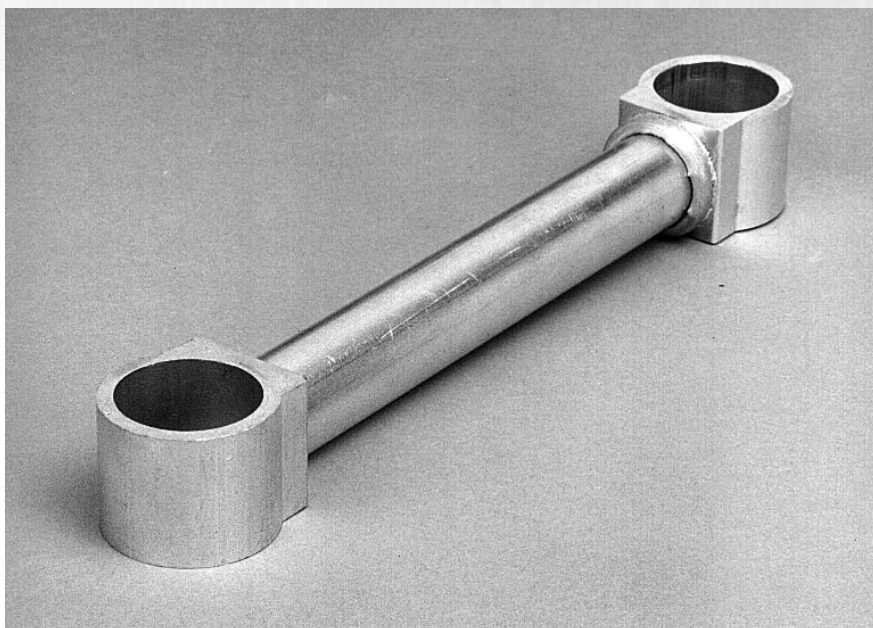


## ORIENTATION

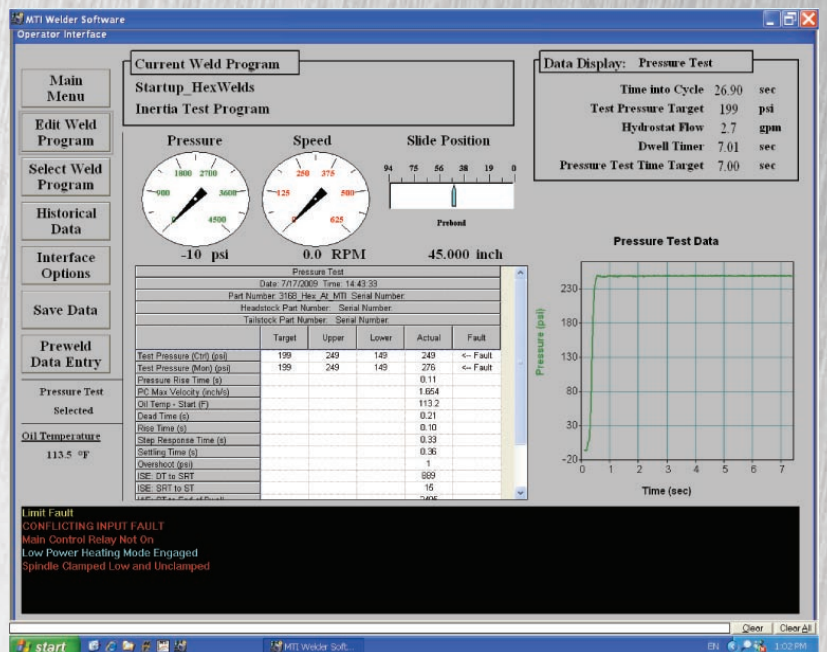
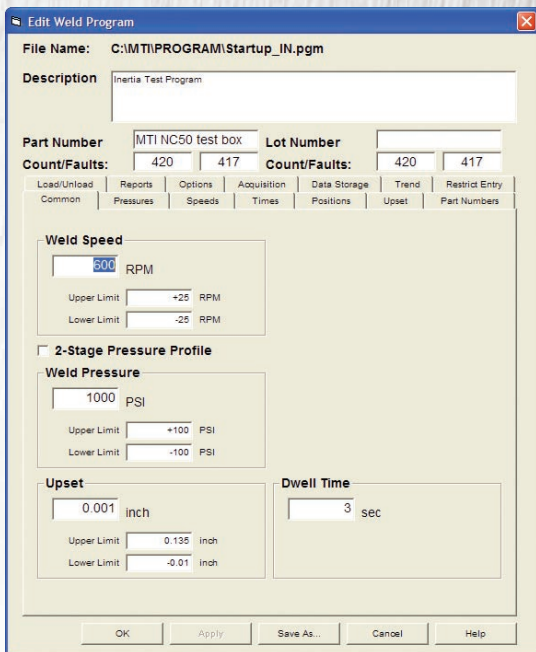
Orientation of one part to the other is possible using any of MTI's Rotational Friction Welding processes and machines.

## LENGTH CONTROL

Welding to a specific length or to a specific burn-off is possible using any of MTI's Rotational Friction Welding processes and machines.



INERTIA - DIRECT DRIVE - RADIAL - LINEAR - STIR - RESISTANCE



## MACHINE OPTIONS/CAPABILITIES DIAGNOSTICS/MAINTENANCE

Machine diagnostics display messages to describe the fault, reason, and possible action to eliminate machine disruptions. Remote diagnostics from our factory is available upon request.

## PARAMETER INPUT AND CONTROL

Weld parameters are input via Windows XP® in a typical weld schedule format. This includes tolerance windows and storage of weld data, as well as parameter fault messages.

## FLASH REMOVAL OR PLUNGE-CUT

If applicable, inside diameter or outside diameter flash can be sheared off directly in the machine.

## ORIENTATION

Orientation of one part to the other is possible using any of MTI's Rotational Friction Welding processes and machines.

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## MACHINE DESIGN ADVANTAGES SPINDLES

MTI offers a wide range of spindle designs for high-speed applications and heavy loads. MTI uses hydrostatic axial bearings. Hydrostatic bearings allow the maximum machine force to be applied dynamically during welding.

## SLIDES

All slide tables are running on roller or linear ball bearings. No metal-to-metal sliding contact.

## DRIVES

Hydraulic drive motors are mostly used for Inertia machines, where Electric AC motors are used for Direct Drive and Hybrid machines. All machines have variable speed ranges.

## TRANSMISSION

Transmissions, brakes, and clutches are eliminated by directly coupling the electric spindle motor to the spindle and using the regenerative braking capability of the drive. In Inertia Welding, external braking is not necessary.

## TOOLING

Fixturing and tooling is designed and built by MTI for the application.

## SERVICE

Direct factory service is available from each of our three worldwide facilities.



**Manufacturing Technology, Inc.**  
Solid-State Joining & Welding Solutions, Equipment & Services

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