In friction welding, one component is rotated while the other component is held stationary. The part being rotated is brought into contact with the stationary part. Rotation continues until enough heat is generated to bring the components to a plastic state and the desired burn off has been achieved, which then the rotation is stopped. Axial force is applied between the two components being welded to result in a solid state bond at the interface forming a friction welded joint.

1954: A.I. Chudicov of the Soviet Union succeeds in friction welding trial

1956: Friction welding technology started being developed by the Soviet Union’s welding R&D center

1961: BWRA (British welding R&D) and Japan also join the development of friction welding in the mid 1960, and friction welding becomes commonly used up until the present day.
CNC Friction Welding Machine (Angle control)

Benefits of CNC Friction Welding

- **Improve Productivity**
  - Reduce cycle time due to precisely control speed using servo motors
  - Increase operational stability without oil temperature change
  - Reduce setup time using servo that automatically adjusted to the length of the material

- **Enhance Quality**
  - Result in precise weld with the servo motor and ball screw control
  - Minimize quality variance due to oil temperature change
  - Achieve highly precise angle control with servo motor control

- **Save Costs**
  - Reduce cycle time with minimized machine idle time
  - Small footprint required due to compact design

- **Green Technology**
  - Reduced CO2 gas
  - Reduced noise and oil waste with a small sized hydraulic unit

CNC Friction Welding Machine

<table>
<thead>
<tr>
<th>Technical Data</th>
<th>CNC 5 SF/DF</th>
<th>CNC 12 SF/DF</th>
<th>CNC 22 SF/DF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal forge load</td>
<td>ton</td>
<td>5</td>
<td>12</td>
</tr>
<tr>
<td>Stop angle accuracy</td>
<td>Angle</td>
<td>±0.5°</td>
<td></td>
</tr>
<tr>
<td>Weldable range (mild steel)</td>
<td>mm</td>
<td>6~20</td>
<td>10~30</td>
</tr>
<tr>
<td>Spindle rotation</td>
<td>rpm</td>
<td>3,000</td>
<td>2,000</td>
</tr>
<tr>
<td>Spindle stroke</td>
<td>mm</td>
<td>250</td>
<td>300</td>
</tr>
<tr>
<td>Max weld area (mild steel)</td>
<td>mm²</td>
<td>350</td>
<td>800</td>
</tr>
</tbody>
</table>
Single/Double Headed CNC Friction Welding Machine for Torque Rods

CNC 22SF/DF, a horizontal type single headed CNC friction welding machine, is designed and built for clients who need to friction and forge weld automotive components such as torque rods in ASTM A513/519 steel with the maximum welding area of 1500㎟ welded at maximum welding force of 10 tons, and forging force of 22 tons under total cycle time of 50 seconds including loading and unloading.

Our recent automotive parts manufacturer inquired about the single headed CNC friction welding model CNC 22SF/DF for friction welding of torque rods shafts 50 to 100 mm. Our CNC friction welding machine was designed with 2 jawed self-centering clamp at the fixed axis and 2 jawed chuck at the rotational axis. The machine comes with robust 2-axis flash removal unit and CNC control for an in-machine flash removal capabilities. The welding parameters was designed to monitor the friction and forge force, total upset amount, friction time, main axis rpm and length of weld for quality assurance of welded joints.

CNC 22SF/DF’s main axis was designed to rotate at 1800 rpm maximum with inverter control and 2 sets of hydraulic disk brake that stops within 0.5 seconds. Both Hydraulic oil tank and the oil cooling unit are installed separately from the machine with Y brand Solenoid Valve and reducing valve for slid control and pressure control respectively. And, with welding precision of ±0.5 mm length between datum faces, and 0.15mm mismatch of axes at weld, this welding machine provides high precision control.

CNC 22SF/DF is powered mainly by AC 220V 60Hz with spindle motor at 60 KW 2000RPM and cutting motor of 3KW 3,000 RPM. CNC 22SF Friction Welding Machine provides excellent machine accuracy, with the main axis vibration tolerance of 0.02mm, chuck install face vibration tolerance of 0.02mm and parallel head chuck center line and sliding tolerance of 0.05mm per 100mm.

CNC 22SF/DF’s the welding operating system has a touch panel with industrial PC where all the operating information is communicated with the PLC and saved into the PC; it also allows your engineers to easily make changes in the welding parameters for special customization. You can view the real-time display of friction pressure, forged pressure, RPM, and part length value.
Single Headed CNC Friction Welding Machine for Automotive Parts

**CNC 22SF**

<table>
<thead>
<tr>
<th>Model</th>
<th>Spindle Speed</th>
<th>Maximum Forge Force</th>
<th>Maximum Solid Diameter</th>
<th>Maximum Weld Area</th>
<th>Spindle Drive Motor</th>
</tr>
</thead>
<tbody>
<tr>
<td>CNC22SF</td>
<td>2,000 rpm</td>
<td>22 Ton</td>
<td>Ø 100 mm</td>
<td>1,500 mm²</td>
<td>60KW</td>
</tr>
</tbody>
</table>

![Diagram of CNC 22SF machine](image-url)
Double Headed CNC Friction Welding Machine for Automotive Parts

CNC 22DF

<table>
<thead>
<tr>
<th>Model</th>
<th>Spindle Speed</th>
<th>Maximum Forge Force</th>
<th>Maximum Solid Diameter</th>
<th>Maximum Weld Area</th>
<th>Spindle Drive Motor</th>
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<tr>
<td>CNC22DF</td>
<td>2,000 rpm</td>
<td>22 Ton</td>
<td>Ø 100 mm</td>
<td>1,500 mm²</td>
<td>60KW</td>
</tr>
</tbody>
</table>
Friction Welding Machine Options

Process monitoring
- Displays important parameters
- Data from every weld is stored and easily retrieved

Information Displayed
- Machine status and diagnostics
- Welding parameter database
- Record of each welding cycle
- Alarm conditions

Flash Removal
- Turning
  - Applicable to spinning machines only (1 and 2 axis NC)
- Shearing
  - I.D or O.D flash can be sheared off directly
  - Applicable to non-spinning machines only

Angle Control
- Mechanically or electrically controls angles on both ends of the product after welding when certain angles are required for applications such as propeller shafts

Auto Stopper
- Reduce setup time using servos that automatically adjusted to the length of the material
Advantages of Friction Welding

- **Weld Dissimilar Metals**
  - Dissimilar metals can be joined
    - Steel + Stainless steel
    - Steel + Powder metal
    - Cu, Al + Stainless steel

- **Non-ferrous metal can be joined**
  - Al + Cu
  - Al + Al or Cu + Cu

- **Reduces Material Costs**
  - Substitution with less costly materials
    - S45C
    - SUS304

- **Reduces Scrap Parts**
  - No need to clean machine chips

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Advantages of Friction Welding

- **Reduces Weight**
  - Forged parts → F.W → Use pipe

- **Reduces Forgings Cost**
  - Solid forging → Forged parts + Friction welding

- **Improves Process**
  - Gun drilling → F.W → Pipe welding

- **Enhanced air tightness at joining section**

- **Elimination of leak inspection process**

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# Hydraulic Friction Welded Samples

## Automotive Components

<table>
<thead>
<tr>
<th>Propeller Shaft / Driveshaft</th>
<th>Camshaft</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intermediate Shaft</td>
<td>Universal Joint</td>
</tr>
<tr>
<td>Driveshaft</td>
<td>Constant Velocity Joint</td>
</tr>
<tr>
<td>Shock Absorber Rod</td>
<td>Worm Gear Driveshaft</td>
</tr>
<tr>
<td>Torque Converter</td>
<td>Turbo Chargers</td>
</tr>
<tr>
<td>Engine Valves</td>
<td>Engine Piston</td>
</tr>
<tr>
<td>Compressor Piston</td>
<td></td>
</tr>
<tr>
<td>Rear Axle Shaft</td>
<td>S-Cam Brake</td>
</tr>
<tr>
<td>Driveshaft Yoke</td>
<td></td>
</tr>
<tr>
<td>Rear Axle Housing</td>
<td>Torque Rod</td>
</tr>
</tbody>
</table>

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# Hydraulic Friction Welded Samples

## Construction Equipment Components

<table>
<thead>
<tr>
<th>Hydraulic Piston Rod</th>
<th>Track Roller Bushing</th>
<th>Track Roller</th>
</tr>
</thead>
</table>

## Electric Components

<table>
<thead>
<tr>
<th>Cable Connector</th>
<th>Battery Terminal</th>
<th>Motor Shaft</th>
</tr>
</thead>
</table>

## Machine Components & Ect.

<table>
<thead>
<tr>
<th>Print Roller</th>
<th>Hose Coupling</th>
<th>Pipe Flange</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Drill Pipe</th>
<th>Tool Holder</th>
<th>Gear Shaft</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Hydraulic Pump Piston</th>
<th>Steel Ball</th>
<th>Flange</th>
<th>Oriented Steel Hex</th>
</tr>
</thead>
</table>