

Ultrasonic metal welding process:

- Consists of joining two metals by applying ultrasonic vibrations under moderate pressure
- The overlap zone - softened between the parts to be welded – solid-state weld by shearing and plastic deformation
- The oxide –removed by the high frequency vibration – metal/metal contact between parts – metallic bonds

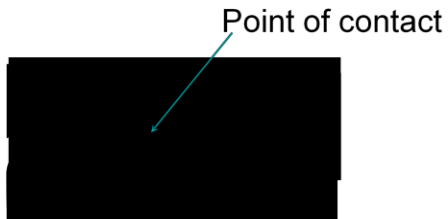
Ultrasonic metal welding process:

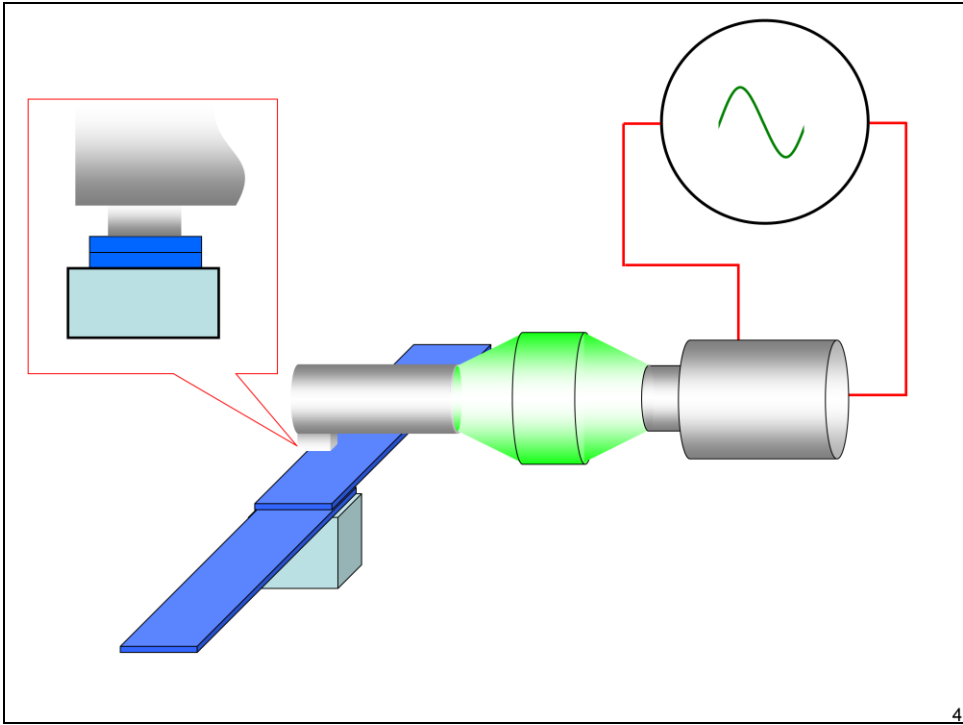
Solid-state welding process – *three stages:*

1. The pressure (applied by the horn) deform the asperities peaks which are smoothed; surfaces brought into close contact to each other
2. Diffusion of atoms and exchange of electrons in the joining surfaces
3. Formation of a strong joint between the parts

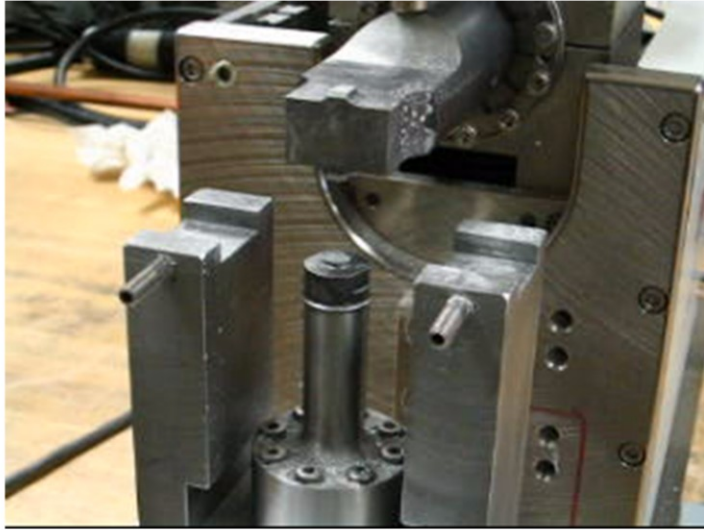
Asperity peak deformation

- When two interfaces are brought together, asperity peaks prevent intimate contact





Welding video



Ultrasonic metal welding system

Equipment:

- System components: transducer (converter), booster, horn

↳ *Resonates at a particular frequency to maximize the overall efficiency*

- **Power supply:** - converts line voltage electrical power into high frequency electrical energy
- **Converter:** - changes electrical energy into low-amplitude mechanical vibrations of the same frequency
- **Booster:** - increases or decreases the amplitude of the vibrations
- **Horn:** - transmits the vibrational energy from the booster into the workpieces

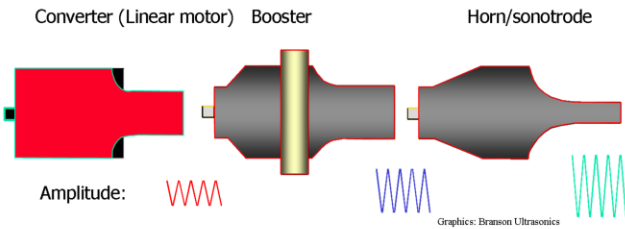
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Resonate: To vibrate at the resonant frequency or natural frequency. This means that when excited by an external force, the system will vibrate at this frequency. For example, if you hit a bell or tuning fork they vibrate at a particular (resonant) frequency. In mechanical terms, it is the frequency where very little force at a frequency produces a very large amount of displacement (Low impedance). $I=F/v$

Ultrasonic metal welding

Tooling

Ultrasonic stack assembly:



Converter:

- Uses piezoelectric elements which expand and contract when excited by the high-frequency voltage (900 VAC)

Ultrasonic metal welding

- **Welding modes:**

- Energy:**

- A preset energy dissipated - the power supply discontinues the ultrasonic energy, independent of the time

- Postheight:**

- Power supply monitors an encoder on the actuator and applies sonics to the parts until the preset postheight occurs

- Time:** - Sonics remain on for a preset length of time

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Encoder: transducer that converts displacement into an electrical signal
E=integral of power

Ultrasonic metal welding

Amplitude and amplitude profiling:

Amplitude:

- Peak-to-peak displacement of the horn at its work face in μm or in
- Controlled electrically by adjusting the voltage into the converter

Amplitude profiling:

- Performs a weld using two different amplitude settings
- The trigger point for the A to B transition during the weld - time method

Ultrasonic metal welding

