

Resistance Spot Welding for Automotive Solenoid Valve — Enameled Wire to Pin Connection

Pin-type wound inductors are components that convert electrical energy into magnetic energy for storage. When current flows through the circuit, the inductor opposes changes in current; when the circuit is open, it attempts to maintain the current. Wound inductors are widely used in communication equipment, automotive components, home appliances, and industrial equipment. They typically consist of a bobbin, winding, shielding cover, encapsulation material, and a magnetic or iron core. The insulation wire used for winding is enameled wire (also known as magnet wire), and to conduct electricity, one end of the enameled wire must be connected to a metal pin.



Figure 1: Pin-type wound inductors with enameled wire connections

Traditional Soldering Method

The traditional method for connecting enameled wire to pins on pin-type wound inductors is soldering. Soldering uses a soldering iron to heat and melt low-melting-point solder (tin melting point: 231.89°C), which fills the gaps at the metal connection points to achieve a fixed joint.

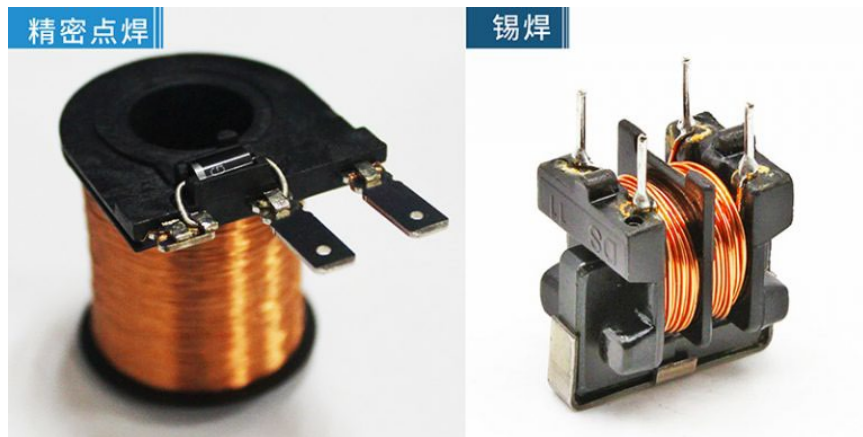


Figure 2: Traditional soldering process for inductor enameled wire

However, soldering of inductor enameled wire is a manual operation with low consistency. During dip soldering, if the bottom of the magnetic core contacts the solder pot, solder spatter forms. If operators do not detect this in time, the spatter may detach during operation due to vibration, causing electromagnetic interference. Additionally, when the soldering iron leaves the solder joint, it may pull up solder spikes (icicles), requiring rework or scrapping. Beyond unattractive solder joints and the consumption of solder flux, the soldering process also pollutes the working environment.



Figure 3: Common soldering defects — spatter, spikes, and inconsistent joints

Resistance Spot Welding Process

Without solder or flux and without contaminating non-welded areas, resistance spot welding is the preferred method. Resistance welding applies pressure to the workpieces while passing

current through the electrodes and the contact area between the enameled wire and the pin. The resulting resistive heat heats the contact surface to forge a welded joint.

Resistance spot welding offers significant advantages:

Advantage	Description
No Filler Required	Eliminates solder consumables, reducing material costs
Machine Operation	Automated process ensures consistent, repeatable weld quality
High Joint Strength	Base metals fuse together, producing strong metallurgical bonds
Low Contact Resistance	Excellent electrical conductivity at the welded connection
Thermal Stability	Joints do not detach due to elevated ambient temperatures
Clean Process	No flux residues, no environmental contamination, no spatter

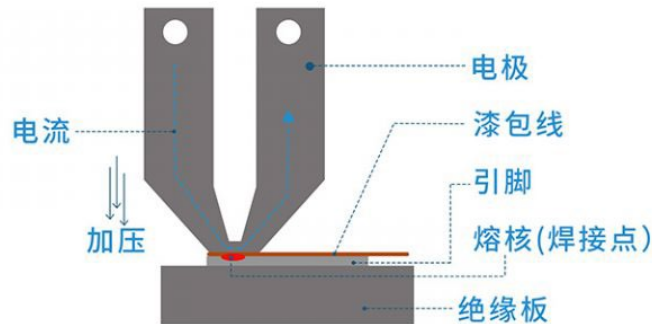


Figure 4: Resistance spot welding principle — electrode, current, pressure, and weld nugget

Application Summary

Resistance spot welding is the ideal solution for connecting enameled wire to metal pins on automotive solenoid valves and pin-type wound inductors. Compared to traditional soldering, it delivers superior joint strength, consistent quality through automated operation, excellent electrical conductivity, and a clean manufacturing process — all without solder, flux, or thermal damage to surrounding components. This makes it particularly suited for high-volume automotive production where reliability and consistency are critical.