

Cold-joint wires



Overview

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Key Takeaways

A cold joint occurs when solder fails to properly melt and bond with the wire or pad, creating a weak, brittle, and high-resistance electrical connection. What is a Cold Joint?

A cold solder joint happens when the solder does not reach the proper melting temperature or fails to wet the metal surfaces fully. Instead of forming a strong metallurgical bond, the solder sits on top of the wire or pad, resulting in a connection that may conduct electricity initially but is prone to failure due to high resistance and mechanical brittleness ().

How to Identify Cold Joints

- **Visual Inspection:** Cold joints often appear dull, grainy, rough, or crystalline, unlike smooth and shiny properly soldered joints. Lead-free solder is naturally duller, so look for a "dry" or cracked appearance ().
- **Shape:** Proper solder forms a concave meniscus around the wire or pad. Cold joints may have irregular shapes or poor wetting.
- **Electrical Testing:** Using a multimeter in resistance mode, a cold joint may show fluctuating or higher-than-expected resistance when the wire is gently pressed or wiggled ().

- X-Ray Inspection: For components like BGAs or QFNs, visual inspection is impossible. Cold joints appear as lighter, less dense areas under X-ray ().

Causes of Cold Joints

- Insufficient heat from the soldering iron
- Dirty or oxidized surfaces
- Improper soldering technique
- Using lead-free solder, which melts at higher temperatures than traditional tin-lead solder ()

How to Prevent Cold Joints

- Set the soldering iron to the correct temperature (typically 350–400°C for lead-free solder) ()
- Clean surfaces: Remove oxidation from wires and pads before soldering
- Use flux: Helps remove oxides and improves solder flow
- Heat the joint evenly: Apply solder to the heated joint, not directly to the iron tip
- Allow proper flow: Keep the solder in contact for a few seconds to ensure bonding
- Inspect joints: Look for smooth, shiny surfaces and proper wetting ()

Fixing Cold Joints

- Apply fresh flux to the joint to remove oxides
- Reheat the joint evenly until the solder flows and bonds properly
- Add a small amount of solder if necessary to ensure a solid connection ()

Summary

Cold joints are a common cause of intermittent or failed electrical connections. Proper soldering technique, adequate heat, clean surfaces, and flux use are essential to prevent them. Regular inspection and testing can help identify and correct cold joints, ensuring reliable and durable wire connections in electronics projects ().

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