Cold Shut in Die Casting — The Hidden Quality Risk Behind Surface Lines

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I. The Problem Statement

In zinc alloy die casting production, a common surface defect is often overlooked: **irregular linear lines or depressions on the casting surface that temporarily disappear after polishing, only to reappear after plating.**

Many die casting shop owners think: “It’s just a surface line, polishing will fix it.” But that’s not the case.

❓ **This line is not a surface issue — it is a hidden internal defect.**

It has a specific name: Cold Shut (also known as Cold Lap or Cold Fold).

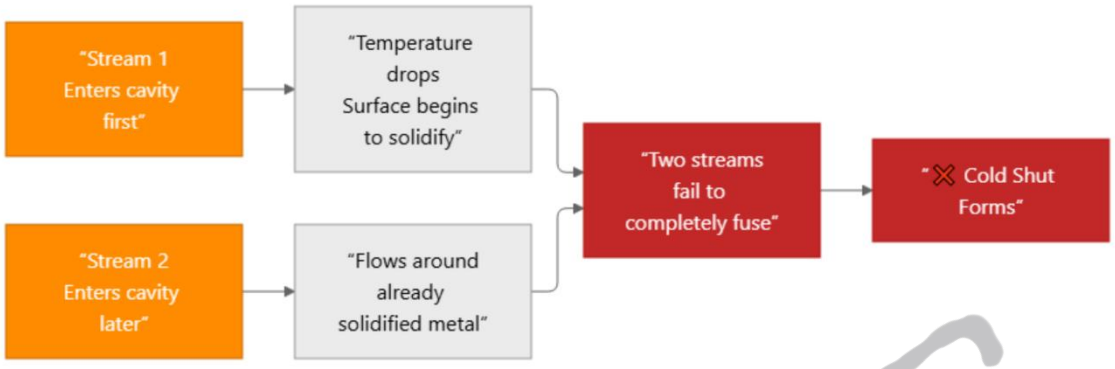
A cold shut won’t cause rejection at the casting stage, but it will hide beneath the plating layer and surface after delivery.

II. Definition and Identification of Cold Shut

2.1 What is a Cold Shut?

A cold shut occurs when two or more streams of molten metal fail to completely fuse during flow in the die cavity.

Simply put: two streams of molten metal meet, but the temperature is too low for them to fuse together.



2.2 Characteristics of Cold Shut

🔍Characteristic	Description
Appearance	Uneven surface with irregular, depressed linear lines
Location	Often on wide surfaces, thin-wall sections, or where metal streams meet in the cavity
Morphology	Linear pits with rounded edges
Internal	Weak bonding between two metal streams — looks like a seam on the surface, but is separated inside

2.3 Cold Shut vs. Flow Lines: How to Distinguish

Comparison Dimension	Cold Shut	Flow Line (Flow Mark)
Root Cause	Two metal streams fail to completely fuse	Trace left by thin metal layer that entered first being covered by subsequent metal
Severity	⚠ Structural defect, separated internally	Surface mark, does not affect structure
Plating Consequence	❌ Plating solution penetrates, blisters during baking	Generally does not affect plating
Can polishing remove it?	⚠Surface temporarily disappears, internal defect remains	✅ Generally removable by polishing

Core distinction: Cold shut is "not fused together"； flow line is “one layer covered by another.”

Ⅲ. Root Cause Analysis of Cold Shut

Cold shut formation involves multiple factors. Below are the six industry-recognized root causes:

❌ Cause	Explanation
Low pouring temperature	Molten metal temperature is insufficient; it cools too quickly after entering the cavity and cannot fuse with subsequent metal flow
Low mold temperature	Mold temperature is insufficient; metal cools too quickly in the cavity
Incorrect alloy composition, poor fluidity	Alloy fluidity is insufficient to fully flow and fuse within the cavity
Poor gate design, long flow path	Metal flow path is too long; temperature drops too much before reaching the merge point
Low filling speed	Metal filling speed is insufficient to complete fusion before solidification
Low pressure	Injection pressure is insufficient for full cavity filling

3.1 Cold Shut from a Material Supplier‘s Perspective

Among the six causes above, two are directly related to the **material side**:

1. **Incorrect alloy composition, poor fluidity** — The aluminum, copper, and magnesium content in the alloy significantly affects fluidity. High impurity levels (such as lead, cadmium, and iron) also reduce alloy fluidity. **The material’s inherent fluidity directly determines the risk level of cold shut**.
2. **Low pouring temperature** — While pouring temperature control falls within the die casting process domain, the material‘s **melting characteristics** and **temperature window** determine the process operating range. Materials with better fluidity have lower cold shut risk at the same temperature.

Other causes (mold temperature, gate design, filling speed, pressure) belong to the die casting process side and are not covered in this article.

IV. Impact on Finished Product Quality

4.1 The Concealment of Cold Shut

The most troublesome aspect of cold shut is its **concealment**:

- Visible surface lines after casting **temporarily disappear after polishing**
- But the defect is not eliminated — **only the surface is smoothed**
- The internal separated interface remains; structural integrity is not restored

4.2 Plating Blisters — The "Time Bomb" of Cold Shut

When a casting has cold shut lines, plating solution penetrates into the cracks. During baking, it turns into vapor, and the pressure pushes up the plating layer, forming blisters.



Consequence chain of cold shut:

- During casting: Surface lines visible, may be ignored
- After polishing: Surface temporarily smooth, problem seems solved
- During plating baking: Solution penetrates → evaporates → pressure pushes up plating layer → **blisters**

Blisters are one of the most common defects in zinc alloy die casting, and cold shut is one of their root causes.

4.3 Long-Term Risks of Cold Shut

Risk Stage	Manifestation
Casting Stage	Visible linear lines on surface, partially ignored
Post-Processing Stage	Polishing temporarily removes surface marks, but internal defect remains

Risk Stage	Manifestation
Plating Stage	Solution penetrates → baking causes blisters → batch scrap
Customer Stage	Blistered parts surface after delivery, leading to returns, complaints, and reputational loss

Cold shut won‘t cause immediate rejection, but it will cost you more after delivery.

V. Material Supplier Perspective: How to Reduce Cold Shut Risk from the Material Side

As a material supplier, we cannot control our customers’ mold design, die casting parameters, cooling systems, or other process-side factors. However, we can do three things well on the **material side**:

✅ Material-Side Measure	Impact on Cold Shut
Optimize alloy composition for better fluidity	Materials with better fluidity have stronger cavity-filling capability at the same pouring temperature, reducing cold shut risk
Strict impurity content control	Impurities (lead, cadmium, iron, etc.) reduce fluidity and increase cold shut tendency
Provide stable batch-to- batch consistency	Minimal composition variation means customers don‘t have to retune process parameters for each batch

5.1 Fluidity: The First Line of Defense Against Cold Shut

The essence of cold shut is metal “failing to fuse.” **Materials with better fluidity flow and fuse more easily within the cavity under the same temperature and pressure conditions**.

Key factors affecting zinc alloy fluidity include:

- Aluminum content: Aluminum improves fluidity, but excessive content may lead to intergranular corrosion
- Copper content: Copper enhances hardness and wear resistance but reduces fluidity
- Magnesium content: Trace amounts refine grain structure and improve overall performance
- Impurity control: Lead, cadmium, iron, and other impurities significantly reduce fluidity

A core value of Xinyi Zinc's 133+ Process — in-house master alloy, three furnaces, three purifications — is ensuring precise composition, ultra-low impurities, and stable fluidity in every batch.

5.2 Batch Stability: Helping Customers "Stop Gambling"

When material composition fluctuates between batches, die casters face a dilemma:

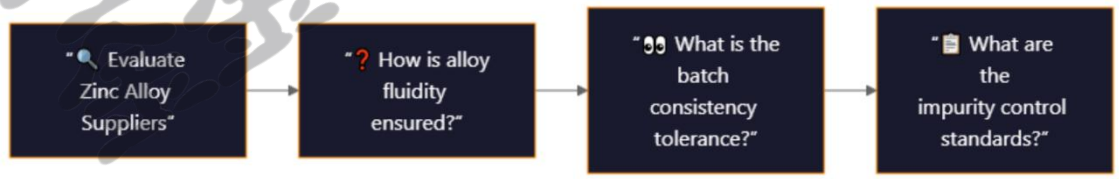
- This batch has good fluidity → process parameters work → castings are normal
- Next batch has poor fluidity → same parameters → cold shuts appear frequently

Die casting operators have to retune parameters and "find the feel" for every batch.

Batch stability directly determines customers' production efficiency and yield stability. This is why we emphasize: **composition deviation ≤ ±0.5%, stable batches, consistent quality.**

VI. Recommendations for Customers

When evaluating zinc alloy suppliers, we recommend paying attention to the following three questions:



The root cause of cold shut lies in fluidity; the root cause of fluidity lies in the material. Choose the right material, and cold shut risk is naturally reduced.

📌 About Us

Foshan Xinyihehui Metal Technology Co., Ltd. , operating under the zinc alloy brand "**Xinyi Zinc**," specializes in the R&D and production of high-purity primary zinc-based alloy ingots for foundry applications. Our product range covers the full Zamak series (No.3, No.5, No.2), ZA series (ZA-8, ZA-12, ZA-27), and customized special alloys, serving automotive, home appliances,

electronics, telecommunications, sanitary hardware, locks, zippers, machinery, mining, and other hardware casting industries.

Our “133+ Process” — in-house master alloy, three furnaces, three purifications — ensures batch-to-batch composition deviation ≤ ±0.5%, delivering consistent quality and stable performance.

Contact Us

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We welcome discussions on zinc alloy selection and process challenges.