

Gemini Notebook



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The Blueprint Specification



1 **Spec:** AWS D1.1 Structural Welding Code Steel

2 **Material:** 3/8in Limited Thickness test coupon

3/8in

3 **Geometry:** 45-degree included angle

ARC VOLTAGE STABLE

PENETRATION DEPTH: 100%

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The Core Loop: Anatomy of a Multi-Pass



4. **Cap Bead:** Reinforcement

3. **Fill Layers:** Volume

2. **Hot Pass:** Cleaning

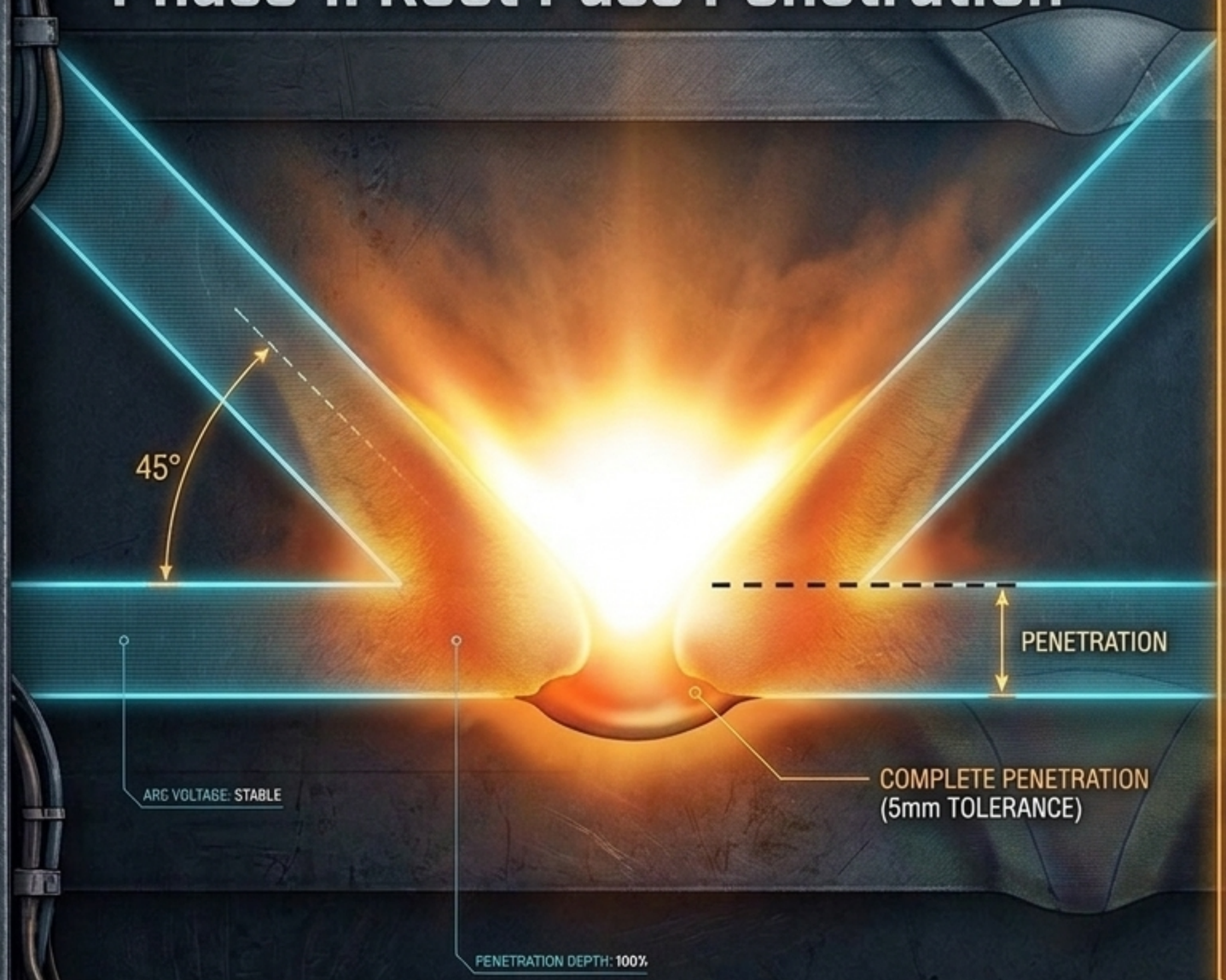
1. **Root Pass:** Penetration

PENETRATION DEPTH: 100%

ARC VOLTAGE STABLE

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Phase 1: Root Pass Penetration



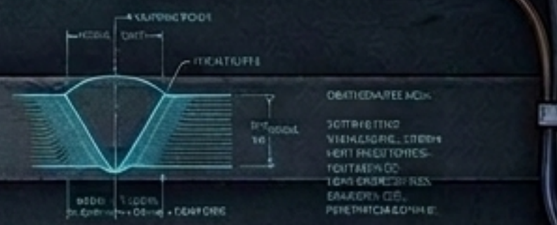


Objective: Secure the foundational tie-in without blowing through the base plate.

Controller Mechanic: The haptic engine vibrates violently if the puddle keyhole exceeds the precise 5mm tolerance, transmitting physical warning of an impending blowout directly into the operator's hands.

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Phase 2: Hot Pass & Deslagging

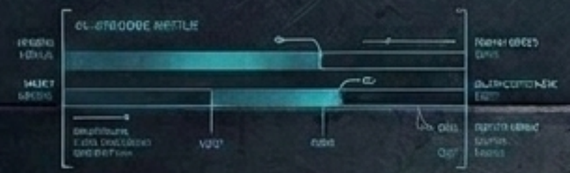


1. Weld



3. Clean

2. Cool



PENETRATION DEPTH: 100%

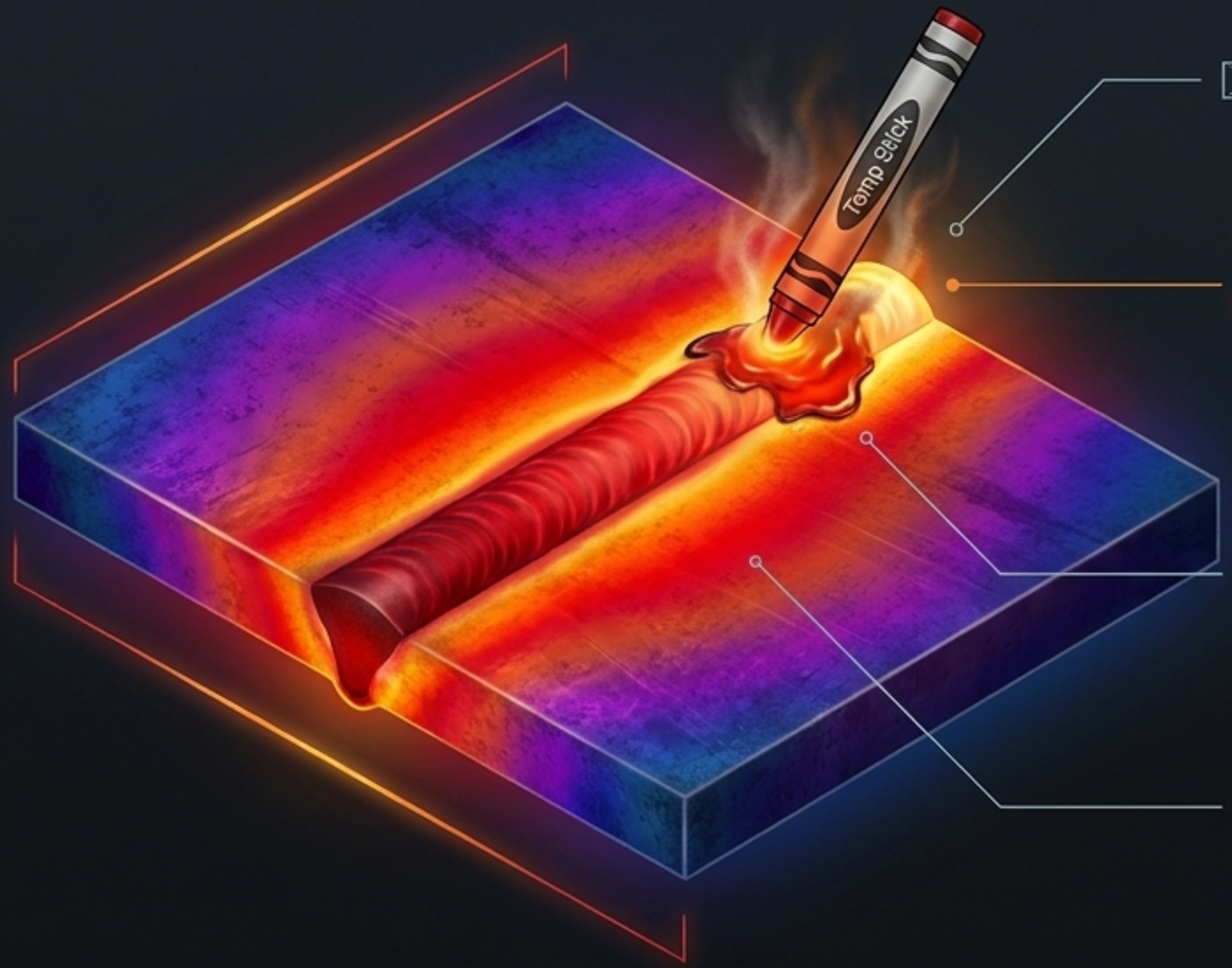
The Saboteur: Trapped impurities.

The Mechanic: Players must actively swap virtual tools to scrub the joint between passes.

The Penalty: Leaving a single pixel of slag traps it under the subsequent Hot Pass, causing an instant defect penalty and invalidating the D1.1 standard.

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Interpass Temperature Constraints

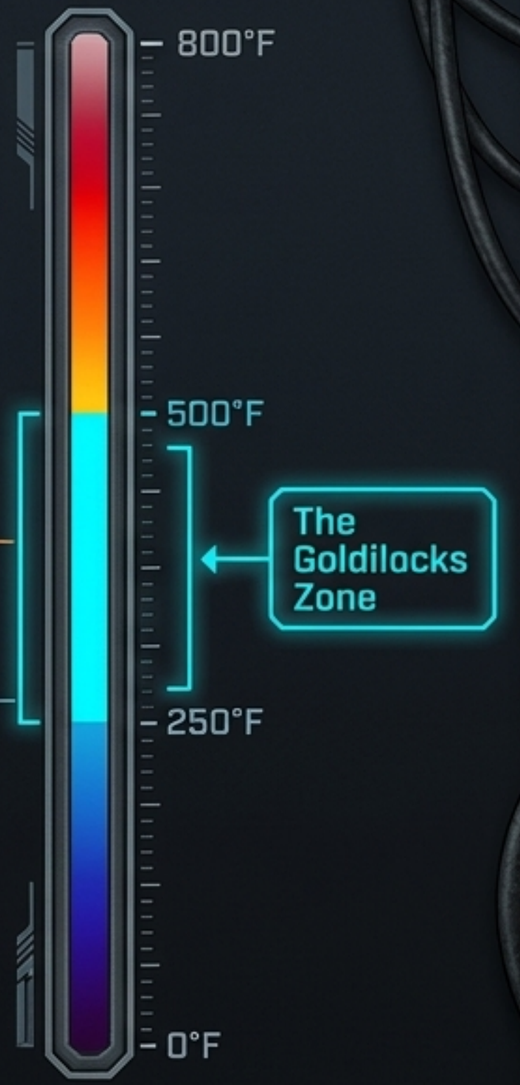


Invisible Constraint: Interpass Temperature Limits.

Too Hot: Metal distorts. The physics engine applies aggressive gravity sag, causing the virtual puddle to drip.

Too Cold: Lack of fusion. Layers fail to structurally tie together.

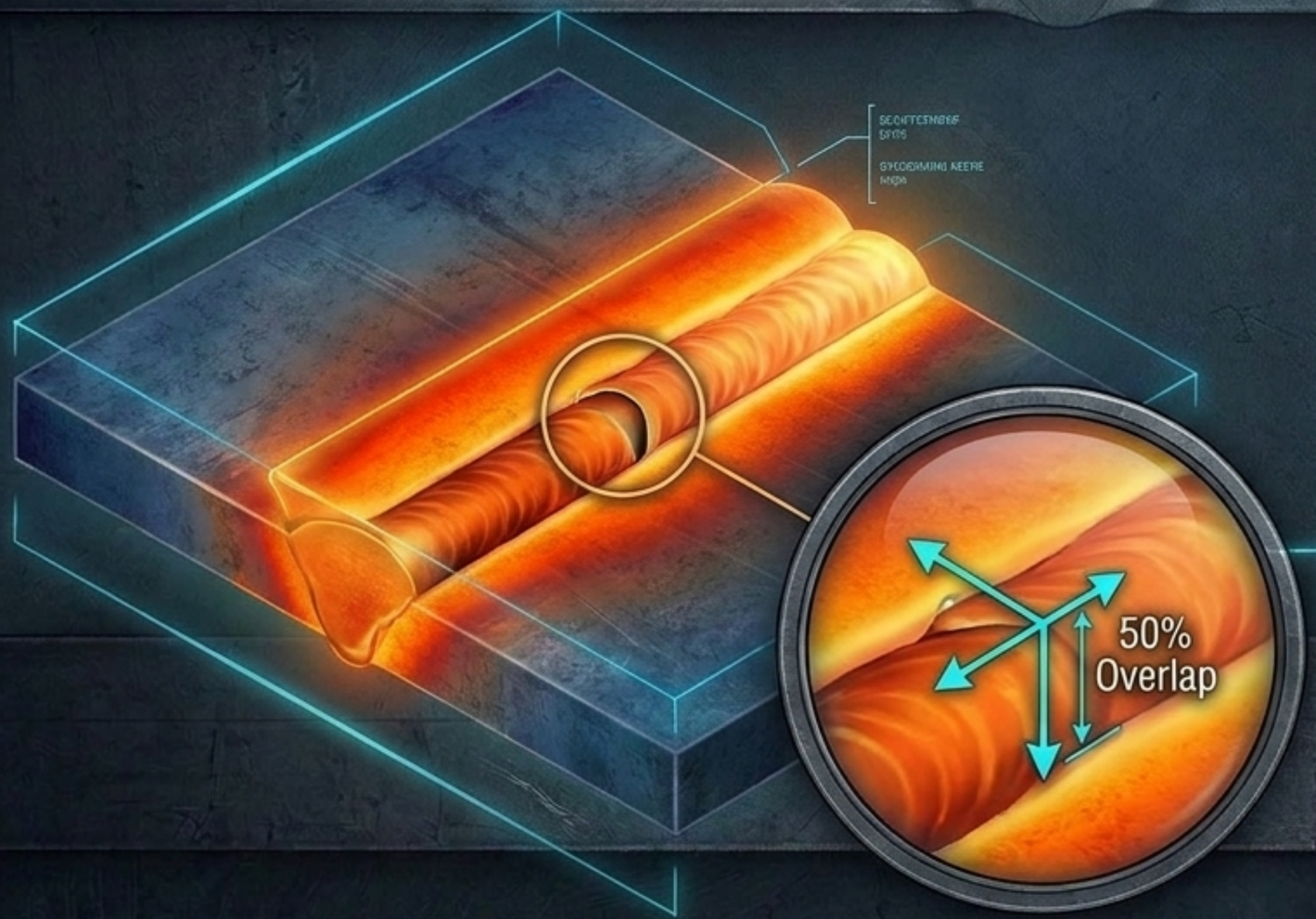
Tactical Pacing: Forces players to master rhythm, stopping to let the virtual metal cool before restriking the arc.



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Phase 3: Fill Layer Stacking





Objective: Volume, split-bead sequencing, and layer fusion.

The 50% Rule

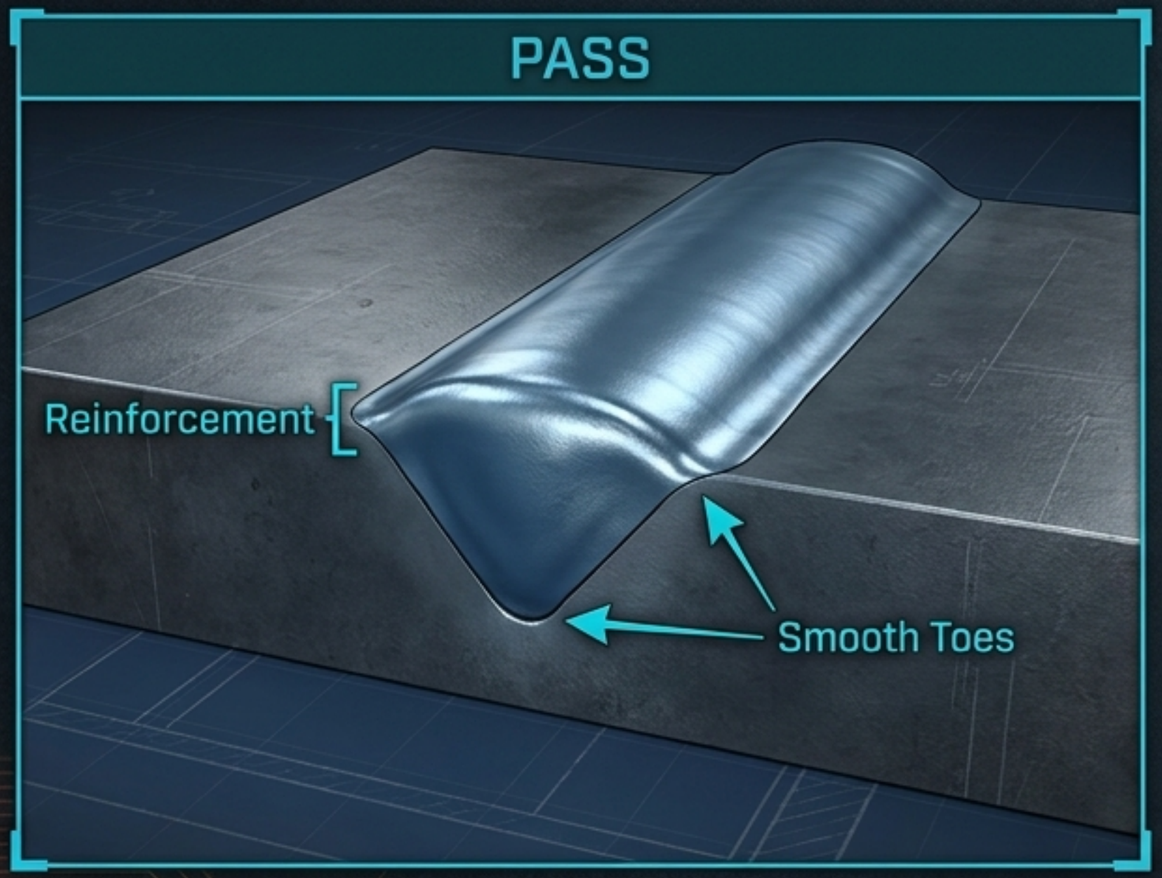
Beads must overlap by precisely 50% to tie together without leaving trapped, microscopic valleys.

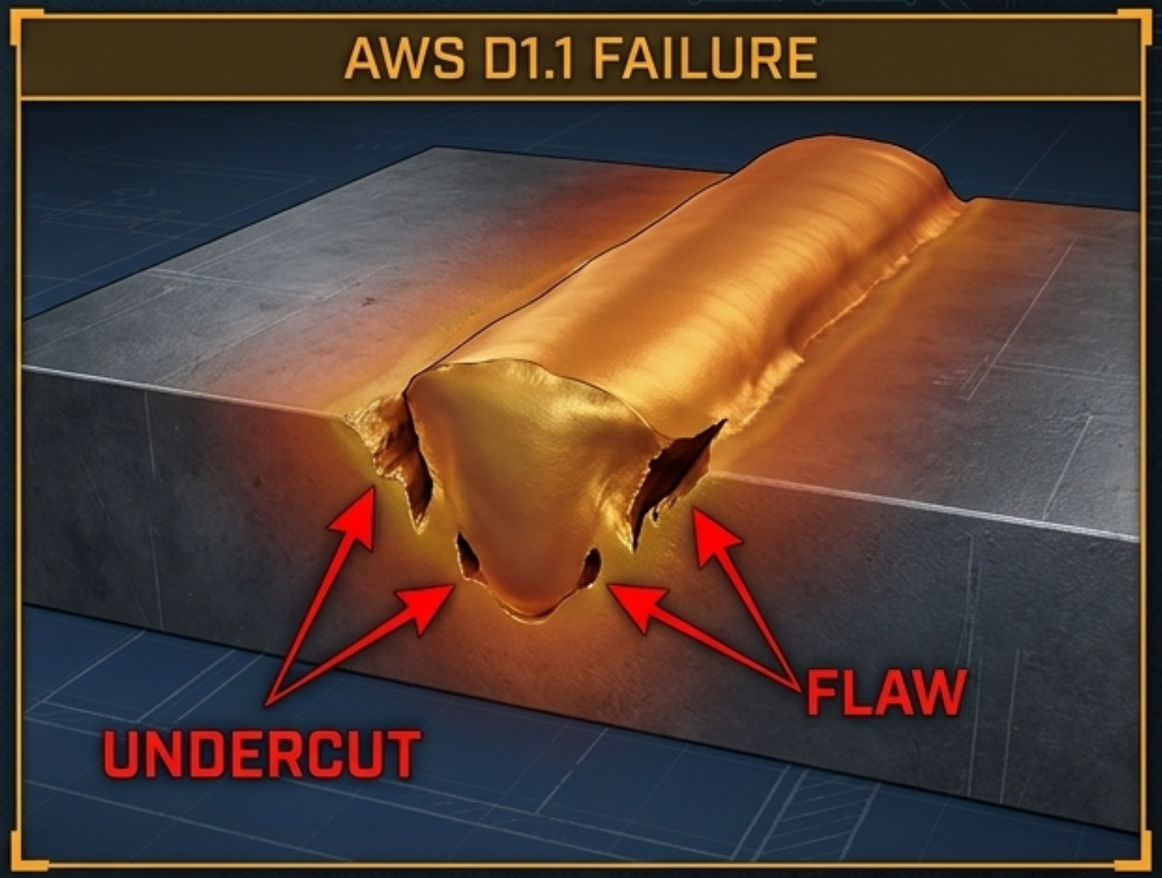
Dynamic Inputs

Players must continuously alter their virtual torch angle, manipulating controller geometry to push the puddle against both the steel side-wall and the previous bead simultaneously.

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Phase 4: Cap Bead Reinforcement





⚠ **Mechanic Alert:** The simulation engine drastically tightens travel speed variance tolerances during the Cap Phase. Moving the torch too fast creates **Undercut gouges—a fatal failure in physical visual inspection.**

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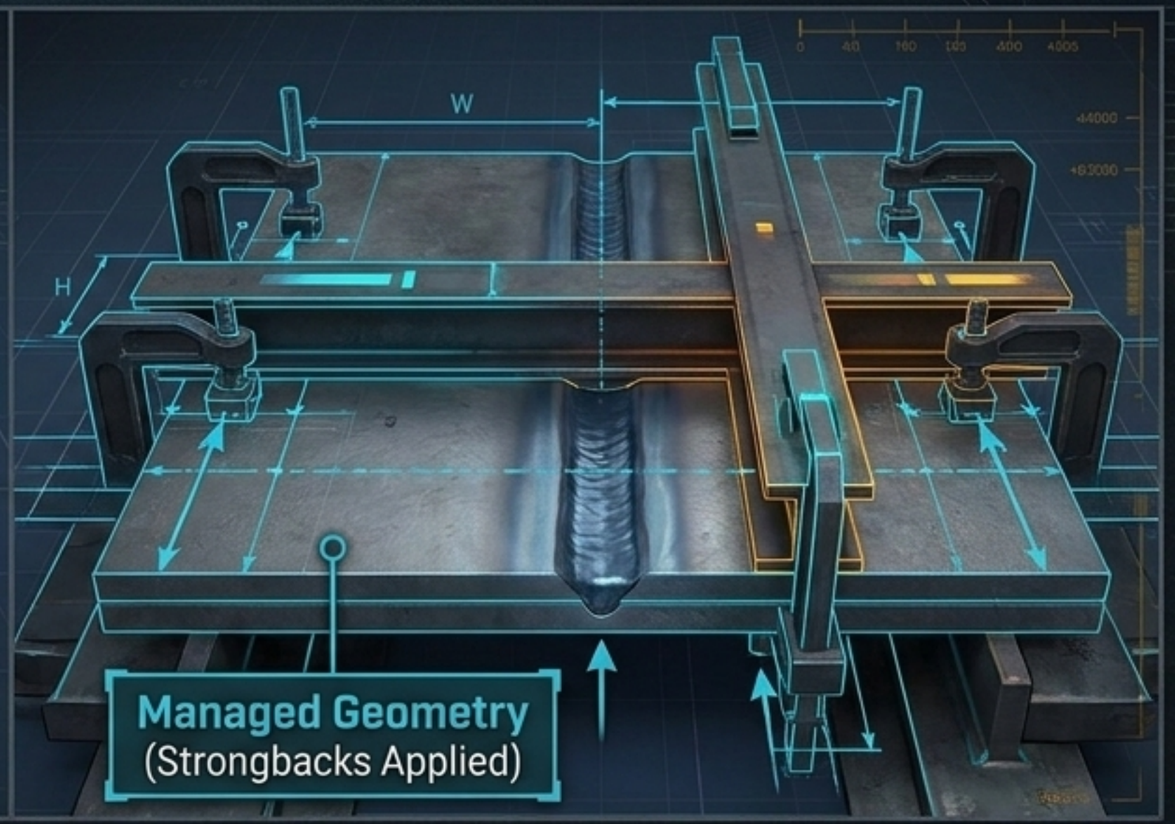
Comparison Matrix: The Layer Diagnostic

Layer Phase	Primary Goal	Key Defect Risk	Controller Mechanic	Pacing
Root	Penetration	Blowout / Keyhole Failure 	Haptic Feedback Resistance	Fast & Aggressive
Hot	Cleaning	Slag Inclusions 	Virtual Tool Swap	Paused & Deliberate
Fill	Volume & Overlap	Trapped Valleys 	Torch Angle Vectors	Rhythmic
Cap	Reinforcement	Undercut Gouging 	Tight Speed Variance Tolerance	Measured & Exact

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The Invisible Threat: Distortion Control



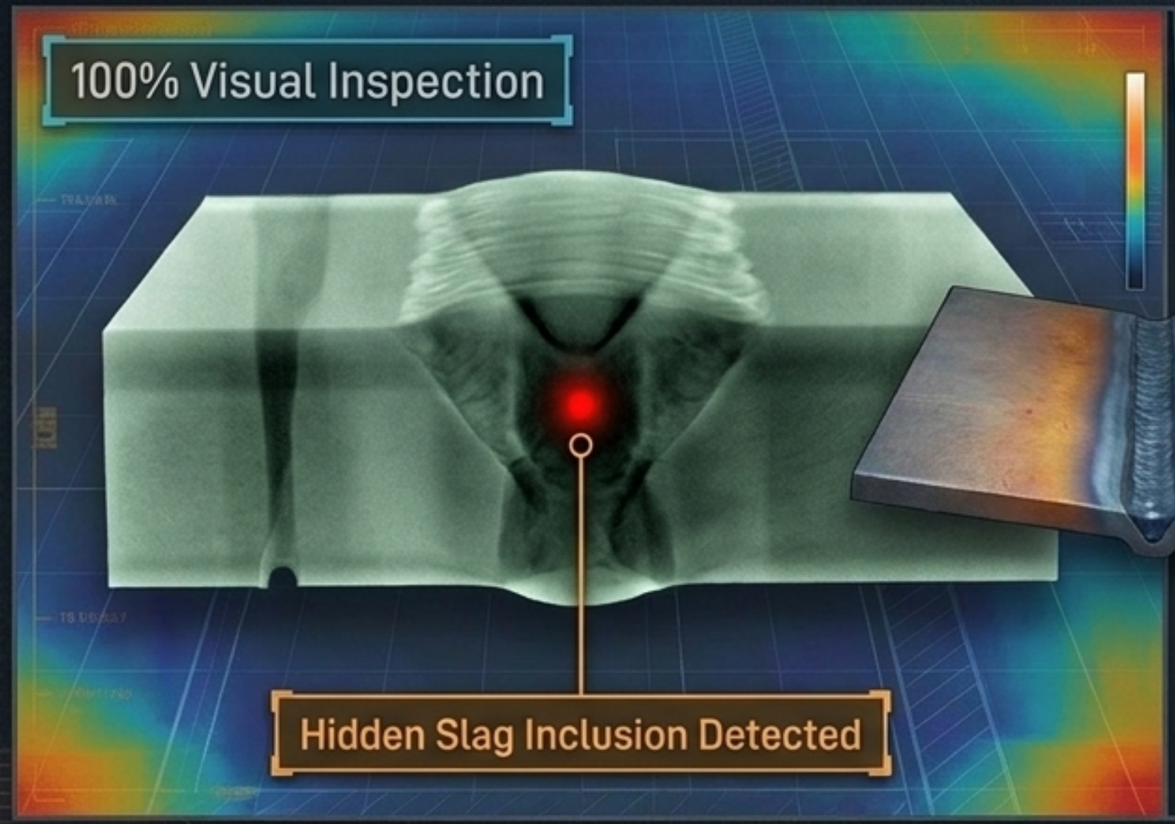


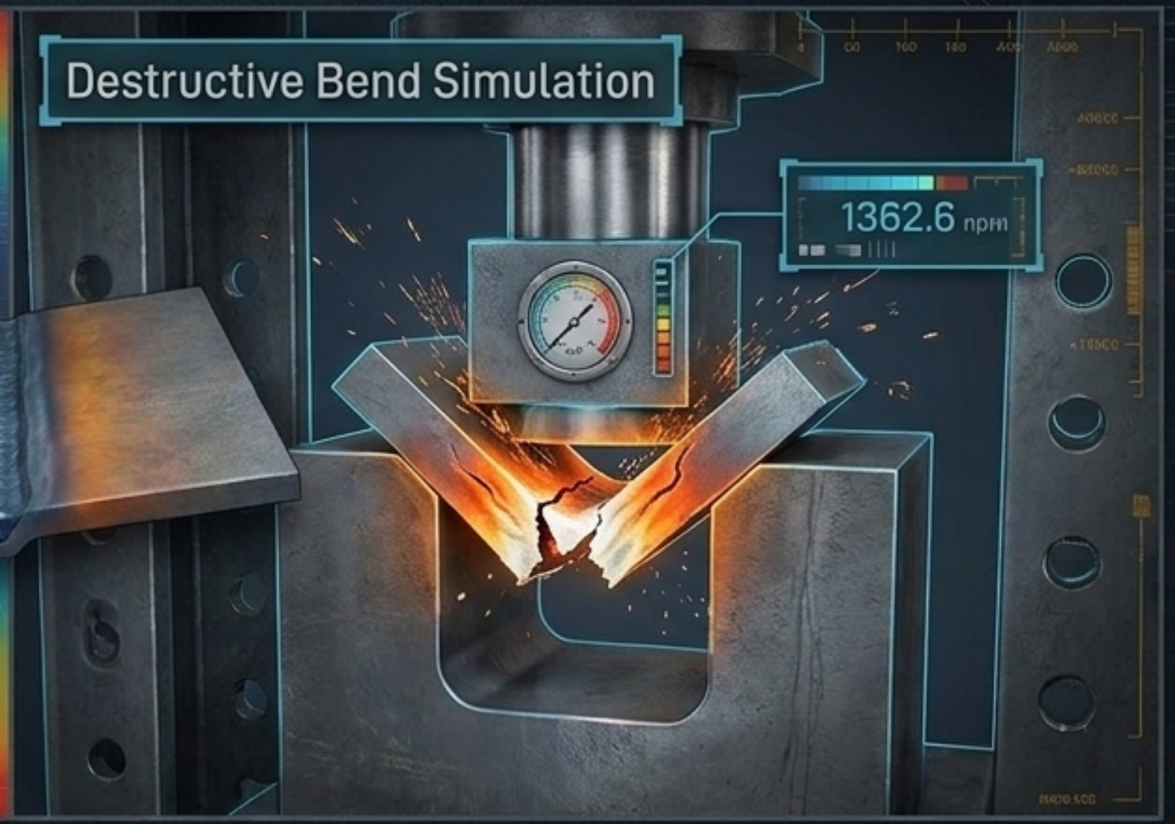
The Macro-Physics Engine

Players must anticipate thermal pull. Validating Game 9 as a true fabrication simulator, players apply physical strongbacks or strategically alternate weld sequences to prevent the assembly from ripping itself apart as it cools.

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Inspection Hunt Integration





The Server Subject Test:
Players must destructively evaluate their own joint. Hidden inclusions will cause the virtual coupon to snap in the hydraulic press, resulting in immediate failure.



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The Meta-Game: Decoding the Scoring Formula



The math simulates the trade: safe, defect-free execution always beats fast, reckless welding. One slag inclusion catastrophically drains the entire point pool.

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The Leaderboard: The Path to Platinum



The Outcome: Mastering Game 9 prepares the user for the physical AWS D1.1 Limited Thickness qualification test and immediate entry into the GHL fabrication hiring pipeline.

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From Simulation to Teleoperation



The digital mechanics mastered in Game 9—100-400ms latency management, multi-pass stacking strategy, and real-time defect inspection—are the precise requirements to operate the robotic labor force of the future.

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