Working principle of fusion-end type cold joint



Overview

Bad joints can easily be created if the pipes or fitting are moved during the cooling period. As the plastic cools and sets after the weld end, if moved it will fracture and cause a leak path.

Key Takeaways

A fusion-end cold joint occurs when the thermoplastic pipe ends fail to properly melt and inter-diffuse, preventing full molecular co-crystallization and resulting in a weak or incomplete joint.

Understanding Fusion-

End Cold Joints

In thermoplastic pipe fusion, such as HDPE or polypropylene, the ends of the pipes are heated to a designated temperature until the material reaches an amorphous, molten state. When properly fused, the molecules from each pipe end inter-diffuse across the joint, forming a plane of co-crystallization that creates a monolithic, full-strength connection. A cold joint occurs when this process is incomplete, typically due to insufficient heating, misalignment, or premature application of pressure.

Molecular Mechanism



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During fusion, the crystalline structure of the polymer transforms into an amorphous state. Fusion pressure causes the polymer chains from each pipe end to mix, and as the joint cools, the molecules re-crystallize, eliminating the original interface. In a cold joint, the molecular inter-diffusion is inadequate, leaving a visible or microscopic interface where the polymer chains did not fully knit together, significantly reducing joint strength.

Causes of Cold Joints

Insufficient heating: The pipe ends do not reach the required melt temperature, preventing proper flow and molecular mixing. Premature pressure application: Applying force before the melt pattern is fully formed can trap unmelted material. Misalignment or poor facing: Uneven or non-parallel pipe ends reduce contact area and hinder molecular inter-diffusion.

Contamination: Dirt, moisture, or oxidation on the pipe ends can interfere with fusion.

Prevention

To avoid cold joints, operators must follow validated fusion procedures: Properly face and clean pipe ends to ensure parallel, smooth surfaces. Heat the pipe ends to the specified temperature for the correct duration to achieve a uniform melt pattern. Apply consistent fusion pressure and maintain it until the joint cools sufficiently.

Ensure alignment and axial support during the fusion process to maximize molecular contact.

Conclusion

A fusion-end cold joint is essentially a failure of molecular inter-diffusion at the interface of thermoplastic pipes. Understanding the principle of co-crystallization and proper fusion technique is critical to achieving strong, leak-free joints in HDPE and other thermoplastic piping systems. Proper training, adherence to standards like ASTM F2620, and careful monitoring of temperature, pressure, and alignment are key to preventing cold joints.

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Article Content

Cold Welding: An Insight into Solid-State Joining in 2024

Cold welding, also referred to as contact welding, is a fascinating phenomenon and a solid-state welding technique that occurs when two clean, flat surfaces come into contact under high

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This document provides guidance on butt fusion and electrofusion jointing of polyethylene pipes. It discusses safety notices, necessary equipment, principles of fusion joining, pre-jointing checks, how

Electrofusion Welding Procedure

Bad joints can easily be created if the pipes or fitting are moved during the cooling period. As the plastic cools and sets after the weld end, if moved it will fracture and cause a leak path.

Fusion Welding Process

A brief description of the principal processes that are currently used for fusion welding aluminium and associated recent process developments are discussed in this section. More complete coverage is

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That junction can be welded using dozens of different weld groove configurations. This article covers both — explaining every joint type and the weld groove options available for each, with

Butt fusion (hdpe welding) is a thermofusion process

Butt fusion involves the simultaneous heating of the ends of two pipe/fitting components which are to be joined, until a molten state is attained on each contact surface.

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The heat required to produce this fusion is obtained from electric arc that is maintained between the tip of a flux coated electrode and the surface of a base metal along the joint being welded.

Fusion Welding

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Grandapex

The most widely used method for joining individual lengths of PE pipe and pipe to PE fittings is by heat fusion of the pipe butt ends as illustrated this technique produces a permanent, economical and flow

INDUSTRY GUIDELINES POP001

At the end of the weld time, wait for the full cooling down time stated on the fitting label to elapse before removing the welding terminals, re-rounding tools and/or alignment clamps.

What is Cold Welding? (Advantages, Disadvantages

Cold welding, or contact welding, is a solid-state welding process that requires little or no heat or fusion to join two or more metals together.

Cold Welding | Diagram, Advantages and Disadvantages

Cold welding is also known as contact welding. In fusion-welding precesses, no liquid or molten phase is present at the joint. In cold welding, metals are joined together without using flux. The welding of

Cold fusion

Cold fusion Diagram of an open-type calorimeter used at the New Hydrogen Energy Institute in Japan Cold fusion is a hypothesized type of nuclear reaction that would occur at, or near, room temperature.

Cold Welding Explained: What is it? How It Works

Cold welding joins metal together with little to no heat. It is one of the more interesting welding methods, and many metals can be cold welded thanks to the laws of physics and our

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This review serves a dual purpose, it distils best practices for fusion-condition optimisation and evaluates joint-integrity assessment methods, offering a unified guideline for butt-fusion jointing

What is Fusion Welding?

Fusion welding processes are commonly used across a range of industries including aerospace, automotive and construction amongst others. Used to join metals for

Fusion welding

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Fusion welding is a generic term for welding processes that rely on melting to join materials of similar compositions and melting points. Due to the high-temperature phase transitions inherent to these

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Cold welding defect is the most common defect in electro-fusion (EF) joint for connecting polyethylene (PE) pipe. In our previous study , the cold welding defect is successfully inspected by

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