



NTSB

SAFETY ALERT

National Transportation Safety Board

★ **Safety Through Reliable Fusion Joints** ★

Proper cleaning and surface preparation procedures can ensure fusion joint reliability in plastic natural gas pipelines

The problem

Fusion joints in high-density polyethylene (HDPE) piping are of great utility in the natural gas service and distribution industry. In a recent NTSB investigation of a New York City building explosion that caused eight deaths and dozens of injuries, NTSB investigators discovered that—

- Inadequate surface preparation or inadvertent contamination of plastic pipe surfaces prior to saddle fusion welding led to a joint with incomplete fusion.
- A weld joint with incomplete fusion can be strong enough to pass initial pressure testing of the piping system but could eventually fail or leak after the joint is placed in service.

A fusion weld joint with incomplete fusion results in a weld joint having reduced bond strength. Incomplete fusion is an internal weld defect. It cannot be detected by visual inspection methods and can be present in a weld joint having a normal external appearance.



Related accident

For decades, pipeline operators and natural gas distribution companies have been using HDPE piping to replace older piping as well as in new installations. In 2014, the NTSB investigated a five-story structure explosion in Manhattan, New York, involving a leak at a fusion weld joint between a service tee and an 8-inch-diameter HDPE natural gas distribution pipeline. In this accident, incomplete fusion was due to surface contamination and resulted in a weak joint in a buried natural gas distribution main that failed. Leaking natural gas flowed undetected, underground into the building. (NTSB accident number DCA14MP002).

What can pipeline operators and fusion welding technicians do?

- Establish high-reliability HDPE fusion welding procedures that include surface cleaning and preparation protocols. Select heater adapter combinations for each size pipe and service tee such that the fusion joints exhibit distinct fusion beads that can be reliably inspected.
- Ensure that technicians are certified to perform the process and inspect their work.

- Be familiar with and confirm that the pipe materials to be joined are marked with the appropriate specifications and manufacturer markings.
- Follow a strict surface preparation and cleaning regimen as indicated in the fusion procedure. Clean the surfaces to be joined and the heater adapter surfaces with an approved cleaning solution/solvent and applicator.
- Know which potential contaminants can reduce the strength of a weld joint for the specific plastic pipe material and take necessary precautions to protect those areas prior to bonding. Potential contaminants can include, but are not limited to—
 - release agents, such as silicone or soybean products
 - silicone-based lubricants
 - lubricating oil
 - rust inhibitors
 - wax
 - residue from certain cleaning solvents
 - water, or moisture from rain or snow
 - dirt and dust particles
 - plastic particles from grinding or cutting plastic pipe
 - natural body oil (perspiration)
- These contaminants can be transferred to a cleaning cloth or to working gloves and, in turn, onto the joint surface prior to fusion.
- Trace amounts of a contaminant (such as a film of oil) can be present on the surface, may not be visible, and can significantly reduce the strength of the weld joint.
- Remove material from the surface using a specified tool or scraping media (such as utility or emery cloth) indicated in the fusion procedure.
- In accordance with procedures, use clean, dry, lint-free, non-synthetic cloth, such as cotton, for wiping surfaces. Replace the cloth often to avoid potential transfer of contaminants.
- After making the fusion joint, inspect the fusion beads to ensure that they are uniformly shaped and sized all around the joint. Nonuniformity of the bead shape and size can indicate variability in heating, pressure, and alignment of the fitting and pipe during fusion.
- **When in doubt, abandon the fusion joint and make a new joint.**

Interested in more information?

Additional guidance for preparing cleaning surfaces in HDPE pipe prior to fusion bonding can be found in ASTM F2620-13, *Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings*.

This NTSB safety alert and others can be accessed from the NTSB's [Safety Alerts](http://www.ntsbt.gov/safety/safety_alerts.html) web page at www.ntsbt.gov/safety/safety_alerts.html.