

Presentation to NTSB Members

NTSB Accident File: DCA14MP002

Location: East Harlem – Manhattan, New York

Date of Accident: March 12, 2014

Frank McCarton

Party Coordinator

City of New York

Summary of City's position

- First: The explosion was caused by Con Edison's improperly installed saddle fusion joint at the 1642 Park Avenue gas-service to gas-main tee connection, which separated due to faulty fusion, allowing gas to escape.
- Second: The City's water main ruptured as a result of the explosion, not before it.
- Third: Over forty feet away from the source of the gas leak, there was a damaged sewer causing a recurring depression in the road - but that was a separate occurrence unrelated to the explosion.

Two distinct occurrences

The NTSB investigation confirmed there were two *unrelated occurrences* on Park Avenue between 116th and 117th Streets preceding the explosion.

1. Gas leak and resulting explosion, fire, and water main break (March 12, 2014).
2. Compromise of sewer line and associated roadway depression (2004-2014).

Gas explosion and water main break (March 12, 2014)

Proposed Cause: Consolidated Edison's defectively installed saddle fusion joint failed due to weakness from improper fusion, settlement caused by improper backfill, ground movement from natural forces, or a combination thereof, allowing gas to escape, fueling the explosion which ruptured the City's water main.

- The water main ruptured as a result of the explosion, not before it.
- It is physically impossible for there to have been a "small" high pressure leak that lasted for months carrying subsurface soil or rock away.

Recurring road depression (2004-2014)

Cause: Preexisting damage to the City's sewer main (an area of missing bricks) caused a recurring road depression localized dozens of feet north of the defective saddle fusion joint and the water main rupture.

Con Edison's defective saddle fusion joint

- The Con Edison installer who fused the joint was not certified at the time for this type of installation.
- Nearly half (150 of the 360-degree circular joint) was incompletely and inadequately fused.
- The saddle fusion joint was improperly fused during Con Edison's installation of the service tee connection to the gas main in December 2011.
- Radial marks on the subject saddle fusion joint are telltale signs of improper or "cold fusion," as confirmed by Con Edison and NTSB lab reports, as well as NTSB interview testimony by the head of Con Edison's gas development laboratory.
- Con Edison acknowledged in its report of a similar failed fusion joint in Hawthorne, NY, that "any slight force" could separate the improperly fused joint.
- Separation of the improperly fused portion of the joint occurred, allowing gas to escape, fueling the explosion.

The remainder of the fusion joint (approx. 210 degrees) separated as a result of an impact from debris or excavation equipment following the explosion.

- The crack in the outlet portion of the tapping tee also occurred after the accident due to an impact from debris or excavation equipment.
- There is no evidence that damage to the 1642 Park Avenue tapping tee and saddle fusion joint occurred pre-explosion and, in fact, the NTSB concluded otherwise.

Evidence of improper fusion of service tee fusion joints

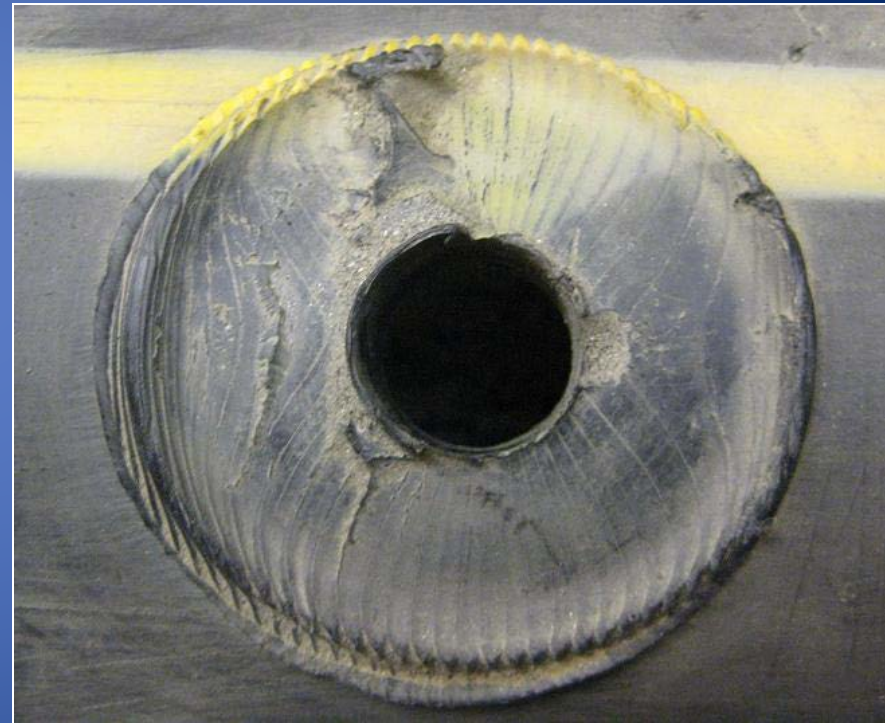
- Con Edison's own Section Manager in charge of its gas development lab, Joseph Madia, confirmed in his NTSB interview that radial marks or "serrated edges" on the fracture surfaces of failed fusion joints are a telltale sign of improper or "cold fusion." Such radial marks were found on the failed 1642 Park Avenue saddle fusion joint.
- Identical radial marks were found on the fracture surfaces of other improperly fused saddle fusion joints:
 - Failed Con Edison saddle fusion joint in Hawthorne, New York, confirmed by Con Edison Gas Development Laboratory Failure Analysis Report GT-11-029, dated Feb. 15, 2011.
 - Exemplar saddle fusion joint intentionally contaminated by NTSB with a mold-release agent (Materials Laboratory Factual Report Nos. 14-069 and 14-070).

Con Edison Gas Development Laboratory

“With the tee insufficiently fused onto the main, any slight force would have knocked the tee from the main...This substantial leak would suggest that the tee was almost completely removed from the main prior to any excavation...The lab has determined that the probable cause for the leakage of the sample was the cold fuse present between the 6” PE main and the Central Plastics Tapping Tee. . . it is likely that the leak originated at the cold fuse. This cold fuse was the result of poor preparation and poor installation of the tapping tee onto the main.”



Tapping Tee Surface



Gas Main Surface

Source: Gas Development Laboratory Failure Analysis Report GT-11-029, Hawthorne, NY

NTSB Test: Contaminated Fusion (Soy Bean Oil)

NTSB noted of the intentionally contaminated exemplar: “The radial pattern fanned out (apart from each other) at the north and south positions, similar to the radial pattern that was found on one portion of the fractured saddle fusion joint from the accident site.”



Tapping Tee Surface



Gas Main Surface

Comparison of Tapping Tees

The images below compare the appearance of tapping tee surfaces after joint separation for a cold fusion joint (Con Edison report) and a contaminated joint (NTSB test) with the appearance of the accident tapping tee that was in front of 1642 Park Avenue.



ConEd Report



NTSB Test



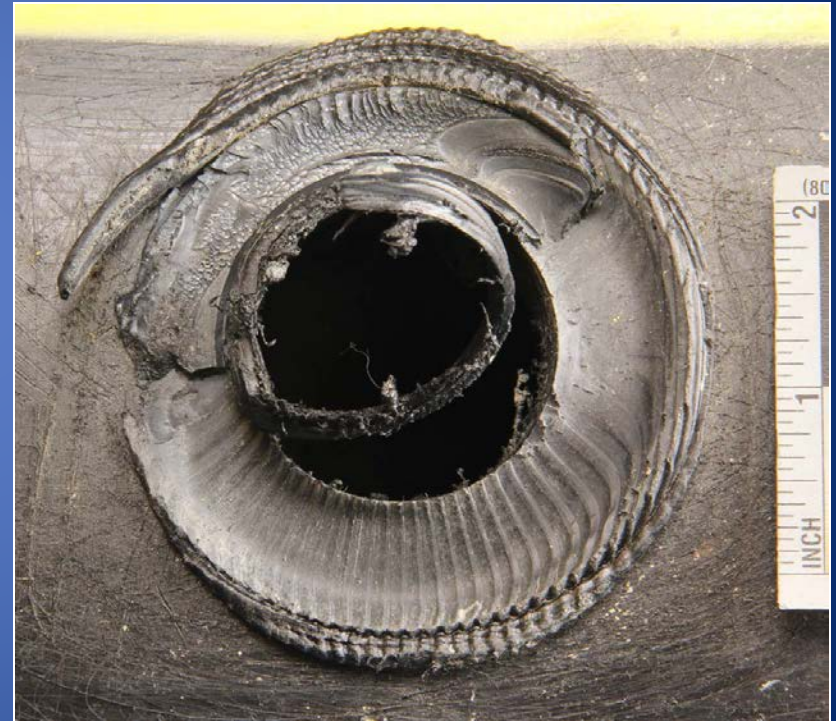
1642 Park Ave.

1642 Park Avenue

The images below are of the tapping tee surface and PE gas main surface of the separated fusion joint that was in front of 1642 Park Avenue.



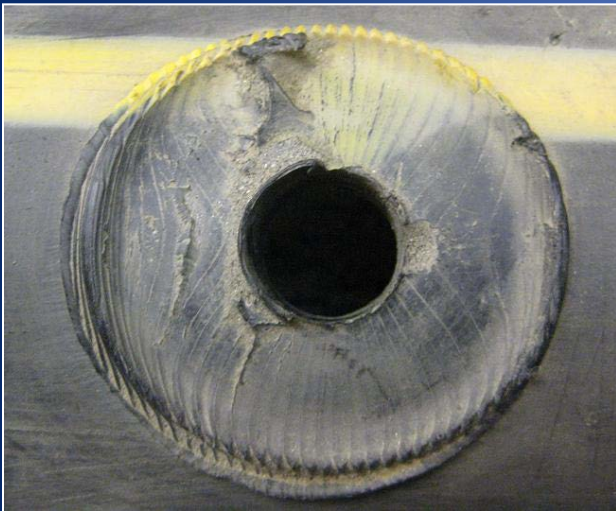
Tapping Tee Surface



Gas Main Surface

Comparison of Gas Mains

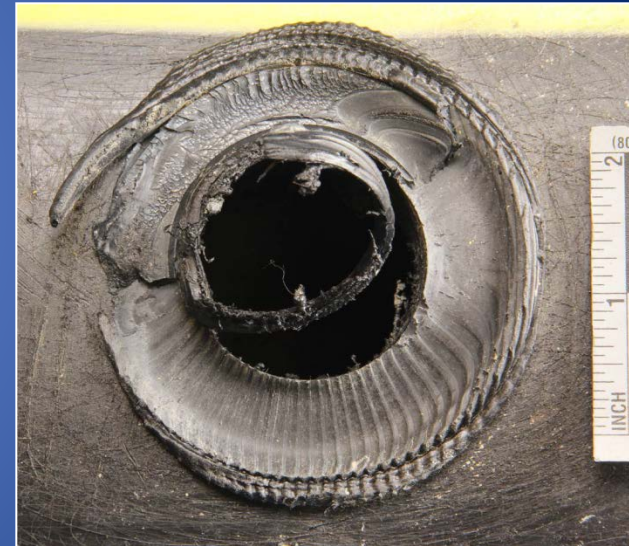
The images below compare the appearance of HDPE gas main surfaces after joint separation for a cold fusion joint (Con Edison report) and a contaminated joint (NTSB test) with the appearance of the accident saddle fusion joint on the gas main that was in front of 1642 Park Avenue.



Con Edison report



NTSB Test



1642 Park Ave.

Conclusion

- The Hawthorne incident showed that a saddle fusion joint fused improperly can separate on its own over time with little force.
- This is the most probable cause of how separation occurred at the 1642 Park Avenue saddle fusion joint, allowing gas to escape, fueling the explosion.

Settlement/subsidence

- If the NTSB finds that settlement contributed to the separation of the fusion joint, any such settlement was caused by the extensive excavations and improper backfill done in 2011 by a plumbing contractor and Con Edison or by ground movement due to natural forces.

Defective backfill at 1642 Park Ave.

- In 2011, the plumber (Plumbing Works) backfilled the area over the sewer with large rocks and did not compact properly, causing voids, as confirmed by post-accident test pits.
- In December 2011, Con Edison replaced a 69-foot section of its cast iron gas main with HDPE pipe, requiring Con Edison to backfill the area above the plumber's work, and repave the roadway.
 - The NTSB interview of Con Edison's contractor revealed that the backfill on this job violated NYC Dept. of Transportation regulations.

Ground conditions

- Thermal conditions may also have contributed to the failure of the improperly fused saddle fusion joint.
 - Seasonal ground freezing would have reached its maximum depth around the time of the accident in mid-March 2014.
 - The depth of seasonal ground freezing would have been greater during the especially harsh New York City winter of 2013/2014.
 - Upward displacement of the 1642 Park Avenue gas-service line due to “frost-jacking” could have caused separation of the weak joint.
 - Separately, the weak joint could have been affected by expansion or contraction of the HDPE components of the gas service connection.

Water main condition

- All facts are consistent with the crack in the City's water main occurring as a *result of* the explosion, not before.
- The City of New York runs the largest and safest water main system in the world, covering more than 2000 miles.
 - The City's record of safety is unmatched: 5-7 breaks per 100 miles is unparalleled by any other major city.
 - The City's monitoring system is world class – six leak detection surveys were conducted in the subject block of Park Avenue within two years prior to the accident, the most recent being 7 days prior.

No advance water leak

- It is impossible for a crack of this size and water leak of this magnitude to have gone undetected for up to 12-18 months before the explosion without any signs whatsoever, as Con Edison suggests.
- First observation of water in the area was several hours *after* the explosion.
- No evidence of any leak during any of the 6 DEP leak detection surveys done in the two years prior to the accident at this location (the last one having been done 7 days prior).
- No reports by residents or businesses of water leaking into basements or on roadway, nor any such reports by plumbing contractor or Con Edison.
- No reports of reduced water pressure.

Water main breaks cause immediate, extensive damage

- Damage to roadway and subsurface (2-4 foot hole opening up in roadway and underground cavity found around area of crack) are typical results from sudden water main failure and massive escape of water under high pressure. DEP estimated the water flow from the circumferential crack to be 6700 gal/minute.
 - Such damage occurs within a matter of minutes, or at most hours after a substantial water main break.
 - Roadway in front of 1642 Park Avenue over the cavity would have collapsed from its own weight or from weight of vehicles, and water would have been visible above ground or in basements if crack of this magnitude had existed pre-explosion.
 - At a minimum, there would have been a pre-explosion roadway depression in front of 1642 Park Avenue, but there was none.

Examination of water main

- The physical properties of the crack suggest a sudden break due to forces from the explosion and building collapses.
 - Such seismic forces pressed the water main onto an underlying rock, causing it to fracture from top to bottom, much like a stick being broken over a knee.
 - The minimal amount of oxidation on the fracture surface measured by the NTSB likely developed after the explosion in the time the moist pipe lay underground before extraction and the weeks prior to NTSB examination.
 - Insufficient evidence was revealed during the NTSB investigation that there was enough oxidation on the fracture surface of the water main or graphitic corrosion at the fracture site to conclude that the crack existed prior to the explosion.
 - Because grey cast iron is a relatively brittle material, a puncture or small crack expands quickly and causes a full break.
 - This metallurgical property supports a finding that the circumferential crack occurred suddenly at one time.
 - It also supports a finding that there could not have been a small pre-existing crack or hole in the water main that leaked over time.

Roadway depression

- The NTSB investigated the damaged sewer main and roadway depression not directly above or near the defective saddle fusion joint — But coincidence does not equal causation.
- There is no evidence to support a conclusion that the damaged sewer or road depression caused the 1642 Park Avenue saddle fusion joint or tapping tee to fail.
 - The area of missing bricks was 36 linear feet north of the failed gas service connection (with a true diagonal distance of more than 43 feet) and more than 23 linear feet north of the water main crack.
 - The southern border of the roadway patch was about 29 linear feet north of the failed gas service connection and about 16 feet north of the water main crack.
 - The area of missing bricks in the sewer caused a localized depression in the roadway directly above, resulting in successive asphalt patching.
 - Google street views over time show consistency of the roadway patch location – it did not shift or move closer to the area of the cracked gas main or failed saddle fusion joint.
 - Soil mechanics dictate that soil skeleton movement is very localized to the area immediately above an underground hole or void; hence the limited area of roadway depression.
 - The gas service line connections to 1644 and 1646 Park Avenue, which were directly below the area of successive asphalt patching, did not leak or fail.

City improvements in response to this roadway depression

- DOT is escalating attention to areas that receive recurring patches.
- DOT has begun notifying utilities of street defects, including cave-ins or sewer depressions reported to DEP as part of their standard procedure.
- DEP has invested nearly \$800,000 to help with prioritization based on predictive risk assessments and is instituting a system to ensure there is record and accountability for prioritization decisions. This effort was under way before this incident, and is expected to be formally rolled out before the new year.

Additional Post-incident City improvements

- The City of New York puts the safety of its citizens first, without compromise.
 - Steps have been taken to heighten public awareness of reporting natural gas odors.
 - Spring 2014 review of City's emergency response to under-street conditions and coordination of underground infrastructure movements.
 - Procedures undertaken to increase coordination among and between City agencies and private utilities.
 - City working with utilities to find ways to reduce costs imposed by permitting restrictions.
 - Accelerated infrastructure improvement.

CONCLUSION

- The facts and evidence examined during the course of the NTSB investigation reveal that the probable cause of the accident was the migration of gas from a leak at the 1642 Park Avenue gas service connection saddle fusion joint because of partial separation of the weak joint.
 - The joint separated because it was improperly fused during its December 2011 installation by an un-certified Con Edison contractor.
 - The improper backfilling of the excavations in that location by Con Edison and a plumbing contractor may have caused settlement or subsidence contributing to the failure of the weak joint.
 - Thermal conditions associated with the severely cold winter may also have contributed to separation of the defective joint.